American Society for Parenteral and Enteral Nutrition
Clinical Nutrition Week 2014 Abstract Presentations

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ORAL ABSTRACT PRESENTATIONS

PREMIER PAPER SESSION AND VARS AWARD COMPETITION

The Harry M. Vars award is annually given to the person presenting the highest-scoring qualified abstract for CNW. The candidates are also evaluated on a manuscript based on their abstract, as well as on their expertise and knowledge of the science as demonstrated during their oral presentation at the Premier Paper Session.

Vars Candidate and Abstract of Distinction

1792860 - Reasons for Enteral Nutrition Cessation in Surgical Intensive Care Unit Patients

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Purpose: Enteral nutrition (EN) is the preferred route of nutrient delivery in the intensive care unit (ICU). However, actual delivery is only about 50% of prescribed calories. Previous studies in mostly medical ICU patients report that the majority of interruptions are avoidable. The purpose of this study was to investigate and categorize reasons for EN interruption in surgical ICU (SICU) patients and determine if they were avoidable.

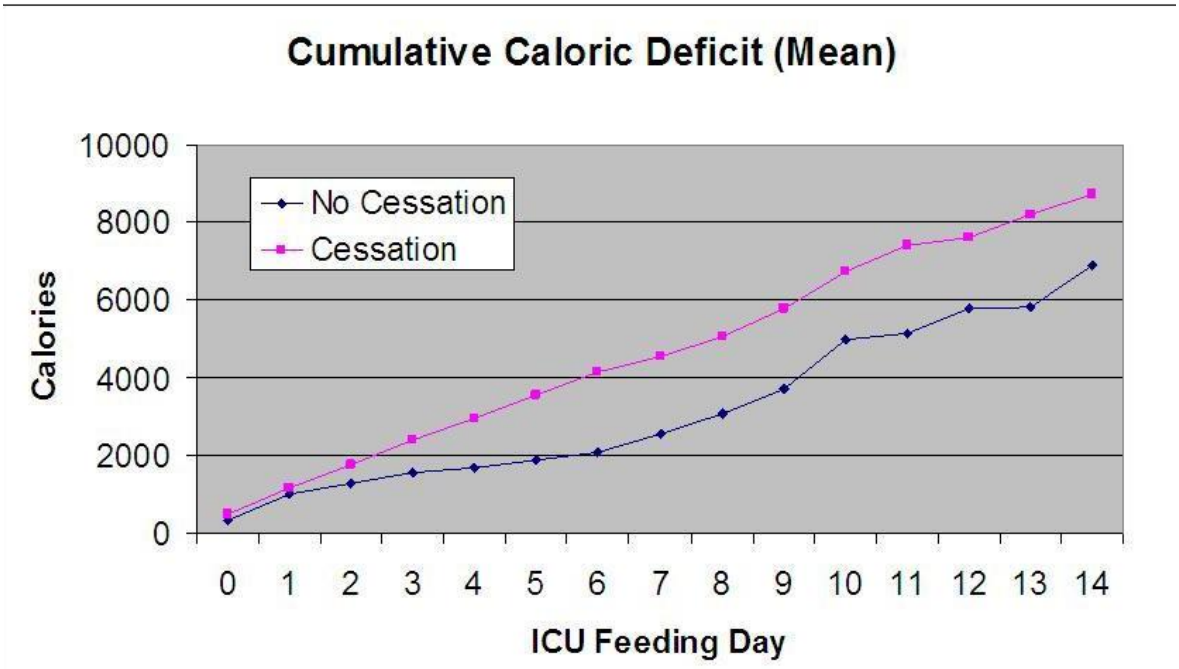
Methods: This prospective observational cohort study was conducted over 9 months in two SICUs. All patients age>18 years who received EN for more than 72 hours were eligible for inclusion. Exclusion criteria were: ICU stay less than 72 hours, previous ICU stay within the same hospitalization, received EN prior to ICU admission, admission diagnosis of intestinal obstruction (mechanical or paralytic ileus), death within 72 hours after ICU admission. Data collected included ICU admission diagnosis, age, gender, acute physiology and chronic health evaluation (APACHE II) score and Charlson Comorbidity Index (CCI).

Data on calorie and protein intake from enteral and parenteral feeding were recorded by the investigators daily during the SICU admission for a maximum of 14 days until initiation of oral intake, ICU discharge, or death, whichever occurred first. All instances of and reasons for EN interruption were recorded. Each episode was categorized as avoidable or unavoidable based on predefined criteria. Outcome variables were defined as hospital and ICU length of stay (LOS), ventilator-free days (VFD), in-hospital and 30 days after ICU admission mortality and complications.

Descriptive data were reported as means and standard deviations (SD), medians and inter-quartile ranges (IQR) or as frequencies (%) as appropriate. Patients were dichotomized into NO CESSATION and CESSATION groups based on whether any EN interruption occurred during SICU course. Outcomes between the two groups were compared using two-sample t-tests, Wilcoxon rank sum tests, or Fisher's exact tests as appropriate. Two-sided P values < 0.05 were considered statistically significant.

Results: Among 94 SICU patients, there were a total of 106 EN interruptions. Reasons interruption were: extubation (n=29), bedside tracheostomy/percutaneous endoscopic gastrostomy (n=23), imaging study (n=16), orthopedic operation (n=12), high gastric residual volume (n=10), interventional radiology procedure (n=6), other operation (n=6), gastrointestinal operation (n=4). A total of 28 (26.4%) of interruptions were considered avoidable. (TABLE 1) There were no differences in baseline demographics. The CESSATION group had significantly greater daily caloric deficit (608 vs. 346 cal, p=0.001) and had significantly greater cumulative caloric deficit (5834 vs. 3066 cal, p=0.001) and longer hospital length of stay (LOS) (33 d vs. 25 d, p=0.01). (FIGURE 1) Ventilator-free days were fewer, and ICU LOS was longer, but this did not achieve statistical significance.

Conclusions: In SICU patients receiving EN, only 26.4% of EN interruptions were potentially avoidable. Patients who experienced any interruption of EN accumulated greater caloric deficit and had worse clinical outcomes. In this patient population, most interruptions cannot be avoided and efforts should be focused on maximizing calorie delivery before or after interruptions, rather than decreasing the frequency of interruption.



Reason for EN interruption	n	Potentially Avoidable	%
Extubation	29	0	0.0%
Trach/PEG	23	0	0.0%
Imaging Study	16	14	87.5%
Ortho Procedures	12	6	50.0%
High GRV	10	0	0.0%
Other	6	4	66.7%
IR Procedure	6	4	66.7%
GI Surgery	4	0	0.0%
Total	**106**	**28**	**26.4%**

Vars Candidate and Abstract of Distinction

1834609 - Long-Term Neurodevelopmental Outcomes of Infants Treated With Intravenous Fat Emulsion Reduction for the Management of Parenteral Nutrition-Associated Cholestasis

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Purpose: A strong association exists between dosage of intravenous fat emulsion (IVFE) and development of parenteral nutrition (PN)-associated cholestasis (PNAC). Intravenous fat emulsion reduction (IFER) is an effective management strategy for PNAC; however, IFER during infancy may lead to reduction of essential nutrients during an important developmental period. Neurodevelopmental outcomes (NDOs) associated with IFER have not previously been reported. Yet, neurodevelopment is greatest during infancy, and thus this remains a critical question. This single-institution, prospective study examined the risk for cognitive and adaptive delays and behavioral concerns, as well as key predictors of NDOs, in pediatric patients previously treated with IFER.

Methods: Patients between 2—5 years of age at the time of study enrollment previously treated with IFER were included. Patients with major congenital or chromosomal anomaly, metabolic disorder, hypoxic ischemic encephalopathy, seizure disorder or cerebral palsy were excluded. NDOs were evaluated by the Ages and Stages Questionnaires-3 (ASQ-3), Parents' Evaluations of Developmental Status (PEDS), and Behavior Assessment System for Children, 2nd Ed. Preschool, Parent (BASC-2). Primary outcome measure was the dichotomized risk categorization on the ASQ-3. Secondary outcome measures included overall and dichotomized risk categorization on the PEDS tool, composite t-scores, trichotomized and dichotomized risk categorization on the BASC-2 tool. A combined overall risk categorization for patients deemed at risk on either PEDS or ASQ-3 was also evaluated. Statistical analysis used Student's t-test and Wilcoxon rank sums tests for continuous variables, and Chi-square and Fisher's exact tests for categorical variables. Linear and logistical regression evaluated the relationship between NDOs and predictive variables. IFER related variables included mean duration of PN and IFER, mean lipid dose (g/kg/day) and documentation of essential fatty acid deficiency (EFAD).

Results: Parental consent was obtained in 25 of 62 patients. Demographics (Table 1) were similar in consented vs. non-consented, except that consented had greater gestational age, p=0.05, and lower incidence of hypoxia, p=0.04. All consented patients had completed PEDS tool, and 72% (n=18) completed ASQ-3 and BASC-2 tools. Figures 1 and 2 summarize dichotomized risk categorization for ASQ-3 and PEDS, respectively. Mean t-scores, trichotomized and risk categorization on the BASC-2 are outlined in Table 2. All 4 composite domains fell within the average, normative developmental range (41-59). A majority of patients were observed to be "typically developing" (67-89%). The combined overall risk categorization revealed that of the 18 children completing all 3 tools, 61.1% were found to be at "no risk". Regression analyses revealed younger gestational age to be a predictor of poor NDO in gross motor (p=0.024) and personal-social (p=0.0441) on the ASQ-3, and on adaptive skills (p=0.032) on the BASC-2. Older age at study enrollment predicted negative NDO on the PEDS tool, p=0.0064. Importantly, IFER-related variables were not found to be predictors of negative NDOs. Surprisingly, higher mean lipid dose predicted both score and risk categorization of externalizing problems on the BASC-2, p=0.031 and p=0.043, respectively.

Conclusions: This study represents the first report of NDOs in pediatric patients treated with IFER during infancy. While limited by small sample size, IFER related variables were not found to be significant predictors of negative NDOs, and IFER treated patients score within the normative range the vast majority of the time. The results set the stage for a larger, multi-center, prospective study.

Table 1. Demographic Data for Consented versus Non-Consented Group

	Group Studied (Consented) N=25	Group Not Studied (Non-Consented) N=37	P value
Gestational Age (weeks) *mean ± SD [range]*	34.77 ± 4.16 [25.86—40]	32.59 ± 4.21 [25.71—38.57]	0.05
Birth weight (gram) *mean ± SD [range]*	2376.9 ± 929.9 [650—3910]	2013.8 ± 797.7 [700—3400]	0.12
Age at study (month) *mean ± SD [range]*	53.8 ± 11.82 [35—81]	54.24 ± 11.67 [33—77]	0.88
Diagnosis			0.45
Hirschsprungs	2 (8%)	0	
CDH	7 (28%)	4 (10.8%)	
EA/TEF	2 (8%)	2 (5.4%)	
SBS	5 (20%)	9 (24.3%)	
Gastroschisis	6 (24%)	13 (34.1%)	
NEC	2 (8%)	4 (10.8%)	
Intestinal Perforation	0	1 (2.7%)	
Hydrops Fetalis	0	1 (2.7%)	
Meconium Ileus	1 (4%)	0	
Congenital cystic adenoid malformation	0	1 (2.7%)	
Atresia	0	1 (2.7%)	
Obstruction	0	1 (2.7%)	
Vaginal Delivery *%*	54.6%	37.8%	0.21
Male Gender *%*	80%	23%	0.13
Current TPN at Study *%*	8%	2.3%	0.56
Respiratory Failure *%*	60%	45.95%	0.28
Hypoxia *%*	4%	24.32%	0.04
Sepsis *%*	32%	29.73%	0.85
Retinopathy of Prematurity *%*	8%	13.51%	0.69
Intraventricular Hemorrhage *%*	4%	8.11%	0.64
Hypotension *%*	44%	45.95%	0.88
Number of operations *Median[25th percentile, 75%percentile]*	7 [5,14]	4 [2,7]	0.01
Duration of TPN (days) *Median [25th percentile, 75%percentile]*	67 [39,100]	61 [36,94]	0.52
Duration Lipid Restriction (days) *Median[25th percentile, 75%percentile]*	43 [15,95]	29 [11, 51]	0.23
Dose of lipids (g/kg/day) *mean ± SD [range]*	0.48 ± 0.24 [0.26—1.28]	0.41 ± 0.18 [0.24—1]	0.10
Essential Fatty Acid Deficiency *Total number*	13	10	p>0.999

Figure 1. Dichotomized Risk Categorization: ASQ-3

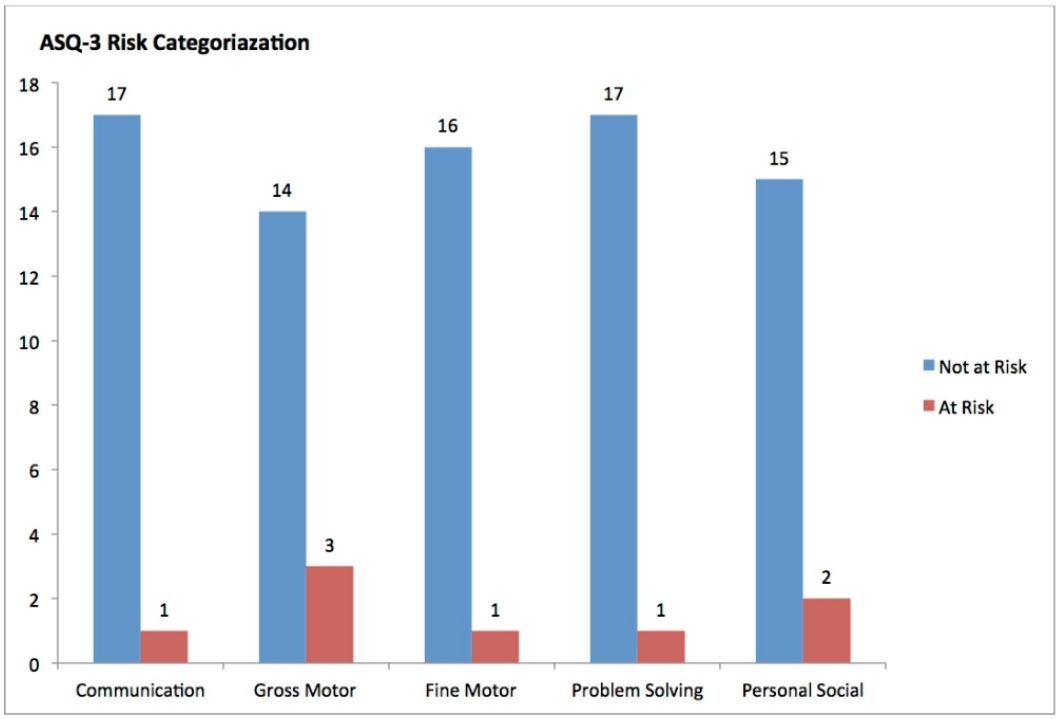

Figure 1. Dichotomized Risk Categorization ASQ-3:
Descriptive statistics for study participants falling in the "at risk" versus "not at risk" category in the five domains of: communication, gross motor, fine motor, problem solving, and personal-social. Logistical regression revealed lower gestational age to be an independent predictor in the domains of gross motor (p=0.0235) and personal-social (p=0.0441). No other variables were found to be statistically significant predictors of outcomes.

Figure 2. Risk Categorization: PEDS

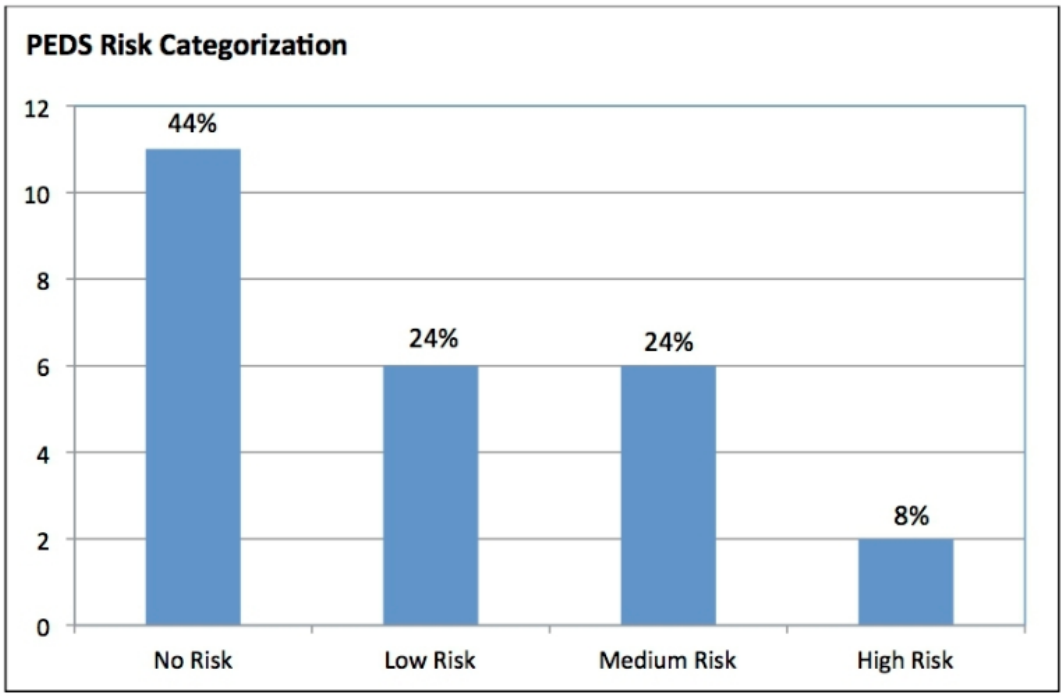

Figure 2. Risk Categorization: PEDS: Graphical description of overall results on the PEDS tool for all 25 consented study subjects. Forty-four percent (n=11) of patients had no concerns identified, "no risk", 24% (n=6) had ≥1 nonsignificant concern, "low risk", or 1 significant concern, "medium risk", and 8% (n=2) had ≥2 significant concern and were categorized as "high risk" for developmental concerns. Dichotomized data reveals that 68% (n=17) are "not at risk" (i.e. no significant concerns) and 32% (n=8) are "at risk" (i.e. >1 significant concern, including those with "low risk"). Logistical regression revealed older average age at study enrollment to be a predictor of outcome, p= 0.0064. IFER related variables showed no correlation to risk categorization.

Table 2. T-score Results: BASC-2 PRS-P

(n=18)	Score *Mean ± SD [range]*	Typically Developing	At Risk	Clinically Significant Problems	At No Risk	At Risk
Externalizing Problems	49.56 ± 7.53 [37—64]	16 (88.9%)	2 (11.1%)	0	16 (88.9%)	2 (11.1%)
Hyperactivity	52 ± 8.29 [38—74]	15 (83.3%)	2 (11.1%)	1 (5.6%)		
Aggression	47.33 ± 7.2 [36—59]	18 (100%)	0	0		
Internalizing Problems	54.5 ± 2.49 [37—75]	12 (66.7%)	4 (22.2%)	2 (11.1%)	12 (66.7%)	6 (33.3%)
Anxiety	49.5 ± 8.56 [36—66]	17 (94.4%)	1 (5.6%)	0		
Depression	50.11 ± 9.44 [32—71]	16 (88.9%)	1 (5.6%)	1 (5.6%)		
Somatization	60.5 ± 13.65 [43—88]	8 (44.4%)	6 (33.3%)	4 (22.2%)		
Behavioral Symptom Index	51.56 ± 10.16 [36—77]	15 (83.3%)	2 (11.1%)	1 (5.56%)	15 (83.3%)	3 (16.7%)
Atypicality	53.22 ± 13.07 [39—81]	12 (66.7%)	4 (22.2%)	2 (11.1%)		
Withdrawal	52 ± 11.39 [30—78]	14 (77.8%)	3 (16.7%)	1 (5.6%)		
Attention Problems	52.72 ± 10.52 [38—71]	14 (77.8%)	3 (16.7%)	2 (11.1%)		
Adaptive Skills	50.83 ± 11.54 [23—70]	15 (83.3%)	2 (11.1%)	1 (5.56%)	15 (83.3%)	3 (16.7%)
Adaptability	51.12 ± 12.08 [32—72]	16 (88.9%)	2 (11.1%)	0		
Social Skills	53.83 ± 11.59 [33—70]	15 (83.3%)	3 (16.7%)	0		
Activities of Daily Living	48.17 ± 9.61 [31—61]	15 (83.3%)	4 (22.2%)	0		
Functional Communication	48.83 ± 10.72 [19—71]	16 (88.9%)	1 (5.6%)	1 (5.6%)		

Table 2. BASC-2 PRS-P: Overall results, reported as mean t-scores ± SD [range], for the BASC-2 PRS-P are displayed for the 18 study participants that completed the BASC-2 PRS-P. The four composite scores are broken down into eight clinical scales and four adaptive scales: 1) externalizing problems (hyperactivity, aggression) 2) Internalizing problems (anxiety, depression, somatization) 3) behavioral symptom index (atypicality, withdrawal, attention problems) 4) adaptive skills (adaptability, social skills, activity of daily living, functional communication). Higher scores on clinical scales and lower scores on adaptive scales indicate a higher risk and greater likelihood of neurodevelopmental problems. Results for participants with scores categorized as "typically developing", "at risk", and "clinical significant problems" are reported as total number within each group and percentage of participants. Overall "at risk" categorization is shown for the four composite domains.

Vars Candidate and Abstract of Distinction

1835138 - Association Between Prehospital Vitamin D Status and Hospital-Acquired Clostridium difficile Infections

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Purpose: Recent evidence suggests that vitamin D is a key regulator of the immune system, and as such, it may play an important role in patient susceptibility to hospital-acquired infections, including hospital-acquired Clostridium difficile infections (HACDIs). The purpose of this study was to investigate whether pre-admission 25-hydroxyvitamin D [25(OH)D] levels are associated with the risk of HACDI. We hypothesized that vitamin D status before hospital admission is associated with the risk of developing HACDI.

Methods: Our retrospective cohort study focused on 568 adult patients from two Boston teaching hospitals between August 1993 and November 2006. We excluded 44 patients who received high-dose vitamin D supplementation (Ergocalciferol 50,000 IU) between the 25(OH)D level draw and hospital admission. The exposure of interest was pre-admission serum 25(OH)D level obtained 7 to 365 days prior to the date of hospitalization. 25(OH)D levels were categorized a priori as <10 ng/mL, 10-19.9 ng/mL, 20-29.9 ng/mL, and ≥30 ng/mL. All cut points were adapted from existing national clinical guidelines. Serum 25(OH)D in all cohort subjects was determined by radioimmunoassay (RIA). The primary end point was incident HACDI. Microbiology reports on stool samples for the study cohort were obtained from the computerized registry at the hospitals under study. All cohort patients had stool sample testing for Clostridium difficile toxin A and B by enzyme-linked immunosorbent assay (ELISA). A positive result was defined as the presence of toxin A or B in at least one stool sample. In order to be considered a HACDI, the first positive toxin result must have been on a stool sample obtained >48 hours after hospital admission in patients with no known history of Clostridium difficile infection. Unadjusted associations between 25(OH)D

levels and HACDI were estimated by bivariable logistic regression models. Adjusted odds ratios were estimated by multivariable logistic regression models with a priori inclusion of covariates thought to be linked with both 25(OH)D level and HACDI. Locally weighted scatter plot smoothing (LOWESS) was used to graphically represent the relationship between pre-hospital 25(OH)D level and risk of HACDI.

Results: The mean age at hospital admission was 63±18 years. Most patients were female, white, and had a medically-related DRG. The mean 25(OH)D level was 19±12 ng/mL. Approximately half (53%) of the 25(OH)D measurements occurred in the 3 months before hospital admission. Over the hospital stay, 11% (95%CI, 9-14) of the cohort met criteria for incident HACDI. Following adjustment for age, sex, race (non-white vs. white), patient type (medical vs. surgical), and Deyo-Charlson index, patients with 25(OH)D levels <10 ng/mL had higher odds of HACDI (OR 2.90; 95%CI, 1.01-8.34), compared to patients with 25(OH)D levels of ≥30 ng/ml. When patients with HACDI were analyzed relative to a larger patient cohort without HACDI or without Clostridium difficile toxin A and B measured (n=5,047), those with 25(OH)D levels <10 ng/mL (OR 4.96; 95%CI, 1.84-13.38) and 10-19.9 ng/mL (OR 3.36; 95%CI, 1.28-8.85) had higher adjusted odds of HACDI compared to patients with 25(OH)D levels ≥30 ng/ml. LOWESS plot (Figure 1) demonstrated a near inverse linear association between 25(OH)D level and risk of HACDI up to 25(OH)D levels near 30 ng/mL. Beyond serum 25(OH)D levels of 50 ng/mL, the curve appears flat.

Conclusions: In our cohort of adult patients, vitamin D status before hospital admission was inversely associated with the risk of developing HACDI. These data support the need for randomized, controlled trials to test the role of vitamin D supplementation to prevent HACDI.

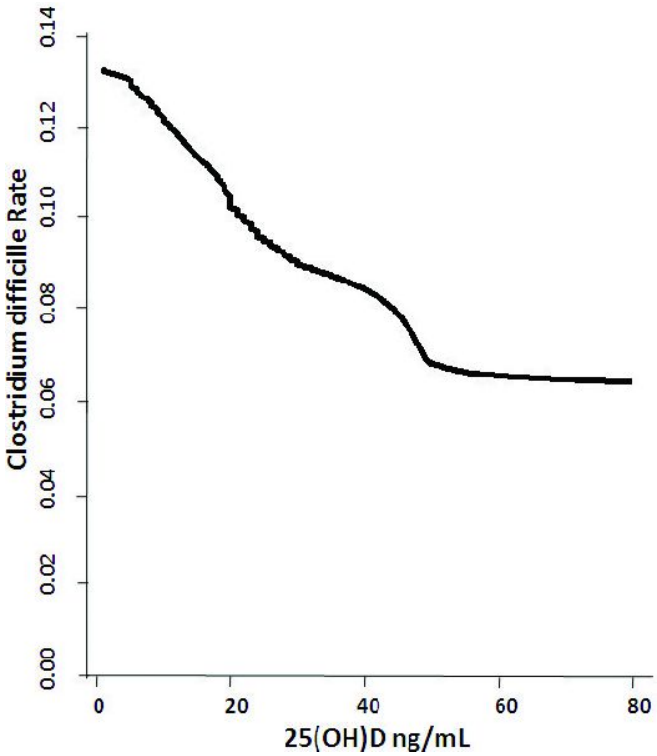

Figure 1. Vitamin D status versus risk of hospital-acquired Clostridium difficile infection. 25(OH)D = 25-hydroxyvitamin D; HACDI = hospital-acquired Clostridium difficile infection. Locally weighted scatter plot smoothing utilized to represent the near inverse linear association between pre-hospital 25(OH)D level and risk of HACDI. Plot constructed with data from inpatients with pre-hospital vitamin D status and toxin A or B measured in stool samples (n=568).

Vars Candidate and Abstract of Distinction

1835359 - Use of Three Nutrition Screening Tools to Assess Nutrition Risk in the Intensive Care Unit

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Purpose: Identifying patients at nutrition risk proves especially difficult in the intensive care unit (ICU) due to the nature of critical illness. Unfortunately, no consensus exists on the most appropriate method to identify these patients. Accurate identification of patients at risk using traditional nutrition screens is limited, as weight loss and BMI may be reflective of fluid status, rather than actual body habitus in critical illness. Furthermore, a nutrition and weight history may be difficult to obtain due to alterations in mental status, hemodynamic instability and need for mechanical ventilation impeding a clinician's ability to obtain vital information. The inclusion of physical assessment in Subjective Global Assessment (SGA) is useful, as it does not require patient interaction; however, this tool, also, requires a detailed patient history. The Nutrition Risk in the Critically Ill (NUTRIC) score is unique in its inclusion of assessment of inflammation and severity of illness. Recent randomized controlled trials have demonstrated that provision of adequate calories and protein in critical illness may have deleterious effects on outcomes; identifying patients with the highest potential to benefit from nutrition support is essential. The objective of this quality improvement project was to apply different nutrition screening tools to a sample of patients admitted to the ICU

Methods: A convenience sample of 302 patients admitted to the medical, surgical, and neuroscience ICU was used. All patients were screened within 24 hours of admission. Routine nutrition screening included the following variables: significant weight loss, BMI<18.5 or >40, presence of dysphagia, or use of enteral/parenteral nutrition prior to admission. Subjective Global Assessment (SGA), composed on intake prior to admission, presence of GI symptoms, weight loss, functional assessment, and physical assessment, was also performed. A NUTRIC score was calculated for each patient using age, APACHE II, SOFA, number of comorbidities, and days from hospital to ICU admission. NUTRIC scores were calculated without using IL-6 values; therefore, patients were classified as having a high score if the sum was 5 or greater. Additional information was collected on demographics, severity of illness, hospital and ICU length of stay (LOS) and disposition. Descriptive statistics were utilized to examine counts/proportions and means +SD

Results: Large differences were seen between screening tools, as 29% (n=89) of patients were screened at risk using routine screening, 38% (n=114) using SGA, and only 13% (n=38) using the NUTRIC score. Only 10 patients met criteria for all three tools (Figure 1). Similar mortality rates were seen between groups (11% routine screening, 12% SGA, 13% NUTRIC). ICU and hospital LOS was longest in patients deemed at risk using the NUTRIC score, compared to both routine screening and SGA (Table 1). Similar demographic data and dispositions were seen between risk groups

Conclusions: Traditional screening tools are likely inappropriate for use in the ICU, as they require patient interviews. Inclusion of both physical assessment and severity of illness may be useful in predicting nutrition risk. Additional research is needed to determine if changes in the nutrition screening process affect outcomes in the critically ill.

Table 1: Hospital and ICU LOS and hospital disposition using Routine Screening, Subjective Global Assessment (SGA), and NUTRIC

	Risk with Routine Screening (n=89)	Risk with SGA (n=114)	Risk with NUTRIC Score (n=38)
Age (mean years ± SD)	61.0±15.4	61.7±15	69.7±12.1
BMI (mean kg/m2 ± SD)	26.5±7.7	27.0±8.1	26.8±8.1
Hospital LOS (mean days±SD)	10.6±8.9	9.8±8.5	11.9±10.5
ICU LOS (mean days ± SD)	4.5±4.2	5.4±5.3	6.4±7.1
Expired (n(%))	10 (11%)	14 (12%)	5 (13%)
Discharged to Rehab (n(%))	14 (15%)	19 (17%)	6 (16%)

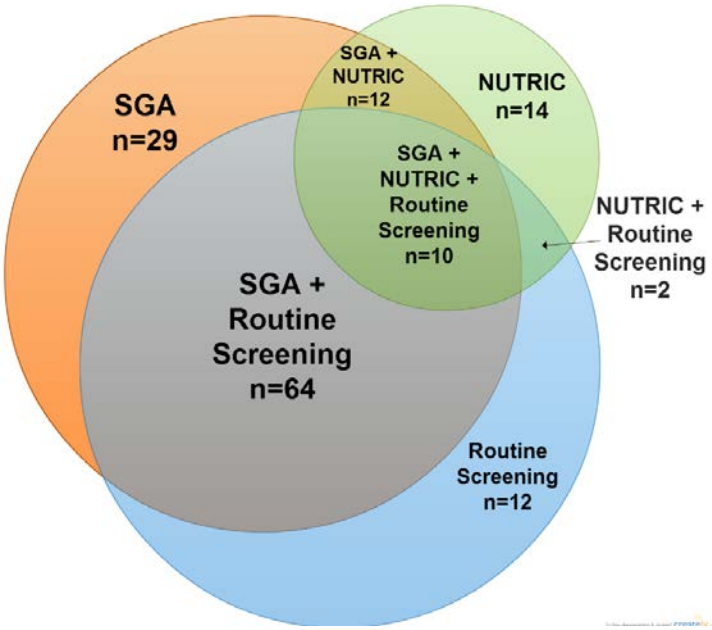

Figure 1: Venn diagram of patients meeting criteria for Subjective Global Assessment (SGA), Routine Screening, and Nutrition Risk in the Critically Ill (NUTRIC) score.

Vars Candidate and Abstract of Distinction

1835649 - Intensive Nutrition in Acute Lung Injury: A Clinical Trial (INTACT)

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Purpose: Patients with acute lung injury (ALI) typically receive 50-60% of estimated energy/protein requirements while hospitalized. We conducted a prospective randomized clinical trial (PRCT) to evaluate the impact of providing intensive medical nutrition therapy (IMNT, i.e. provision of > 75% of estimated energy and protein needs) from diagnosis of ALI in the ICU to hospital discharge on clinical outcomes.

Methods: At diagnosis of ALI participant's were randomized to receive either standard care (SC, e.g. standard EN and ad lib feeding) or IMNT provided as delivery of > 75% of estimated energy (30 Kcal/Kg; adjusted IBW was used in those with BMI > 30) and protein (1.5 gm/Kg; adjusted IBW used in obese) requirements as EN throughout the duration of mechanical ventilation and continued with medical nutritional diet therapy upon weaning from the ventilator to hospital discharge. Primary outcomes included infection rates, number of days on mechanical ventilation, in the ICU and in the hospital, and mortality.

Results: A total of 78 patients (40 IMNT, 38 SC) were recruited. There were no significant differences between groups for (mean + SD) age (55 yrs +17), BMI (30 +9.1), APACHE II score (25.5 + 8.9) , baseline white blood count (12.2 + 9.8 cells/mcL) glucose levels (152.6 + 51.7 mg/dL), estimated energy (2056 +323 Kcals) or protein needs (110 + 18 gm) and all had nutrition risk screening scores > 3. Patients in the IMNT received significantly higher percentage of estimated energy (88.4 + 24% vs. 60.0+ 21.5%, $p < 0.0001$) and protein needs (76.1 + 17.7% vs. 54.4 + 20.7%; $p < 0.0001$) compared to SC. No significant difference for IMNT and SC in the hospital (27.2 + 18.2 vs 22.8 + 14.3 days) or ICU (15.5 + 12.8 vs 16.1 + 11.5 days) length of stay, days on mechanical ventilation (9.4 + 9.4 vs 9.3 + 7.7 days) or infection rate (1.0% vs. 2.0% of days, p=.2392) occurred. At the end of the 4th year significantly greater mortality rates were found in the IMNT vs SC groups (16/40, 40% vs 6/38, 15.8%, $p = 0.02$)

and the trial was stopped. Multiple logistic regression results indicated the odds ratio for death in IMNT vs SC, controlling for age and apache II score was 9.52; 95% CI 2.29-39.25, p = 0.0014).
Conclusions: In patients with acute respiratory failure provision of IMNT to meet >75% of estimated energy and protein needs from ALI diagnosis to hospital discharge resulted in higher mortality rates. These findings extend those of recent larger PRCT in ICU populations that have reported no difference or worse outcome with greater energy/protein feeding. Our estimated energy/protein needs were similar to these trials however our participants received greater proportions of their needs than previous trials.

NUTRITION AND METABOLISM PAPER SESSION: PARENTERAL NUTRITION

1830501 - Death Receptor Dependent Apoptosis in Parenteral Nutrition-Associated Liver Disease
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Purpose: Parenteral nutrition (PN)-associated liver disease (PNALD) occurs in patients receiving long-term PN and may progress from cholestasis to liver cirrhosis, hepatic failure and death. One possible mechanism of PNALD is apoptosis induced by high levels of retained hydrophobic bile acids. In our in vitro model of PNALD, we previously reported that apoptosis was associated with increased mRNA expression of death receptors Fas and tumor necrosis factor-associated apoptosis-inducing ligand (TRAIL)-receptor 2 (TRAIL-R2) (Tillman EM, et al., J Parenter Enteral Nutr. 2012:36:36-42). Although this in vitro model of PNALD suggests that apoptosis occurs via death receptors, this has not been shown in an in vivo model of PNALD. The aims of this study were: 1. Determine if apoptosis occurs via death receptor-dependent mechanisms in an in vivo mouse model of PNALD. 2. Determine whether hepatocellular apoptosis induced by the hydrophobic bile acid, chenodeoxycholic acid (CDCA), occurs solely via the death receptors Fas and TRAIL-R2 using an in vitro hepatocyte culture model of PNALD using blockade by specific antibody treatment.
Methods: Expression of Fas, Fas-ligand (Fas-L), TRAIL-R2, and TRAIL was evaluated in liver tissue from C57BL adult male mice that were exposed to dextran sulphate sodium (DSS) and PN for 7 or 28 days as previous described (El Kasmi KC, et al., Hepatology. 2012:55:1518-1528). Cultured HepG2 cells were treated with 200 μM CDCA, CDCA + Fas antibody, CDCA + TRAIL-R2 antibody, and CDCA + Fas antibody + TRAIL-R2 antibody. Controls included cells incubated with vehicle alone (EtOH). Apoptosis was evaluated using the Apo-ONE® Homogeneous Caspase-3/7 Assay, and mRNA levels were measured by quantitative RT-PCR.
Results: Expression of Fas was increased 1.5-fold in mice pretreated with DSS followed by 7 days of PN. In mice that received DSS pretreatment followed by 28 days of PN, Fas mRNA was increased by 2-fold. Expression of TRAIL was decreased 0.75-fold in mice treated with DSS and 7 days of PN and decreased 0.5-fold with DSS and 28 days of PN. Interestingly, there was no change in Fas-L or TRAIL-R2 mRNA. Treatment of HepG2 cells with 200 μM CDCA resulted in peak caspase activity at 12 hours. Incubation with an antibody to Fas resulted in attenuation of the caspase-3/7 response by 44%. When cells were incubated with an antibody to TRAIL-R2, the increase in caspase-3/7 activity was attenuated by 9%. The addition of antibodies to both Fas and TRAIL-R2 resulted in 44% attenuation of the caspase-3/7 response to CDCA treatment.
Conclusions: PNALD is associated with apoptosis that occurs via death receptors in an in vivo model. Bile acid-induced hepatocellular apoptosis occurs predominately via Fas and to a lesser extent via TRAIL-R2. These data confirm our earlier mRNA findings. Although there was a 44% attenuation of the caspase-3/7 response to CDCA when both Fas and TRAIL-R2 were blocked with corresponding antibodies, these data suggest that bile acid-induced apoptosis also occurs via mechanisms independent of the death receptors Fas and TRAIL-R2.

Abstract of Distinction
1834778 - Thrombosis Is Not Associated With Use of Ethanol Lock in Adult Home Parenteral Nutrition Patients
Mandy L. Corrigan, MPH RD LD CNSC; Denise M. Konrad, RD LD CNSC; Sulieman Abdal Raheem, MD; Tushar Gohel, MD; Annette Pearson, RN, VA-BC; Ezra Steiger, MD, FACS, FASPEN; Donald F. Kirby, MD FACP FACN FACG AGAF CNSC CPNS

Nutrition Support Team, Cleveland Clinic, Cleveland, OH.
Purpose: Ethanol lock therapy (ELT) has proven to be an effective therapy for preventing catheter associated blood stream infections (CRBSI) with few side effects in home parenteral nutrition (HPN) patients. Use of 70% ELT and thrombosis/occlusion was reported in a small case study of 4 pediatric intestinal failure patients utilizing ELT. Our aim was to compare adult HPN patients with and without ELT to evaluate any association of catheter associated deep vein thrombosis (DVT) in HPN patients receiving ELT.
Methods: A retrospective IRB approved chart review was completed for patients receiving HPN during 2008 to 2012 managed by a multidisciplinary Nutrition Support Team. Data collection included age, gender, hypercoagulable state, history of DVT (prior to HPN, during HPN), history of pulmonary embolism (PE), history of cancer, presence of thrombogenic medications and anticoagulation medications, catheter type (Hickman, Peripherally Inserted Central Catheter [PICC]/Hohn, Port), catheter tip location (defined as optimal if tip on imaging located in the mid to lower 3rd of the superior vena cava, cavoatrial junction, or right atrium), HPN duration, number of catheters during HPN therapy, presence or absence of ELT, and concentration of ethanol if applicable.
Results: Of the total 491 patients, 172 utilized ELT (35%) and 319 (65%) did not have ELT. Of the patients that received ELT, nearly all (98%) received 3 mL of 70% ethanol and 4 patients (2%) had 50% ethanol. The median duration of HPN was 17.3 months and the median duration of ELT was 13.6 months (27% of patients were still ongoing with HPN & ELT at time of analysis). Catheter tips were in optimal position in 457 (93%) patients. Patients receiving ELT were significantly more likely to have a past history of DVT ($p=0.025$), a Hickman catheter ($p<0.001$), longer duration of HPN ($p<0.001$), and more than 5 catheters during HPN therapy ($p<0.001$). There was no thrombosis in 421 patients (85.7%). Of the 70 patients (14.3%) with thrombosis, 20 received ELT and 50 did not receive ELT. There was no significant association between use of ELT and thrombosis (16% vs. 12%, $p=0.20$). History of DVT during PN, history of PE, use of anticoagulation medications, PICC/Hohn catheters, and history of 5 or more catheters were found to significantly increase the hazard of thrombosis. On univariable analysis, there was no evidence to suggest that use of ELT was associated with thrombosis ($p=0.53$). On multivariable analysis ELT was not associated with thrombosis ($p=0.07$) adjusting for PICC/Hohn, history of DVT, anticoagulation and thrombogenic medications, and number of catheters during HPN. The presence of a PICC/Hohn was associated with DVT ($p<0.001$) and patients had a 4.4 times higher hazard of thrombosis compared to patients with a Hickman or Port.
Conclusions: Use of ELT was not associated with DVTs in a large sample of adult HPN patients. Our study confirms findings that PICC/Hohn catheters have a higher likelihood of DVT compared to tunneled Hickman catheters for HPN. The use of ELT in silicone catheters for HPN patients is a viable option for prevention of CRBSI without concern for DVTs.

Abstract of Distinction

1835544 - Treating Dehydration at Home Avoids Healthcare Costs Associated with Emergency Department Visits and Hospital Readmissions in Adult Home Parenteral Nutrition and Home Intravenous Fluid Patients

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[1]Digestive Disease Institute, Cleveland Clinic Foundation, Cleveland, OH; [2]Westlake Care Community, Lakewood, CO.
Purpose: Administration of home parenteral nutrition (HPN) and home intravenous fluids (HIVF) has proven cost effectiveness over hospital care. These savings are reduced by hospital readmissions and/or emergency department (ED) treatment for dehydration, a common complication among this population. In 2010, our service developed a protocol to educate patients on the signs and symptoms of dehydration and to treat at home by keeping IVF on hand for immediate use by administering 1 liter of HIVF for 3 days. Our aims were to evaluate the effectiveness of our protocol by comparing 2009 and 2010 data and to assess healthcare costs avoided by treating dehydration at home versus ED visits and readmissions.
Methods: A retrospective analysis was completed using an IRB approved database to identify HPN/HIVF patients with dehydration. Dehydration was defined as having negative fluid balance with at least 1 physical symptom (e.g. decreased weight or urine output, increased enterostomy output, excessive thirst, dry mouth, cramping in extremities) and/or alteration in labs from baseline. Data collected included age, gender, primary diagnoses, HPN or HIVF indication, presence of a fistula or enterostomy, laboratory values, vitals, physical signs of dehydration, and dates of ED visits or admissions for dehydration. To determine potential cost avoidance the cost of ED visits, admission, and home treatment were obtained from Cleveland Clinic's Decision Support Database, Health

Information Management and Clinical Documentation, and Homecare Pharmacy. Hospital admission costs were based on the ICD-9 code for dehydration and Medicare rates without a complication or comorbidity (CC) or major CC.

Results: In 2009, 273 patients were serviced which increased to 330 patients in 2010. There were 83 episodes of dehydration identified in 77 patients in 2009. Of these, 64 episodes (77%) were successfully treated at home compared to 6 ED visits (7.5%) and 13 admissions (15.5%). In 2010, there were 201 episodes of dehydration among 102 patients. We successfully treated 170 episodes (84.5%) in the home with 9 episodes (4.5%) requiring ED visits and 22 hospital admissions (11%) (Figure 1). The number of dehydration episodes per patient was significantly higher in 2010 (1-2 episodes in 2009 versus 1-8 in 2010, $p<0.001$). On multivariable logistic regression, patients were 16 times more likely to have multiple episodes of dehydration identified in 2010 (OR 16.4; CI 95%; $p<0.001$). The increase in dehydration can be attributed to a shift in the patient population between the 2 years with 50% of patients having malabsorption in 2010 compared to only 16% of patients in 2009 ($p<0.001$). The average cost to treat dehydration is $275 at home, $1,074.44 in the ED, and $4,823.82 for hospitalization. By treating dehydration at home, we demonstrated a cost avoidance ranging between $51,159 to $291,124 in 2009 and $135,904 to $773,299 in 2010.

Conclusions: There were more than twice as many episodes of dehydration identified and treated at home in 2010 compared to 2009. Our protocol helped educate and provide the resources required to resolve dehydration at home. Additionally, we potentially avoided over $700,000 in healthcare costs with the protocol.

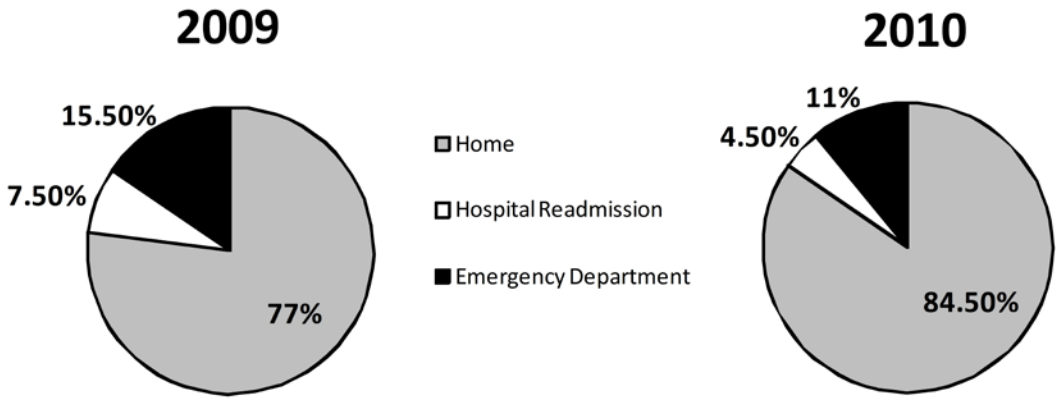

Figure 1: Treatment of dehydration in the home setting increased after implementation of the protocol and hospital admissions and ED visits decreased.

1834251 - Comparison of Central Line–Related Thrombosis and Infection Rates Among New and Existing Home Parenteral Nutrition Patients: Two Years of Sustain™ Data

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ASPEN, Silver Spring, MD.

Purpose: Central line-related thrombosis (CLT) and infectious complications (CLABSI) in home parenteral nutrition (HPN) patients according to previous reports, (Howard) occur most often in patients new to HPN therapy. The purpose of this study is to compare the rates of CLT and CLABSI for patients new to HPN to those on existing HPN therapy when entered into a national HPN data registry.

Methods: This study analyzed data from the Sustain™ HPN Registry which is used to collect cross-sectional and longitudinal data from HPN patients across the U.S. A comparison of reported CLT and CLABSI rates in pediatric and adult HPN patients was compared between those patients new to HPN (NEW) and those who were on HPN therapy (EXISTING) prior to entry into the Sustain HPN Registry. NEW patients can be defined as those who have been on HPN less than 30 days.

Results: Between August of 2011 and July of 2013, 1000 patients were entered into the Sustain HPN Registry. Of the 708 patients with at least 1 follow-up visit, 146 hospitalizations occurred for a catheter related complication .

While EXISTING patients had a longer time on PN, when normalized per 1000 PN days, they had more than double the central line associated bloodstream infection (CLABSI) rate, had 4 times the CLT rate, more than double the catheter replacement rate, and more than double the hospitalization rate when compared to the NEW patients.
Conclusions: Although previous data has shown that new HPN patients have higher rates of catheter complications, this study demonstrates that EXISTING patients have a higher rate of CLT and CLABSI. This new information provides a framework for future analysis of both patient and catheter characteristics to determine any specific contributing variables. However, this information can be used to today to communicate the importance of catheter care education and management in patients receiving HPN.

Table 1. Sustain™ results.

Sustain Date 8/2011-7/2013	NEW	EXISTING	All Sustain
Total n	458 (64.7%)	250 (35.3%)	708
# pediatric patients	41 (33.3%)	82 (66.7%)	123
# adult patients	417 (71.3%)	168 (28.7%)	585
# of follow-up visits	663	774	1407
# of follow-up visits/pt.	1.45	2.98	1.99
Total PN days	53568	51963	105531
Mean PN days/ pt.	117	207.9	149.1
CLABSI per 1000 PN days	0.616	1.424	1.014
Catheter Thrombosis per 1000 PN days	0.037	0.154	0.095
New catheter insertion rate per 1000 PN days	0.504	1.155	0.824
Rate of Hospitalizations per 1000 PN days	0.765	2.021	1.383

1833515 - Catheter-Related Bloodstream Infection Rates in Advanced Oncology Patients on Home Parenteral Nutrition: Impact of a Standardized Catheter Care Protocol

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Purpose: Catheter-related bloodstream infections (CRBSIs) are associated with higher morbidity and mortality as well as increased medical care costs. Cancer patients, who are often immune-compromised, are more susceptible to CRBSI while receiving parenteral nutrition (PN). Incidence of CRBSI in the oncology population has ranged from 0.35 to 5.36 /1000 catheter days depending on the neutrophil status of patients. The most recent study from Italy by Cotogni had the lowest reported incidence of CRBSI (0.35/1000). Only half of their patients were receiving active oncologic treatments during the study period. The impact of standardized catheter care in reducing CRBSI has been well established.
The purpose of this retrospective, non-randomized study was to quantify the impact of following a comprehensive, standardized catheter care protocol on the incidence of CRBSIs in oncology patients on home parenteral nutrition (HPN) who were receiving anti-cancer therapies.
Methods: Data was collected on 116 adult oncology patients receiving HPN from January 1, 2012 to December 31, 2012. Data collected included demographics, catheter type, dwell days, and cancer stage, as well as clinical data and length of PN therapy. ASPEN guidelines were used for PN indication. All patients were receiving active oncologic therapies. Patients were managed by 12 different home infusion sites throughout the country. Patients received detailed pre-discharge teaching by a team of hospital and home infusion nurses, registered dietitians, and a dedicated case manager prior to going home with PN. Patients in the study were followed using a specific catheter care protocol that included: A strict aseptic flushing and dressing change protocol; weekly sterile dressing changes with use of Chloraprep; and MicroClave® connectors and SwabCaps® on all lumens that were not in use. Also included was a weekly assessment that provided details about the patients' clinical status, compliance with catheter care and HPN, and catheter status. The use of printed materials and custom multimedia videos were used to reinforce infusion technique and patient/caregiver compliance with catheter maintenance protocol.

CRBSIs, defined using the CDC definition, were reported to the home infusion provider nurse and documented in the medical record. Catheter dwell days ranged from the start date with the home infusion provider until the catheter was removed or the patient ended service with the home infusion provider. Retrospective analysis was determined through medical record review.
Results: Seventy two females (62%) and 44 males (38%) with an age range of 24 to 85 years were included in the study. One hundred and sixteen catheters were included in the study, which covered 6,186 calculated dwell days. The average length of therapy was 53 days. Fifty seven percent of the patients had implanted ports, 40% had PICCs and 3% had tunneled catheters. The most common cancer types were colorectal (25%), pancreas (23%) and gynecological malignancies (22%). There were 53 analytic and 63 non analytic patients. Sixty six percent of the patients had advanced stage cancer (stage 3 and 4) while 10% had unknown stage. The incidence of CRBSIs was 0.48 per 1,000 catheter days. The catheter infections were confirmed in 3 patients, 2 with ports and 1 with a tunneled catheter.
Conclusions: Little U.S. comparative data exists on the rate of CRBSIs in the HPN population. This study indicates that following a standardized catheter maintenance protocol that includes intensive instruction from clinicians and weekly clinical and compliance assessments minimizes the incidence of CRBSIs in a high risk oncology population undergoing active oncology, oncologic, or anti-cancer treatments.

Abstract of Distinction

1835750 - Stimulating a Culture Change: Implementation of Evidence-Based Guidelines and Reduction of Inappropriate Parenteral Nutrition Usage

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Purpose: Though enteral nutrition (EN) has long been established as the preferred method for providing nutrition support (NS), many physicians ordered parenteral nutrition (PN) for reasons inconsistent with evidence based guidelines (EBG) as defined by ASPEN/SCCM in 2009. Audits conducted by Saint Francis Hospital in August 2012 indicated that 4.8% (25 patients daily) of the adult inpatient population were receiving PN, with approximately 67% ordered inappropriately. The purpose of this initiative was to reduce inappropriate PN usage.
Methods: In order to improve consistency with assessments and physician communication, only registered dietitians (RD) who were certified nutrition support clinicians (CNSC) completed assessments on PN patients. A form was developed and used to communicate the RD assessment of the appropriateness of PN, citing supporting EBG. This form was then placed in the medical record for physician review. It included recommendations for more appropriate nutrition therapy when applicable. In order to strategize and further concentrate efforts, Pharmacy and Therapeutics Committee formed an interdisciplinary subcommittee with representatives from nutrition, pharmacy, administration, nursing, education and physicians from several specialty areas. A physician champion in conjunction with an RD offered multiple presentations to nurses and physicians. A physician grand round dinner session, including CEUs was offered and additional sessions were provided to those physician groups with specific interest or in need of further education. Upon the recommendation of the P&T subcommittee, a Cortrak device was purchased and a team of ICU nurses were trained in placement of post pyloric feeding tubes in order to achieve proper tube placement for patients who had failed gastric feeding or when small bowel feeding was considered best practice. The subcommittee then proposed implementing restrictions on PN ordering. This was accomplished by revising the PN order form to include an EN/PN decision tree to guide the clinician to choose the most appropriate route of nutrition support (NS). The form also requires mandatory selection of evidence based patient criteria for PN in addition to a reason EN is contraindicated. Prescribers who order PN without selecting provided criteria are contacted to request criteria selection. Refusal to select an indication for use on PN order is considered an incomplete medication order and PN order will not be fulfilled. Use of PN outside of approved criteria is considered non formulary use; such requests are communicated to a nutrition physician champion for peer-to-peer discussion and education with the prescribing physician.
Results: Over the course of a 12 month time period, the overall usage of PN decreased from 4.7% of adult patient population down to 2.2%. The average daily number of patients receiving PN decreased from 25 to 12. Inappropriate orders for PN decreased from 67% to 24% of total orders. This reduction of PN resulted in an estimated cost savings of $664,300 annually in substrate alone.
Conclusions: The hospital previously maintained a culture where PN was considered acceptable even when EBG did not support usage. However, through intensive physician and nursing education; focused nutrition assessment by RDs with CNSC certification; increased physician involvement through peer to peer discussion and education; and with the application of an existing pharmacy protocol restricting inappropriate PN; a culture change began to evolve.

The overall result is that NS is now being provided in a manner more consistent with best practice guidelines and in turn the frequency of inappropriate PN usage has significantly decreased.

NUTRITION AND METABOLISM PAPER SESSION: ENTERAL NUTRITION

Abstract of Distinction

1835530 - Improving the Adequacy of Enteral Nutrition in Critically Ill Patients Utilizing a 24-Hour Volume-Based Feeding Protocol: A Pilot Study in an Academic Tertiary Care Center

Erica Varner, BS, RD[3]; Kevin Schimpf, BS, RD[3]; Tamara Kinn, MS, RD, LDN, CNSC[4]; Julie Martin, RD, LDN[4]; Krystin Clark, MS, RD, LDN, CNSC[5]; Barbara Pudelek, RN, MSN[6]; Daniel F. Dilling, MD, FACP, FCCP, FAASM; Lena B. Palmer, MD, MSCR[1]; Deepa Handu, PhD, RD, LDN[4]

[1]Division of Gastroenterology and Nutrition, Loyola University Medical Center, Maywood, IL; [2]Division of Pulmonary and Critical Care Medicine, Loyola University Medical Center, Maywood, IL; [3]Nutrition and Food Services, Edward Hines, Jr. VA Hospital, Hines, IL; [4]Clinical Food and Nutrition, Loyola University Medical Center, Maywood, IL; [5]GI Nutrition Adult Nutrition Support Team, University of Chicago, Chicago, IL; [6]Nursing Administration, Loyola University Medical Center, Maywood, IL.

Purpose: Prior studies indicate widespread feeding inadequacy in critically ill patients which may contribute to poor outcomes. Volume-based, as opposed to rate-based, enteral nutrition protocols have been effective at improving feeding adequacy, but the ability to translate this success to other hospital systems is unknown. The purpose is to investigate whether a 24-hour, nurse driven, volume-based enteral nutrition (EN) protocol will improve feeding adequacy compared to the current rate per hour enteral feeding practices in the Medical Intensive Care Unit (MICU) and the Surgical Intensive Care Unit (SICU) at an urban academic tertiary care center.

Methods: A prospective, non-randomized, before/after pilot study was conducted between January - March 2012 and February-April 2013. A team composed of dietitians, nurses, and physicians met to adapt a published volume-based feeding protocol and to educate staff nurses in its use. All subjects meeting eligibility criteria were enrolled consecutively over the time of the study. Collected data included duration of continuous EN, total length of hospitalization, days on mechanical ventilation, utilization of protein supplementation and pro-kinetic agents, EN rate at initiation and maximum rate/hour, hours to reach goal rate, daily volume adequacy, average caloric and protein adequacy, and causation of feeding interruptions. All data was obtained from the electronic medical record. Descriptive statistics including percent (%), mean (m), and standard deviation (SD) were used to describe demographic characteristics. One-Way ANOVA and chi-squared tests were conducted to determine the relationship between demographic characteristics and clinical outcomes. Statistical analysis was performed using SPSS ver. 16 (Chicago, IL).

Results: Fifty-two subjects were tracked; 29 in the pre-intervention (rate-based EN) and 23 in the post-intervention (volume-based EN) group. The average percent goal volume received per subject was 68.27% ± 13.03% (m± SD) in the pre-intervention group compared to 80.65% ± 19.43% in the post-intervention group, which was statistically significant (p= 0.008). Only 7/29 (24.1%) subjects in the pre-invention group reached feeding adequacy (≥70% of goal volume for ≥70% of feeding days) as opposed to 10/23 (43.4%) in the post-intervention group. There were more interruptions in the pre-intervention group [6/subject ±4 versus 5/subject ±4 (m±SD)], resulting in an average of 5.38 hours more feeding in the post-invention group, but this was not statistically significant (p=0.352 and 0.742, respectively). There was no documented reason for the majority of interruptions in both groups. Documented reasons included emesis, weaning, high gastric residual volumes, procedures, physician order, abdominal distension, mechanical issues, aspiration, and hemodynamic instability. In the post-intervention group, only 9/112 (8%) of EN rates were changed after an interruption, and all of these changes were inaccurate. Per protocol, 100% of rates should have changed to a new, accurate rate.

Conclusions: In the volume-based EN group, higher volumes were delivered and more subjects achieved feeding adequacy; however, this may have been due to less frequent interruptions as opposed to the protocol itself. Lack of post-interruption rate changes and inaccurate changes in the volume-based EN group suggests adherence to the protocol was poor. Further study is needed before a volume-based feeding protocol can be adopted for routine use.

Abstract of Distinction

1835590 - Comparison of Documented Enteral Nutrition Delivery versus Actual Enteral Nutrition Delivery

Marianne Aloupis, MS, RD, CNSC, LDN[1]; Carolyn Spencer, RD, CNSC, LDN[1]; Charlene Compher, PhD, RD, CNSC, FADA, LDN[2]; Michele Nicolo, MS, RD, CNSC, CDE, LDN[1]

[1]Clincial Nutrition Support Services, Hospital of the University of Pennsylvania, Philadelphia, PA; [2]Nutrition Sciences, University of Pennsylvania School of Nursing, Philadelphia, PA.

Purpose: It is well recognized that enteral tube feeding is the preferred mode of nutrition support in hospitalized patients unable to consume oral nutrition. Previous studies have demonstrated that patients fed enterally only receive roughly 75% of the ordered feeding goal. Written flow sheets have been the traditional means of documentation of volume of formula actually given. Accuracy and completeness of flow sheet documentation depends upon many factors; one of which may be the transition from paper to electronic flow records. It is concerning that important patient data may be lost in the transition to electronic medical recordkeeping. With the advent of programmable enteral feeding pumps that maintain feeding history, a comparison can be made between documented enteral nutrition delivery and actual enteral nutrition delivery. The objective of this retrospective, descriptive analysis was to assess the adequacy of enteral nutrition delivery and the accuracy of documentation of enteral nutrition administration in an electronic medical record.

Methods: Data was collected for 61 mixed medical-surgical, ICU and non-ICU patients in a large academic hospital ordered for enteral nutrition (EN) (Figure 1). We assumed that the 72-hour mean daily volume reported in the EN feeding pump history was the actual amount of feeding the patient recieved, and compared the goal intake and the intake recorded in the electronic medical record (EMR) with actual delivery. Independent student t-test analysis was used to compare mean goal volume and mean volume delivered for 72 hours from enteral feeding pump for medical versus surgical, or floor versus ICU. Ordered supplemental protein was compared to documented supplemental protein delivery in the (medication administration record) MAR.

Results: Significant differences were found between mean daily goal volume (M=1317.7 ml, SD=377.6) and mean daily volume delivered over 72 hours from enteral feeding pump history (M=844.6 ml, SD=409.5); $p < 0.0001$); mean daily goal volume (M=1317.7 ml, SD=377.6) and mean daily volume delivered over 72 hours documented in the EMR (M=739.8 ml, SD=411.8); $p < 0.0001$); mean daily volume delivered over 72 hours from enteral feeding pump history (M=844.6 ml, SD=409.5) and mean daily volume delivered over 72 hours reported in the EMR (M=739.8 ml, SD=411.8); p=0.004). Figure 2 summarizes mean daily volume among the three groups. A significant difference was found in the ordered amount of liquid protein (M=1.216, SD=.555) and the liquid protein documented in the MAR (1.417, SD=0.497); =0.006). 48.3 % of patients had EN held for medication delivery to avoid drug-nutrient interactions. No significant differences were found in mean daily goal volume estimated for 72 hours and mean actual daily volume delivered for 72 hours for medical versus surgical admission, or floor versus ICU location.

Conclusions: Patients are not receiving the entirety of ordered EN feedings, regardless of their type of admission. Documentation of EN delivery in the electronic record varied from pump history. The use of the feeding pump history, however, may be a tool with which to benchmark future improvements in delivery of feedings as a result of targeted interventions.

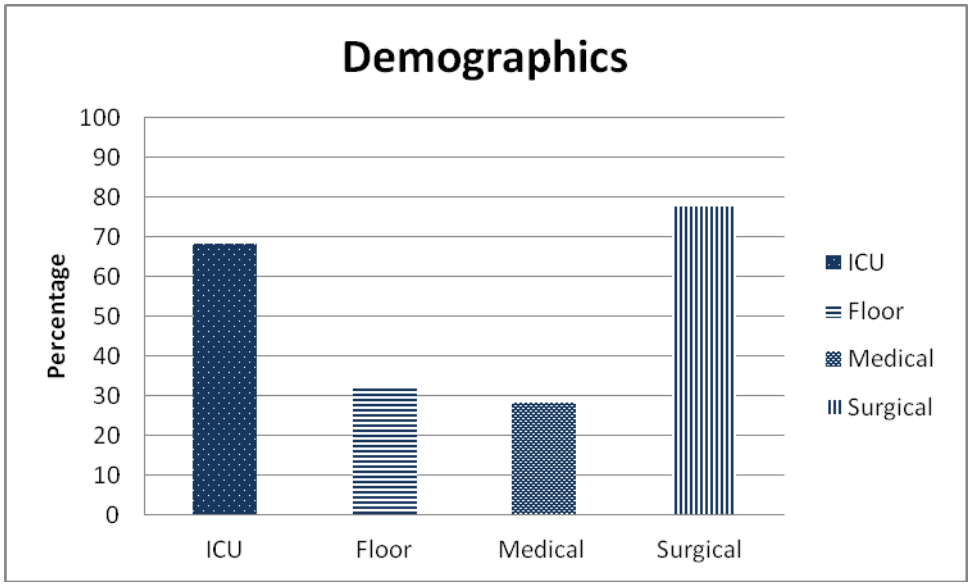

Figure 1. Patient demographics according to location and service.

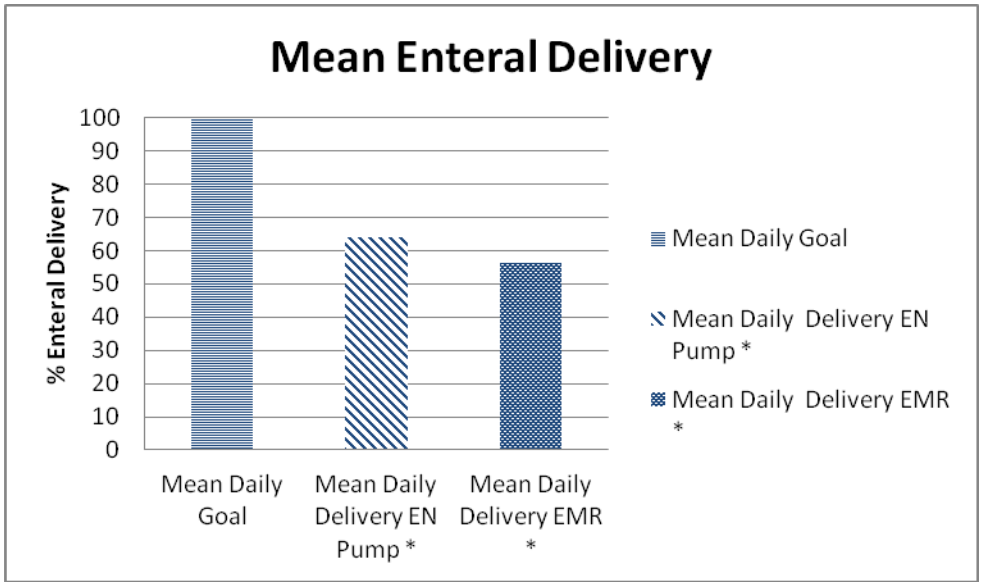

Figure 2. Mean daily EN volume delivery obtained from enteral pump history and mean EN volume delivery documented in EMR compared to mean daily goal volume (* p<0.0001).

1833676 - The Critical Evaluation of Long-Term Enteral Nutrition: Results of a Prospective, Multicenter Study

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Purpose: Enteral nutrition (EN) has been recognized as the best therapeutic option for patients unable to eat, but with functioning gastrointestinal tract, particularly at long-term basis. However, due to growing health care costs, some authors have recently questioned its real value. The unique reimbursement situation for home EN (HEN) in Poland, allowed the critical evaluation of clinical value of EN.
Methods: The prospective observational study of 456 HEN patients (206 women, 250 men, mean age 46.0 years). All patients were fed with a home-made diet before the enrollment to HEN due to the lack of reimbursement in Poland before 2007, and received enteral nutrition with a complex care afterwards. Twelve months from both periods were analyzed as far as the incidence of hospital admissions, length of hospital stay (LOS), complications, laboratory tests and costs of treatment were concerned.
Results: Implementation of HEN significantly reduced the number of hospital admissions, (1.98 vs 1.26/patient/year, p<0.001) and LOS (39.7 vs 11.9 days/patient/year, p<0.001). HEN was associated with a significant decrease in the prevalence of pneumonia (31.7% vs 11.2%, p<0.001), urinary tract infection (14.2% vs 5.7%, p<0.001), and undernutrition (13.9% vs 7.0%, p<0.001), but not respiratory failure (5.3 vs 7.0%). HEN resulted also in decrease of costs (6,215.52 to 2,009.77 USD/year/patient, p<0.001). The improvement was, however, observed only in few laboratory parameters.

Conclusions: Enteral nutrition represent a remarkably effective therapeutic option for long-term nutritional intervention.

1833893 - L-Citrulline Supplementation Prevents the Decline of Arg/ADMA Ratio in Liver and Kidney of Septic Rats

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Purpose: Nitric Oxide (NO) homeostasis and bioavailability is crucial to proper hemodynamics and immune defense. Studies have demonstrated that endothelial NO (eNO) levels are significantly impaired in the setting of sepsis. NO production is dependent on its precursor L-Arg and the L- Arg inhibitor, ADMA. In addition, the L-Arg/ADMA ratio has proven to be a reliable measurement of NO bioavailability. This is a preclinical study that provides the first data assessing the impact of enteral supplementation of L-Citrulline (L-CIt) on preventing liver and kidney reduction of the Arg/ADMA ratio in a rat model of sepsis. The objective was to study the effect of enteral L-Cit supplementation on modulating the levels of L-Arginine (L-Arg), Asymmetric Dimethylarginine (ADMA) and in preventing the decline of L-Arg/ADMA ratio in liver and kidney of septic rats.
Methods: Sepsis was induced by cecal ligation and puncture model as previous described and under an animal use committee approved protocol. Amino acid levels were measure by high-performance liquid chromatography tandem mass spectrometry (LC/MS/MS) in liver and kidney. Macrophage quantification was analyzed in spleen. Statistical analysis was performed utilizing the student t-test and ANOVA. P-values of less than 0.05 ($p<0.05$) were considered statistically significant.
Results: L-Cit supplementation leads to an increase in L- Arg, decrease of AMDA and an increase in the Arg/ADMA ratio, suggesting a potential for increasing NO bioavailability in sepsis. In addition L-Cit supplementation may have broader immunologic impact as evidenced by decreased macrophage recruitment in the spleen.
Conclusions: Our data suggests that oral L-Cit supplementation has beneficial effects in end organs primarily associated with multisystem organ dysfunction in sepsis, especially the hepatorenal axis. The data also suggests that L- Cit supplementation may blunt the septic response in macrophages. Thus, L-Cit may be an important neutraceutical for the septic patient.

1835637 - Code Brown: Incidence of Diarrhea in Critically Ill Patients on Defined Enteral Formulas

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Purpose: In January of 2013, a change in the institutional enteral formulary appeared to coincide with a marked, albeit anecdotal, increase in the incidence of diarrhea among critically ill patients on a specific defined formula. By August of 2013, for financial reasons, the institutional enteral formulary was once again changed, returning to the same products used to 2012. This study was conducted in order to objectively determine if there was a true difference incidence of diarrhea with the two different formulas.
Methods: A retrospective chart review was conducted on patients admitted to the surgical intensive care unit from October 2012 until March 2013 and who were started on one of two defined enteral formulas. Formula A is defined as the enteral formula used in 2012, and formula B is the formula administered after the institutional change in January 2013. The charts were reviewed for type of enteral formula utilized, incidence of diarrhea, medications that influence diarrhea, interventions to control diarrhea, and additional tests to rule out other causes of diarrhea. Other observations included stool studies and the need for diarrhea management.
Results: No significant differences were noted in demographic factors including age, gender, and indication for admission between the two groups. There was also no statistical difference between the two groups in regards to the number of antibiotics administered, the number of laxative or antimotility agents received, or the number of Clostridium dificile tests ordered. Patients on formula A had an average of 1.42 days of diarrhea versus those on formula B, which had an average of 4.25 days of diarrhea. The patients that received formula B were found to be 3.11 times more likely (CI 1.42-6.08) to have diarrhea than patients that received formula A. Patients that received formula B were also 3.21 times more likely (CI 1.17-8.84) to have a rectal tube and collection bag versus patients

receiving formula A. Patients on formula B experienced significantly more days of diarrhea versus patients on Formula A, p <0.001.

Conclusions: There was a significant increase in diarrhea during the enteral formulary change as defined by a quantity and consistency of liquid stool that required placement of a rectal tube and collection bag. Possible mechanisms for this noted difference include differences between the two formulas in the carbohydrate component, the osmolality, as well as the medium chain to long chain triglyceride composition. Prospective analysis quantifying the incidence of diarrhea after changing back to the original formula to confirm these results is currently underway.

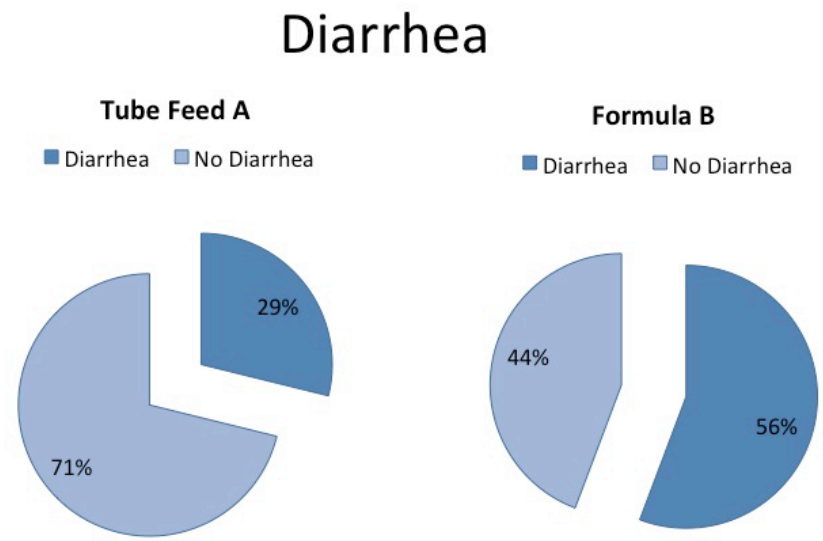
Group Statistics

	Group	N	Mean	Std. Deviation
Antimotility	Impact	52	.19	.595
	Pivot	61	.30	.882
DaysDiarrhea	Impact	52	1.42	3.759
	Pivot	61	4.25	5.881
NumLax	Impact	52	2.62	1.647
	Pivot	61	2.02	1.717
NumAbx	Impact	52	3.71	2.371
	Pivot	61	3.18	2.579
CDiffTests	Impact	52	.58	1.304
	Pivot	61	.79	1.427

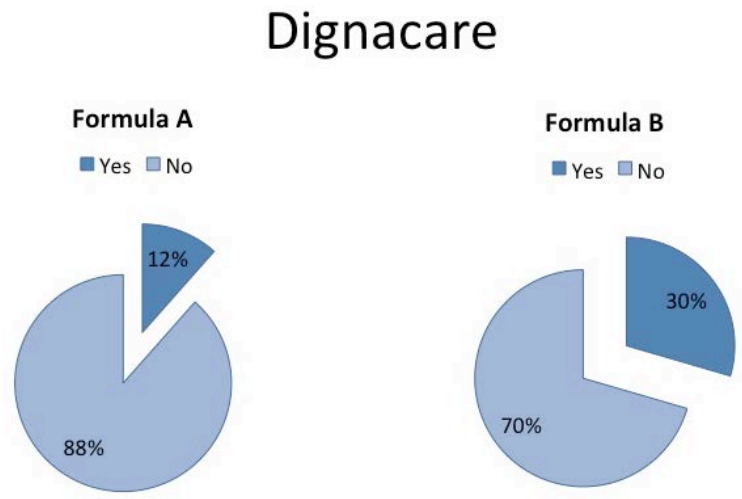
Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
Antimotility	Equal variances assumed	2.172	.143	-.713	111	**.477**
	Equal variances not assumed			-.735	105.735	.464
DaysDiarrhea	Equal variances assumed	13.044	.000	-2.980	111	.004
	Equal variances not assumed			-3.082	103.362	.003
NumLax	Equal variances assumed	.011	.917	1.883	111	**.062**
	Equal variances not assumed			1.889	109.444	.061
NumAbx	Equal variances assumed	.212	.646	1.132	111	**.260**

	Equal variances not assumed			1.140	110.344	.257
CDiffTests	Equal variances assumed	1.367	.245	-.811	111	**.419**
	Equal variances not assumed			-.817	110.449	.416



Incidence of diarrhea between the two formulae



Necessitation of rectal tube for diarrhea management for both formulae

1835840 - Preoperative Enteral Nutrition With Fistuloclysis Before Definitive Surgery

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Purpose: Patients with postoperatory enterocutaneous fistulae need Nutritional Support (NS). Total Enteral Nutrition (TEN), whenever possible, should be preferred. We wished to report two patients who successfully received TEN as fistuloclysis and were operated on and discharged uneventfully.
Methods: Two adult patients on Total Parenteral Nutrition (TPN), with postoperatory enterocutaneous fistulae with exposition of intestinal mucosa, were given TEN infusing a semielemental formula through fistulous tracts. It was previously shown, that on X-Ray contrast studies, there was a suitable length of small bowel for absorption. The objective was to reach the infusion of 2,000 ml of the formula per day in order to stop TPN. It was necessary to use loperamide every four hours through fistuloclysis to avoid diarrhea
Results: Both patients had fistuloclysis as the sole means of Nutritional Support (NS) for 9 weeks and 8 months, respectively, as outpatients. Loperamide could control loose stools. They had nutritional repletion and were successfully operated on to surgically repair their fistulae, being discharged in good condition.
Conclusions: Fistuloclysis for TEN may be an acceptable method of NS to replace TPN to reach nutritional repletion, under the care of a Nutritional Support Team, once it has been shown that the fistulae cannot close spontaneously.

NUTRITION AND METABOLISM PAPER SESSION: MALNUTRITION/OBESITY/PRACTICE CONCEPTS

Abstract of Distinction

1828892 - Evaluation of Lean Body Weight Equation Against Dual-Energy X-Ray Absorptiometry Measures

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Purpose: Body composition can be determined by several methods, including dual-energy x-ray absorptiometry (DXA). While an accepted method, DXA is not practical in most clinical settings. Instead, one of several empiric equations may be used in practice to estimate an adult patient's lean or ideal body weight for purposes of designing or assessing an intervention regimen. A lean body weight (LBW) equation developed by the Duffull-Green group, and based on body composition data, was derived and validated in a group of adult subjects across a wide BMI range. Whether this predictive equation will perform as well in patients, or perform better than a widely used empiric equation is not known.
Objective: To determine how well the Duffull-Green LBW equation predicts lean body mass of patients as measured by DXA at a single point in time and over time. This is compared to findings using the Hamwi optimum (aka "ideal") body weight (IBW) equation.
Methods: De-identified patient data available to our research team from two clinical settings were pooled. The data includes patient sex, ethnicity, age, measured height and weight, calculated BMI, calculated LBW, calculated IBW, as well as reported DXA measures for each patient. The calculated LBW and calculated IBW were each compared with the DXA-derived lean body mass by simple linear regression. A mixed model was then used to determine how well the LBW equation performed over time in patients with more than one DXA measure. Pearson correlations were estimated at each time point to evaluate associations between the calculated weight and DXA lean body mass; beyond the first visit (time 0), groups were defined as 6-9, 9-12, 12-15, and 24-48 months from time 0. Concordance correlation coefficients (ρ_c) were used to evaluate the agreement of the correlated data. Limits-of-agreement analysis provided an estimate of bias (mean±SD). All inferential tests used an $\alpha = 0.05$ to assess statistical significance. Statistical analyses were performed using SAS (v9.3, Cary, NC).
Results: The 39 patients (35 women) identified themselves as white, black, or hispanic (34, 4, 1) and were 18-67 years of age at the time of the first DXA measure. Most of the patients (n=32) were obese (BMI 36.3-65.3 kg/m^2) and the remaining had PN-dependent intestinal failure (BMI 13.9-25.6 kg/m^2). In this dataset 32 patients had more than one DXA measure over time. The BMI in the obese patients at follow-up DXA measures, conducted 7-13 months following bariatric surgery, was 22.0-48.9 kg/m^2. The LBW equation was a significant predictor of lean body mass (R^2=0.67, $p<0.0001$), while the IBW equation was not (R^2=0.04, $p=0.2536$). For LBW the ρ_c was 0.75 compared with 0.17 for IBW. The LBW equation remained a significant predictor of lean body mass over time ($p<0.0001$) without significant interaction by number of months since first visit. Limits-of-agreement analysis indicated bias of 3.5 (+14,-10.5) percent with the LBW equation.

Conclusions: The Duffull-Green LBW equation predicts DXA-derived lean body mass well at a single point in time, with the performance remaining constant over time, in patients with BMI 13.9-65.3 kg/m^2. When DXA measurements are not practical, the data suggest that this predictive equation is an acceptable method for LBW determination across a wide range of BMI. The Hamwi equation, which does not consider BMI, performs poorly in predicting lean body mass.

Abstract of Distinction

1835294 - Evaluating the impact of malnutrition on DRG coding in an acute care hospital

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Purpose: The Academy and ASPEN published consensus criteria to define moderate or severe malnutrition in adult patients. Due to the increased cost of caring for malnourished patients during hospital admissions, the Center for Medicare and Medicaid permits hospitals to receive greater reimbursement for a hospital admission when the discharging physician adds a single comorbid condition (CC) such as moderate malnutrition or a major comorbid condition (MCC) such as severe malnutrition to the DRG diagnosis code. In a point prevalence survey, our purpose was to determine 1) how many malnourished patients had the potential to have a CC or MCC added to their DRG, 2) to estimate any variance from actual billing, and 3) to project the potential annual impact of correcting any coding errors.

Methods: In a 750-bed tertiary referral center with a Case Mix Index of 2.04, assessment for moderate and severe malnutrition was done prospectively on all consecutive adults referred by nutrition screen, parenteral or enteral nutrition orders, admission to ICU or BMI < 18.5 kg/m2 during one week in December, 2012. Staff in the coding department screened the patients' diagnostic coding records retrospectively to determine whether a CC or MCC could have been added to the DRG. The billing variance between the actual charge to insurance and the charge if a CC or MCC for malnutrition was added was calculated. The total number of nutrition assessments for the past fiscal year was used to project future impact.

Results: Figure 1 gives the number and percentage of patients with malnutrition, and those with a potential CC or MCC. Seventy-four (44.0%) of the total of 168 patients were documented as moderately or severely malnourished, 31 of whom had a DRG that would permit the addition of a CC or MCC. Eleven of the 31 could only be recoded if they had severe malnutrition (a MCC) but they only had moderate malnutrition. However, if the remaining 20 patients were recoded with a CC or MCC, the mean variance in billing was $11,083.42/case or $221,648.33 total. If a similar 11.9% of all 10,692 patients evaluated with nutrition assessments each year could be coded at a higher level, the projected 1273 cases would yield an additional $14,109,194 in revenue.

Conclusions: In high-acuity hospitals, more than 40% of the patients referred are malnourished. The hospital costs to provide nutrition care are substantial, but may not be recovered due to coding errors. An important next step to the efforts to identify malnutrition in hospitalized patients is to support physicians in recognizing malnourished patients and to organize systems to code appropriately for their cost of
care.

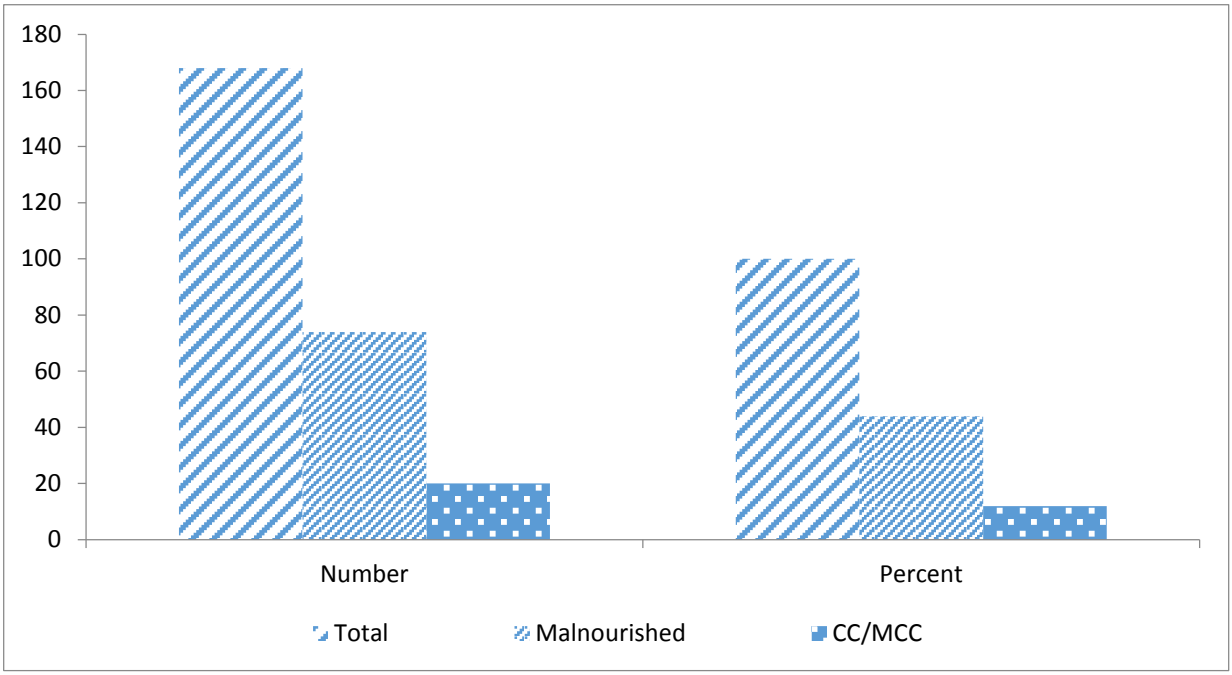

Figure 1. Patients evaluated for malnutrition in one week, those who qualified as moderately or severely malnourished, and those whose DRG code could have added a CC or MCC (number of cases and percentage of total cases).

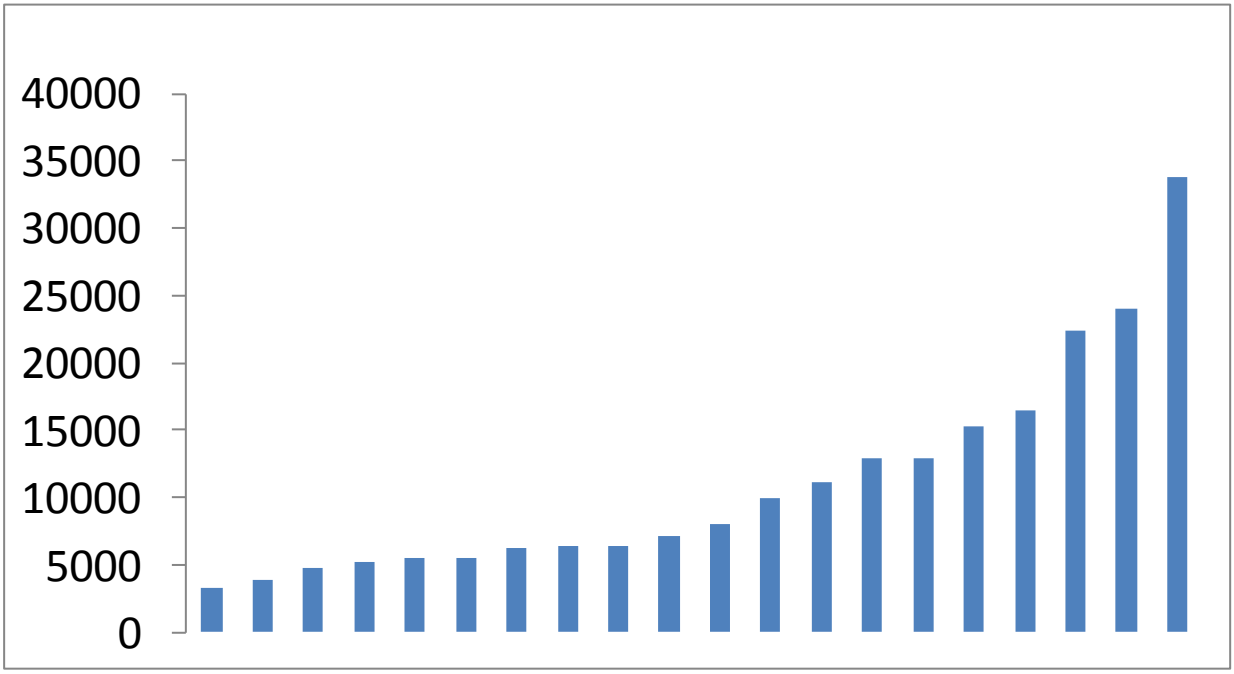

Figure 2. Variance in dollars for each of 20 cases where recoding the DRG with a CC or MCC was justified due to the recognition of malnutrition.

1835501 - Impact of Clinical Pharmacist in Perioperative Medication Management of Bariatric Surgery Patients

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Purpose: Nearly 200,000 patients in the US undergo bariatric surgery each year, primarily Roux en Y Gastric Bypass (RNY) and laparoscopic sleeve gastrectomy (LPSG). Many bariatric surgery patients are on complex medication regimens that require modification in the perioperative and postoperative periods. Smaller bariatric surgery programs often lack a "medical bariatrician" to manage medication issues. Clinical pharmacists can have a major impact as part of the multi-disciplinary care of these patients in the perioperative setting.
Methods: Surgeons office notified hospital based clinical pharmacist of all patients scheduled for bariatric surgery 10-14 days before surgery date. After home medication regimen entered in hospital electronic medical record by surgery intake nurse, pharmacist conducted review of home medications to identify and address potential perioperative or postoperative changes. Recommendations for modifications to medications were then summarized on standardized form (Figure 1) and placed on inpatient chart for surgeon use during hospitalization for surgery. A copy of recommendations was also sent to bariatric surgeon office for use in follow up visits. Data on the types of medication issues addressed by the pharmacist were collected on all patients undergoing bariatric surgery during the study period. Physician response to recommendations were documented for recommendations requiring MD action.
Results: 73 patients underwent RNY (n=24) or LPSG (n=49) from May 1 through August 31 2013. Pharmacists made 109 intervention in 52 of 73 patients (73%). Types of interventions were (a) clarification of home medication (b) conversion of home med (such as beta blocker) to iv form for hospitalization (c) change dosage form for discharge (d) discontinue home medication (e) modification of insulin regimen (f) disease state specific recommendation (for example coordinating inpatient glucose management for Type 1 diabetic on insulin pump undergoing RNY) (Figure 2). Bariatric surgeons changed patient medications based on recommendations made from intervention categories b, c, and d in 41/47 (87%) of cases.
Conclusions: Clinical pharmacists were able to help optimize perioperative use of medication in three quarters of bariatric surgery patients during the four month study period. At bariatric surgery centers without access to a medical bariatrician, pharmacists can improve continuity of care and reduce medication related complications in perioperative care for these patients.

Figure 1: Example Bariatric Medication Reconciliation Recommendation

HOME MEDICATION	Change on admit to	Discharge Home on
Exforge HCT 10mg/320mg/25mg one po daily	Enalapril 1.25mg q6h iv prn sbp over 160	Exforge HCT 10mg/320mg/25mg one po daily
Doxazosin 8mg po BID		Doxazosin 8mg po BID
Oxybutynin 5mg po bid		Oxybutynin 5mg po bid
Carvedilol 25mg po bid	Metoprolol 5mg iv q6h routine, hold for HR less than 60	Carvedilol 25mg po bid
Glimiperide 6mg po daily		DC
Red yeast rice 600mg po daily		Red yeast rice 600mg po daily
Novolog flexpen 9 units sq TID with meals		Novolog flexpen TID with meals sliding scale
Lortab 10/325 ½ tab po q4hp		Lortab 10/325 ½ tab po q4hp
Aspirin 81mg po daily		Aspirin 81mg po daily

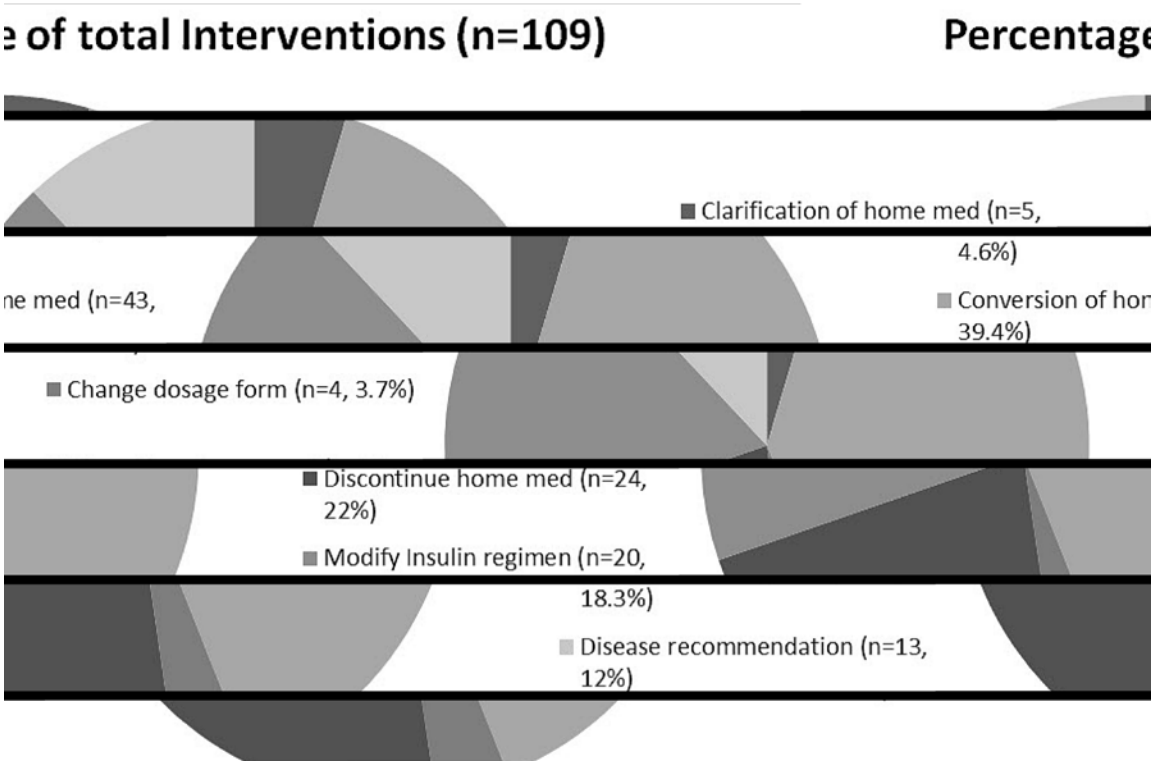

Figure 2: Pharmacist Interventions

1835751 - Estimated Energy Equations Versus Indirect Calorimetry in Pre-Bariatric Surgery Obese Adults: A Comparative Study

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Purpose: Indirect calorimetry is the gold standard for the prediction of resting metabolic rate (RMR) of adults in the clinical setting. Due to the expense of indirect calorimeters and the unavailability of such devices in many settings, predictive equations remain the best alternative. With the increasing prevalence of obesity, the question endures as to which predictive equation most accurately assesses RMR in the obese, outpatient population. Of the more than 200 predictive equations, Mifflin St. Jeor, World Health Organization, and Harris Benedict equation have demonstrated validity in estimating RMR in this specific patient population.
The purpose of this study is to determine whether the Mifflin St. Jeor, World Health Organization, or any of three common derivations of the Harris Benedict equation (using actual, ideal, or mean body weight) provide a caloric estimation that falls within 100 kilocalories of actual RMR measured by a MedGem indirect calorimeter in a sample of adult, pre-surgical, bariatric patients at the Mayo Clinic Hospital in Florida.
Methods: This is a comparative, retrospective, and quantitative study analyzing the statistical accuracy of RMR measurements produced by five different predictive equations, compared to a MedGem indirect calorimeter RMR reading in adult, pre-surgical, bariatric patients. A convenience sample of 186 pre-surgical, bariatric patients screened at the Mayo Clinic Florida Department of Bariatric Surgery from January 1, 2007 to March 31, 2012 was used. Both a paired T test and simple linear regression analysis were computed to identify associations between patient RMRs measured with the MedGem indirect calorimeter and those calculated with five different predictive equations.
Results: The most accurate equation was the Harris Benedict equation using ideal body weight which provided caloric requirement estimations within 100 kilocalories of the MedGem result 19.4% of the time. The equation with the lowest mean difference from the MedGem result was the Harris Benedict equation using mean body weight; with a mean difference of 358.5 kilocalories (312.6 to 404.4, 95% confidence interval). None of the RMR estimation methods were significantly associated with RMR based in indirect calorimetry (Pearson's correlation coefficient ranged from -0.08 to 0.01, all p-values $\geq$ 0.25).

Conclusions: None of the five examined predictive equations produced results that were statistically accurate, defined as a caloric estimation which falls within 100 kilocalories of a patient's indirect calorimetry (MedGem) reading. The results of this trial underscore the need for further development in RMR estimation methods in the obese, outpatient population.

Table 1. Comparison of estimated energy equations versus indirect calorimetry.

Method	% within 100 kilocalories	% overestimated	% underestimated
World Health Organization vs Indirect Calorimetry	7.0	16.1	83.9
Mifflin St. Jeor vs Indirect Calorimetry	15.6	36.6	63.4
Harris Benedict equation using actual body weight vs Indirect Calorimetry	15.1	30.7	69.4
Harris Benedict equation using ideal body weight vs Indirect Calorimetry	19.4	17.2	82.8
Harris Benedict equation using mean body weight vs Indirect Calorimetry	17.7	42.5	57.5

Abstract of Distinction

1835655 - Mobile Nutrition and Metabolic Assessments: A Multidisciplinary Approach to Individualized Nutrition Care in Children Dependent on Home Ventilation

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Purpose: The population of children on home mechanical ventilation in Massachusetts is increasing, with over 250 children on transtracheal ventilation reported in 2005. Artificial respiratory support and limited mobility may be associated with lower energy expenditure, and place this cohort at risk for overfeeding if nutrient intake is based on standard equations. Caloric excess may result in increased carbon dioxide load and need for increased respiratory support. On the other hand, movement disorders, recurrent infections and suboptimal energy prescription, increase the risk of underfeeding. Suboptimal protein delivery may result in loss of lean body mass and impair muscle strength. We aimed to examine the feasibility of a mobile, multidisciplinary, team approach to optimize nutrient intake by in-home nutrition and metabolic assessments in this cohort.

Methods: Pediatric patients dependent on chronic mechanical ventilation at home for at the least 12 hours per day were enrolled. A multidisciplinary team composed of a registered dietitian, a respiratory therapist and physicians completed home visits. First, the respiratory therapist completed a respiratory assessment, recording baseline ventilator support, minute ventilation and volumetric carbon dioxide elimination (VCO2) using a capnometry and pulmonary mechanics monitor. A 30-min indirect calorimetry (IC) test was completed, to obtain resting energy expenditure (REE). Nutrition assessment by the dietitian included, weight to the nearest 0.1kg, height by a stadiometer in standing or supine position to the nearest 0.1cm, mid upper arm circumference (MUAC;cm), skinfold measurements (tricep, sub-scapular, iliac and bicep;mm), and 3-day diet recall to determine actual energy intake (AEI), and protein intake (g/kg/day). Bioelectric impedance assay (BIA) was performed to obtain lean body mass (LBM) and fat mass (FM) values.

Results: Nutrition and metabolic assessments were completed in 11 subjects dependent on home mechanical ventilation. Average age was 7.1yo and 5 were male. Underlying diagnoses included neuromuscular disorders (5/11), epilepsy (4/11), central hypoventilation syndromes (2/11) and inborn errors of metabolism (2/11). Mean (range) distance traveled and time for home visits were 17.2 miles (0.9-51.2) and 28.8 mins (4-60), respectively. Home visits lasted approximately 90 mins. Warm-up time for IC device, need for an unstimulated test and coordination with home activities were factored into the total visit time. IC was interrupted in 2 patients by short, self-resolving seizure activity and in 4 patients due to need to perform tracheal suctioning. Activity levels of subjects were recorded during the IC test, 5 patients were awake and interactive but comfortable during IC. No technical

difficulties were experienced using portable IC, weighing scale, or BIA and these were completed in all patients. One patient did not tolerate skinfold measurements, which appeared to be the most uncomfortable procedure in the study. Height/length measurements were limited by contractures in a majority of the population. This model allowed for individualized recommendations for diet modification based on subjects' measured REE and current intake of energy and protein.
Conclusions: A mobile comprehensive nutrition and metabolic assessment model is feasible and provides a unique opportunity to titrate and optimize macronutrient intake with anthropometric and body composition monitoring. Limitations of performing these assessments out-of-hospital were not specific to location of the study. Individualized dietary interventions may improve outcomes in vulnerable populations outside the hospital setting, who are at risk of nutritional deterioration.

1835597 - Diagnostic Accuracy and Cost Effectiveness of Malnutrition Screening and Subsequent Nutrition Intervention Among Adult Hospitalized Patients: A Systematic Review

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Nutrition, Food Studies and Public Health, New York University, New York, NY.

Purpose: Disease-related malnutrition negatively impacts adult hospitalized patients leading to an increase in length of hospital stay and health care costs. To recognize malnutrition in this setting, malnutrition screening tools have been developed and some have been validated. The first objective of this review was to identify the diagnostic values of these screening tools for hospitalized adult patients. A second objective was to identify studies that examined the costs and/or effectiveness of nutrition screening and subsequent nutrition intervention compared to standard nutrition care in hospitalized adult patients.
Methods: A literature search was conducted using PUBMED, CINAHL+, EMBASE and Global Health through August 2013. Additional studies were identified through a reference search. Quality of the studies was assessed using the quality assessment of diagnostic accuracy studies method (QUADAS-2). Studies for objective one were eligible if they calculated the diagnostic values of malnutrition screening tools for hospitalized adult patients. For objective two, controlled trials were eligible if they studied the costs and/or effectiveness of malnutrition screening and subsequent nutrition intervention in hospitalized adult patients.
Results: The quality of the studies for objective one was variable. Due to a lack of a gold standard for the measurement of nutritional status, it was difficult to determine whether the conduct or interpretation of the index test and reference standard could have caused bias. Twenty-two studies met the inclusion criteria for objective one. Table 1 shows the demographics of these studies and the diagnostic values of the nutrition screening tools. The Malnutrition Universal Screening Tool (MUST) and the Nutrition Risk Screening-2002 (NRS-2002) were most frequently tested with the Subjective Global Assessment (SGA) as the reference standard and scored >80% for specificity. More fluctuation was seen for sensitivity (figure 1). Three studies were identified that examined the costs and/or effectiveness of malnutrition screening and nutrition intervention. All studies showed a lower length of hospital stay for the treatment groups compared to the control groups, although not always significant. None of the studies in both objectives were conducted in the United States (US).
Conclusions: The MUST and the NRS-2002 should be further tested in larger adult hospitalized populations using the SGA as a common reference standard. To decrease the prevalence of malnutrition in hospitalized patients and subsequently decrease length of stay and health care costs, it is essential that patients are screened for malnutrition and treated accordingly. There is a need for more evidence concerning the cost-effectiveness of malnutrition screening and treatment among adult hospitalized patients, especially in the U.S.

Table 1. Characteristics of included studies.

Author, year	Screening Tool	Population	Sex (% male)	Age (sd)	Country	Reference Standard	Patients (N)	Sensitivity (%)	Specificity (%)	PVV[1]	NPV[2]	Reliability (K)	Agreement (K)
Poulia et al; 2012	SGA MNA-SF[3] MUST[4]	Elderly hospital inpatients	52	Mean: 75.2 (8.5)	Greece	Combined Index Tool[6]	248	SGA: 84.3 MNA-SF: 98.1 MUST:	SGA: 91.4 MNA-SF: 50 MUST:	SGA: 95.2 MNA-SF: 79.9	SGA: 74.3 MNA-SF: 93.2	N/A	SGA: 0.707 MNA-SF: 0.545

	NRS 2002[5]							87.3 NRS 2002: 99.4	76.8 NRS 2002: 6.1	MUST: 88.4 NRS 2002: 68.2	MUST: 75 NRS 2002: 83.3		MUST: 0.638 NRS 2002: 0.088
Tamma m et al; 2009	INSYS T[7] I INSYS T II	Adult hospital inpatient s	?	?	UK	MUST MNA[8]	61	*MUST* INSYST I: 95 INSYST II: 95 *MNA* INSYST I: 100 INSYST II: 95	*MUST* INSYST I: 80 INSYST II: 65 *MNA* INSYST I: 83 INSYST II: 65	*MUST* INSYS T I: 72 INSYS T II: 59 *MNA* INSYS T I: 75 INSYS T II: 59	*MUST* INSYS T I: 97 INSYS T II: 96 *MNA* INSYS T I: 100 INSYS T II: 96	INSYST I: 0.77 INSYST II: 0.39	*MUST* INSYST I: 0.73 INSYST II: 0.53 *MNA* INSYST I: 0.76 INSYST II: 0.53
Mei-Yu Tu et al; 2012	MUST	Adult Hospital inpatient s with colorecta l cancer	25	Mean: 62.1 (11.5)	Taiwa n	SGA	45	MUST: 96	MUST: 93.8	MUST: 82.8	MUST: 93.8	MUST: 0.7	N/A
Vallén et al; 2011	MEON F-II[9] MEON F-II - CC[10] MUST	Elderly hospital inpatient s	42	Mean: 79.8 (7.9)	Swede n	MNA	100	MEONF -II: 73 MEONF -II-CC: 68 MUST: 57	MEONF -II: 88 MEONF -II-CC: 90 MUST: 93	MEON F-II: 81 MEON F-II-CC: 82 MUST: 86	MEON F-II: 82 MEON F-II-CC: 80 MUST: 75	N/A	MEONF-II: 0.82 MEONF-II-CC: 0.81 MUST: 0.78
Lawson et al; 2012	MUST MST[11]	Adult renal hospital inpatient s	?	Media n: Study 1: 65 (range 17-98) Study 2: 61 (range 20-90) Study 3: 64 (range 25-85)	UK	SGA	Study 1: 190 Study 2: 46 Study 3: 40	*Study 1* MUST: 53.8 MST: 48.7	*Study 1* MUST: 78.3 MST: 85.5	*Study 1* MUST: 73.7 MST: 66.2	*Study 1* MUST: 60 MST: 78.7	N/A	*Study 3* MUST: 0.58 MST: 0.33
Mirmira n et al; 2011	NST[12]	Adult hospital inpatient s	48.7	Mean: 49.5 (16.3)	Iran	Nutrition al assessme nt by dietician	414	86.7	61.7	79	73.1	Nurse 1 (1st day) vs. nurse 2: 0.68 Nurse 1 (2nd day) vs. nurse	N/A

													2: 0.74 Nurse 1 in 2-d period: 0.87	

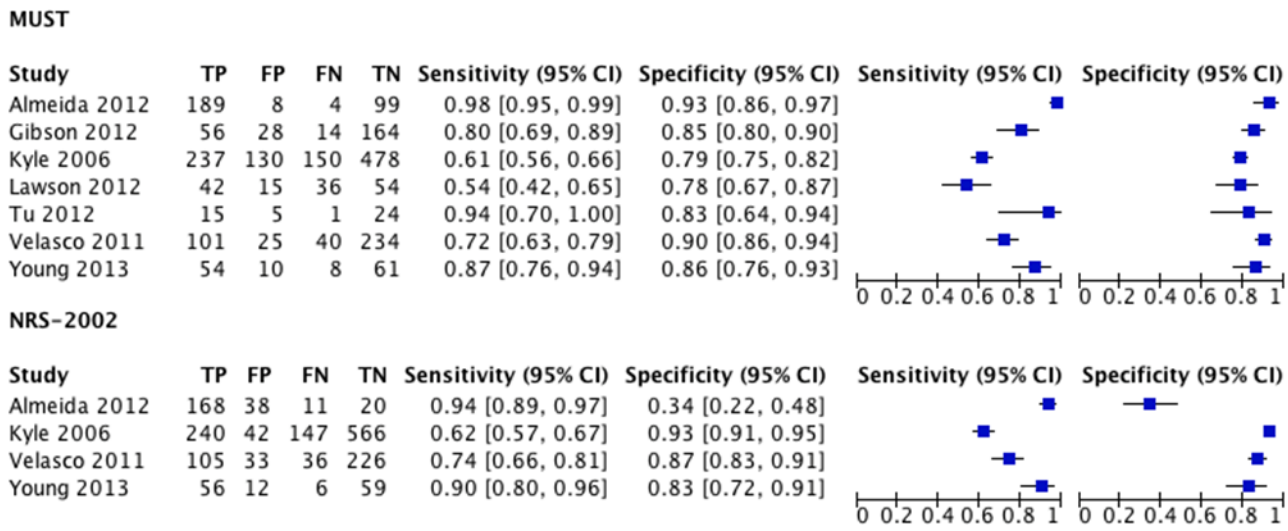
Table 2. Characteristics of included studies (cont.).

Author, year	Screening Tool	Population	Sex (% male)	Age (sd)	Country	Reference Standard	Patients (N)	Sensitivity (%)	Specificity (%)	PVV[1]	NPV[2]	Reliability (K)	Agreement (K)
Ranhoff et al; 2005	MNA-SF MNA-SF and BMI<23	Elderly acute medical patients	30	Mean: 81.5 (5.6)	Norway	Nutritional assessment by nutritionist	69	MNA-SF: 100 MNA-SF and BMI<23: 86	MNA-SF: 38 MNA-SF and BMI<23: 71	N/A	N/A	N/A	N/A
Young et al; 2013	MST MNA-SF NRS 2002 MUST SNAQ©[13] SNAQ[14] Rapid Screen	Elderly hospital inpatients	50	80 (8)	Australia	SGA MNA	134	*SGA* MST: 90.3 MNA-SF: 100 NRS 2002: 90.3 MUST: 87.1 SNAQ©: 79 SNAQ: 86.9 Rapid Screen: 29 *MNA* MST: 67.7 MNA-SF: 95.6 NRS 2002: 72.2 MUST: 67.8	*SGA* MST: 84.7 MNA-SF: 52.8 NRS 2002: 83.3 MUST: 86.1 SNAQ©: 90.3 SNAQ: 78.9 Rapid Screen: 100 *MNA* MST: 88.3 MNA-SF: 79.1 NRS 2002: 95.3 MUST: 93.0	*SGA* MST: 83.6 MNA-SF: 64.6 NRS 2002: 82.4 MUST: 84.4 SNAQ©: 87.5 SNAQ: 77.9 Rapid Screen: 100 *MNA* MST: 90.5 MNA-SF: 90.5 NRS 2002: 97.0 MUST:	*SGA* MST: 91 MNA-SF: 100 NRS 2002: 90.9 MUST: 88.6 SNAQ©: 83.3 SNAQ: 87.5 Rapid Screen: 62.1 *MNA* MST: 89.5 MNA-SF: 89.5 NRS 2002: 62.1 MUST: 58.0 SNAQ©:55.8 SNAQ:	N/A	N/A

								SNAQ ©: 62.2 SNAQ: 69.3 Rapid Screen: 20.0	SNAQ ©: 100 SNAQ: 83.7 Rapid Screen: 100	95.3 SNAQ ©: 100 SNAQ: 89.7 Rapid Screen: 100	57.1 Rapid Screen: 37.4		
Haid et al; 2012	INST[15]	Surgical hospital inpatients	52.9	Mean: 57.4 (16.3)	Austria	NRS 2002	634	43.9	98.8	89.47	?	N/A	N/A
Almeida et al; 2012	NRS 2002 MUST	Surgical inpatients	44	Mean: 60 (17)	Portugal	SGA	300	NRS 2002: 80.0 MUST: 85.0	NRS 2002: 89.0 MUST: 93.0	NRS 2002: 87.0 MUST: 89.0	NRS 2002: 100 MUST: 99.0	N/A	NRS 2002: 0.85 MUST: 0.91
Valesco et al; 2011	NRS 2002 MUST MNA	Hospital inpatients	60.2	Mean: 67.4 (16.1)	Spain	SGA	400	NRS 2002: 74.4 MUST: 71.6 MNA: 95.0	NRS 2002: 87.2 MUST: 90.3 MNA: 61.3	NRS 2002: 76.1 MUST: 80.1 MNA: 57.2	NRS 2002: 86.2 MUST: 85.4 MNA: 95.7	N/A	NRS 2002: 0.62 MUST: 0.63 MNA: 0.49
Gerasimidis et al; 2007	NST	Hospital inpatients	44.5	Median: 64 (18-95)	UK	MUST	202	95.3	64.9	95	66.4	N/A	0.57
Kyle et al; 2006	MUST NRS-2002	Hospital inpatients	52.7	LOS 1-10 days: mean 50.5 (21.9) LOS> 11 days: mean 64.4 (18.7)	Switzerland	SGA	995	MUST: 61.2 NRS-2002: 62.0	MUST: 78.6 NRS-2002: 93.1	MUST: 64.6 NRS-2002: 85.1	MUST: 76.1 NRS-2002: 79.4	N/A	MUST: 0.26 NRS-2002: 0.48
Stratton et al; 2004	MST MNA-	Hospital inpatients <64 years Surgical	60	Mean: 44 (14) Mean:	UK	MUST	75	90.7	80.9	92.4	22.6	N/A	0.707

	sf MNA-sf	patients Elderly hospital inpatients	? ?	61 (20.2) Mean: 78 (7.37)			85 86	91.2 60.4	72.5 97.3	68.8 96.6	92.5 66.1	N/A N/A	0.605 0.551
Gibson et al; 2012	MUST Mod-MST[16]	Acute hospital inpatients	48.5	Mean: 70.8 (16.3)	Australia	SGA	262	MUST: 80 Mod-MST: 77	MUST: 85 Mod-MST: 83	MUST: 66 Mod-MST: 63	MUST: 92 Mod-MST: 91	N/A	N/A
Venrooij et al; 2011	SNAQ© MUST CSSM[17]	Hospital inpatients undergoing cardiac surgery	72.3	Mean: 65.7 (10.1)	The Netherlands	FFMI[18]	325	SNAQ©: 18.5 MUST: 59.3 CSSM: 74.1	SNAQ©: 93.6 MUST: 82.7 CSSM: 70.1	SNAQ©: 20.8 MUST: 23.9 CSSM: 18.5	SNAQ©: 92.6 MUST: 95.7 CSSM: 96.7	N/A	N/A
Elkan et al; 2007	MNA SGA MUST NRS-2002	Hospital inpatients (women) with rheumatoid arthritis	17	Median: 65.5 (60.0-75.0)	Sweden	FFMI	60	MNA: 85.0 SGA: 46.0 MUST: 45.0 NRS-2002: 45.0	MNA: 39.0 SGA: 82.0 MUST: 19.0 NRS-2002: 19.0	N/A	N/A	N/A	N/A
Nursal et al; 2005	Q-SGA[19] MQ-SGA[20]	Hospital inpatients	48.8	Mean: 54.4 (14.8)		SGA	2197	Q-SGA: 90 MQ-SGA: 90.9	Q-SGA: 67 MQ-SGA: 85.6	N/A	N/A	N/A	N/A
Kim et al; 2011	MSTC[21]	Cancer hospital inpatients	58.8	Mean: 58.6 (11.1)	Republic of Korea	SGA	1057	94.0	84.2	67.8	97.6	N/A	0.70
Lim et al; 2009	3-MinNS[22]	Acute hospital inpatients	59	Mean: 51.9 (15.4)	Singapore	SGA	818	86.0	83.0	67.0	94.0	N/A	N/A
Thorsdottir et al; 2005	MNA SSM[23] Simplified model	Elderly hospital inpatients	36.6	Mean: 83 (7.9)	Iceland	FNA[24]	60	MNA: 77.0 SSM: 89.0 Simplified model: 89.0	MNA: 36.0 SSM: 60.0 Simplified model: 88.0	MNA: 63.0 SSM: 76.0 Simplified model: 91.0	MNA: 53.0 SSM: 91.0 Simplified model: 85.0	N/A	N/A

Figure 1. Forest plot: Malnutrition Universal Screening Tool (MUST) and Nutrition Risk Screening-2002 (NRS-2002) versus the Subject Global Assessment (SGA) as the reference standard. TP, True Positives; FP, False Positives, FN, False Negatives; TN, True Negatives.



NUTRITION AND METABOLISM PAPER SESSION: CRITICAL CARE

Abstract of Distinction

1835113 - Malnutrition and Posthospital Discharge Mortality in ICU Survivors

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Purpose: Critically ill patients who survive to hospital discharge suffer significant long term morbidity. Whether malnutrition has prognostic implications for ICU survivors has not been studied. We hypothesized that malnutrition near ICU admission would be associated with increased mortality following hospital discharge in critically ill patients who survive hospitalization.

Methods: We performed a single center observational study of patients treated in medical and surgical ICUs in Boston. We studied 6,283 patients, age 18 years or higher, who received critical care, survived hospitalization and received a formal standardized evaluation by a registered dietitian between 2004 and 2011. Nutrition status evaluation included data collected on serum albumin, transferrin, total lymphocyte count, weight loss, % ideal body weight, muscle wasting, and energy intake. The exposure of interest, malnutrition, was considered to be present if the patient was formally diagnosed by a registered dietitian with any of the following: nonspecific protein-calorie malnutrition, protein-calorie malnutrition (mild protein-calorie malnutrition, moderate protein-calorie malnutrition, severe protein-calorie malnutrition, or marasmus). Patients were not considered to have to have malnutrition if diagnosed as "not at risk" or "at risk" for developing malnutrition. We included formal registered dietitian evaluations from 10 days prior to 2 days after critical care initiation. The primary outcome was all cause mortality in the 30 days following hospital discharge. Mortality was determined using the US Social Security Administration Death Master File and 365 day follow-up was present in all cohort patients. Adjusted odds ratios (OR) were

estimated by multivariable logistic regression models with inclusion of covariate terms thought to plausibly interact with both nutrition status and mortality post hospital discharge. Adjustments included age, race, gender, Deyo-Charlson Index, patient type (medical versus surgical), sepsis and number of organs with acute failure.
Results: Nonspecific malnutrition was recorded in 55.2%, specific malnutrition in 11.4%, and malnutrition was absent in 33.4%. The post discharge 30 and 90-day mortality rates were 8.1% and 14.4% respectively. In patients who received critical care and survived hospitalization, malnutrition was a robust predictor of all cause mortality following hospital discharge and remained so following multivariable adjustment. Patients with nonspecific malnutrition have an OR for mortality in the 30 days following hospital discharge of 1.60 (95%CI, 1.28-1.99; P<0.001) and an adjusted OR of 1.60 (95%CI, 1.27-2.02; P<0.001) relative to patients without malnutrition. Patients with specific malnutrition have an OR for mortality in the 30 days following hospital discharge of 2.72 (95%CI, 2.05-3.61; P<0.001) and an adjusted OR of 2.68 (95%CI, 1.99-3.59; P<0.001) relative to patients without malnutrition. Similar significant robust associations post multivariable adjustments are seen with death by 90 days post-discharge. Estimating the receiver operating characteristic curve AUC shows that malnutrition has moderate discriminative power for mortality 30-days following hospital discharge (AUC = 0.58; SE=0.01; 95% CI 0.56-0.60; P<0.001), and for mortality 90-days following hospital discharge (AUC = 0.60; SE=0.009; 95% CI 0.58-0.62; P<0.001).
Conclusions: In adult critical illness survivors, malnutrition near ICU admission is a robust predictor of all cause mortality following hospital discharge. With heightening societal and political interest in cost-effective healthcare delivery, malnutrition may be a prognostic and potentially modifiable marker for patients who are at high risk for post hospital discharge mortality.

Abstract of Distinction

1831152 - Assessment of a Novel Nutrition Screening Tool for Critically Ill Patients

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Purpose: Observational studies have revealed that critically ill patients are consistently underfed with significant calorie and protein deficits occurring within the first week of intensive care unit (ICU) stay. Yet existing nutrition screening tools have not been developed with the critically ill patient in mind. Current tools are either impractical, treat all ICU patients the same regardless of presence of acute or chronic starvation or inflammation and do not give a visual depiction of daily calorie/protein deficit. To overcome these deficiencies and to help monitor nutritional adequacy in ICUs in real time, an electronic Bedside Nutrition Monitoring Tool was created.
The objective of this paper is to assess the effectiveness of the Bedside Nutrition Monitoring Tool in improving the calorie and protein deficit in ICU patients.
Methods: The Bedside Nutrition Monitoring tool was originally developed in 2012 for the The PEP uP (Enhanced Protein-Energy Provision via the Enteral Route Feeding Protocol) Nutrition Collaborative. Features of the tool included cumulative calorie and protein adequacy graphs generated in real time and built in prompts to assist the ICU dietitian in making decisions about modifying the rate and volume of overall nutrition received. Participating ICUs collected data on baseline APACHE, SOFA score, inflammatory markers, history of weight and oral intake, comorbidities, timing of start of nutrition, calorie and protein prescription and daily amounts received. From the baseline data, the Nutrition Risk Assessment in Critically ill Patients Score (NUTRIC Score) and Malnutrition Screening Tool (MST) score were calculated by the tool and any risk of malnutrition was identified. Endpoints included calorie and protein adequacy and initiation of enteral nutrition compared to guidelines. Energy and protein adequacy was compared between patients with a high (>5) vs. a lower NUTRIC score (<5) and those with a high MST score (2 or more) vs. low MST score (0-1).
Results: From September 2012 to August 2013, a total of 15 ICUs participated and collected data for 152 patients for a total of 1199 days. Twenty-two patients had an APACHE score <15, 46 patients scored 15-19, 51 patients scored 20-28, and the remaining 33 patients scored >28. The average SOFA Score was 11.1 ± 5.2. On average, the time from ICU admission to initiation of EN was 0.8 (+1.8) days and patients received 61.9% of prescribed calories, 58.2% of prescribed protein and accumulated an average deficit of 633 kcals/day and a 39.2 gms protein/day. A total of 70.4% of patients had a high NUTRIC score (>5) and 42.8% of patients were identified as being at risk of malnutrition according to the MST. Patients with a high NUTRIC score received 63.4% prescribed calories and 59.3% prescribed protein compared to patients with a low NUTRIC score (58.6% cals and 55.6% protein, p=0.28 and 0.37 respectively). Patients with a high MST score received 64.9% prescribed calories and 63.0% prescribed protein compared to patients with a low MST score (59.8% cals and 54.7% protein, p=0.10 and 0.01 respectively).

Conclusions: Despite being fed within 48 hours of ICU admission, suboptimal delivery of energy and protein continues to be an issue in critically ill patients. Energy and protein adequacy was no better in higher risk patients as determined by the NUTRIC score and only slightly better in patients with a high MST score. Based on these results, the Bedside Nutrition Monitoring Tool is not effective in improving calorie and protein deficits in the critically ill. Further insight is needed into the barriers surrounding the use of this tool and optimizing energy and protein intake in this population.

Abstract of Distinction

1834539 - Nutritional Adequacy and Health-related Quality of Life in Critically Ill Patients Requiring Prolonged Mechanical Ventilation

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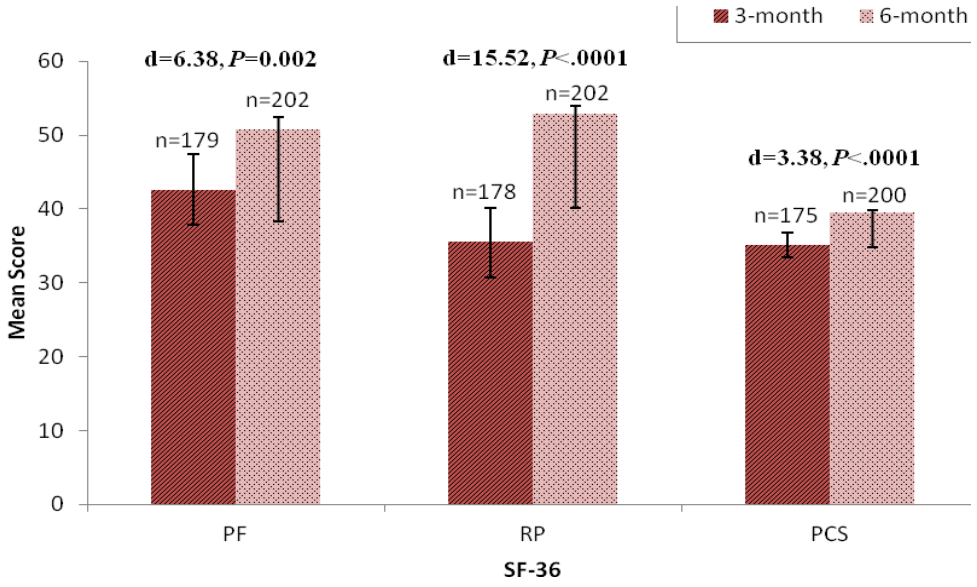
Purpose: The objective of this study was to examine the association between nutritional adequacy and health-related quality of life (HRQoL) in six-month survivors requiring prolonged mechanical ventilation in the intensive care unit (ICU).

Methods: The study was conducted as a retrospective cohort study on data collected prospectively in the context of a multicenter randomized controlled trial (the REDOXS study) in critically ill patients with multiorgan failure. Patients survived to six-months follow-up and were mechanically ventilated for more than eight days in the intensive care unit were included. Nutritional adequacy was obtained from the average proportion of prescribed calories received during the first eight days of mechanical ventilation in the ICU. HRQoL was prospectively assessed using Short-Form 36 Health Survey (SF-36) questionnaire at three-months and six-months post ICU admission.

Results: At six-months follow-up, 302 of the 475 patients who were mechanically ventilated and remained in the ICU for > 8 days, were alive and therefore eligible for inclusion (Figure 1). Among these survivors, the increases in scores for Physical Functioning (PF), Role Physical (RP), and Physical Component Scale (PCS) of the SF-36 from three-months to six-months were statistically significant. At three-months follow-up, a 25% increase in nutritional adequacy was associated with improvements in PF, RP, and PCS of 7.29 ($P = 0.02$), 8.30 ($P = 0.004$), and 1.82 ($P = 0.07$) points respectively (Table 1). At six-months follow-up, a 25% increase in nutritional adequacy was associated with improvements in PF, RP, and PCS of 4.16 ($P = 0.14$), 3.15 ($P = 0.25$), and 1.33 ($P = 0.19$) points respectively (Table 1). A stronger association with nutritional adequacy was found at three-months compared results obtained at six-months. Consistent results were obtained after performing multiple imputation on missing values.

Conclusions: Nutritional adequacy is associated with HRQoL in six-month survivors requiring prolonged mechanical ventilation in the ICU. Increasing nutritional intake can help facilitate faster physical recovery.

Figure 1. Three-month and six-month mean scores for PF, RP, and PCS of SF-36.



(Error bars indicate 95% confidence intervals of the mean score; d is the mean difference between three-month and six-month mean score and p-values were calculated by paired t-test.)

Table 1. Parameter estimates of the effect of nutritional adequacy on SF-36 scores.

SF-36		**Nutritional Adequacy[a] per 25% increase**			
		Crude Estimate[b] (95% CI)	**p-value**	**Adjusted Estimate[b,c] (95% CI)**	**p-value**
Physical Functioning	3-month (n=179)[d]	7.71 (2.29, 13.14)	0.006	7.29 (1.43, 13.15)	0.02
	6-month (n=202)[d]	5.25 (0.03, 10.47)	0.05	4.16 (-1.32, 9.64)	0.14
Role Physical	3-month (n=178)[d]	8.27 (3.03, 13.52)	0.002	8.30 (2.65, 13.95)	0.004
	6-month (n=202)[d]	5.00 (-0.16, 10.16)	0 .06	3.15 (-2.25, 8.54)	0.25
Physical Component	3-month (n=175)[d]	1.82 (-0.07, 3.70)	0.06	1.82 (-0.18, 3.81)	0.07

Scale	6-month (n=200)[d]	1.77 (-0.15, 3.69)	0.07	1.33 (-0.65, 3.31)	0.19

[a]Proportion of caloric prescription received by enteral nutrition and parenteral nutrition over first 8 days of mechanical ventilation and intensive care unit stay; [b]The estimate provides the change in SF-36 scores for every 25% increase in nutritional adequacy; [c]Adjusted for age, APACHE II score, baseline SOFA, Functional Comorbidity Index, admission category, and region; [d]n provides the number of responders for each SF-36 score.

1831973 - Low Energy Intake Is Associated With Reduced Duration of Mechanical Ventilation in Critically Ill Underweight Patients

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Purpose: Critical illness is associated with a hypercatabolic state, increased oxidative stress, insulin resistance, and alterations in neuroendocrine and sympathetic nerve function. Some researchers therefore recommend energy restriction to avoid accelerating these undesirable responses to stress. This is supported by some evidence in which better outcomes were observed with lower energy intake in critically ill patients. These studies were, however, generally conducted with normal body weight patients. The aim of this study was to determine how energy intake influences mortality and morbidity of critically ill, underweight patients.

Methods: This study was a single-center retrospective chart review. All consecutive patients who were admitted to the emergency intensive care unit (EICU) between August 2011 and December 2012 were screened for eligibility. Patients older than 18 years of age, with a body mass index (BMI) of less than 20.0 kg/m2, who were mechanically ventilated within the first 48 h of admission, and who stayed in the EICU for more than 72 h were enrolled in this study. Patients were categorized into four groups according to their initial Sequential Organ Failure Assessment (I-SOFA) score and their average daily energy intake during EICU stay up to 7 days; Group M-1: I-SOFA ≤8 and <16 kcal/kg/day; Group M-2: I-SOFA ≤8 and ≥16 kcal/kg/day; Group S-1: I-SOFA >8 and <16 kcal/kg/day; Group S-2: I-SOFA >8 and ≥16 kcal/kg/day. Clinical outcomes were compared between M-1 and M-2, and between S-1 and S-2. Data were provided as median and interquartile range for continuous variables and number and percentage for categorical variables. The Mann-Whitney U test was used for continuous data and Fisher's exact test was used for categorical data.

Results: Of 971 patients screened for eligibility, 51 were enrolled for the study. Of these, 10 were categorized in Group M-1, 9 were in M-2, 10 were in S-1, and 22 were in S-2 (Figure 1). Demographics and clinical characteristics were not significantly different between M-1 and M-2, or between S-1 and S-2. Patients included in M-1 and S-1 received nutrition support later than those in M-2 and S-2, respectively (Table 1).

Outcomes are shown in Table 2. There was no significant difference in the all-cause mortality or the length of stay between M-1 and M-2, or between S-1 and S-2. The mechanical ventilation duration (MVD) was significantly shorter in M-1 than in M-2 (2.7 (1.0-5.7) vs 9.2 (4.2-17.4) days; P = 0.040). Similar results were obtained between S-1 and S-2 (3.1 (0.7-6.0) vs 8.8 (6.1-23.1) days; P = 0.013). The number of patients who underwent tracheostomy during their hospital stay was significantly lower in M-1 than in M-2 (20% vs 32%; P = 0.002). No significant difference was observed in M-1 and M-2 or in S-1 and S-2 in the duration of antibiotic therapy, serum levels of C-reactive protein, insulin therapy, or in the incidences of liver dysfunction, renal dysfunction, or hypoglycemia.

Conclusions: In patients whose BMI <20.0 kg/m2, the average energy intake <16 kcal/kg/day during the first week in EICU was associated with reduced MVD regardless of their I-SOFA score, and in those with an I-SOFA score >8 there was a lower requirement of tracheostomy for those who received <16 kcal/kg/day.

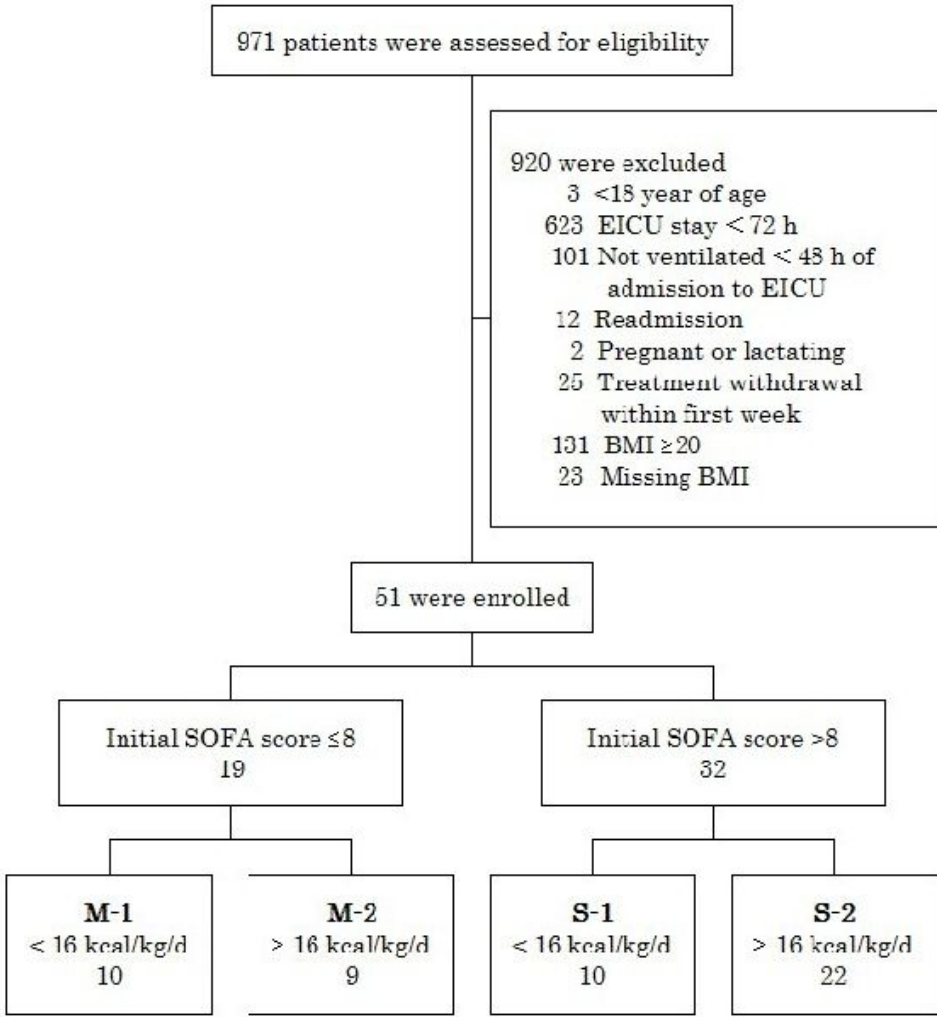

Figure 1. Flow diagram showing patient selection BMI, body mass index; EICU, emergency intensive care unit; SOFA, Sequential Organ Failure Assessment

	Initial SOFA score ≤8			Initial SOFA score >8		
	Group M-1 < 16 kcal/kg/d *n*=10	**Group M-2** ≥ 16 kcal/kg/d *n*=9	*P* Value	**Group S-1** < 16 kcal/kg/d *n*=10	**Group S-2** ≥ 16 kcal/kg/d *n*=22	*P* Value
Demographics						
Age, years; median (IQR)	65.2 (40.5-75.6)	64.8 (59.1-75.8)	.806	66.9 (35.7-82.4)	71.8 (63.1-81.5)	.360
Sex			.395			.073
Female, n (%)	5 (50)	6 (67)		8 (80)	10 (45)	
Male, n (%)	5 (50)	3 (33)		2 (20)	12 (55)	
Height, cm; median (IQR)	163.2 (152.3-168.1)	158.0 (151.5-165.0)	.566	153.5 (150.0-164.0)	160.1 (151.5-170.0)	.252
Weight, kg; median (IQR)	46.5 (38.8-55.2)	43.1 (41.0-45.0)	.437	44.2 (37.0-50.5)	47.0 (38.0-55.0)	.515
BMI, kg/m^2; median (IQR)	18.4 (15.7-19.6)	17.6 (16.0-18.8)	.414	18.5 (15.8-19.2)	17.8 (16.3-19.2)	1.000
Clinical characteristics						
APACHE II score, median (IQR)	20.0 (15.5-23.0)	20.0 (19.0-21.5)	.680	24.0 (21.0-29.3)	31.5 (19.8-39.3)	.309
Initial SOFA score, median (IQR)	6.0 (5.0-7.0)	7.0 (5.5-8.0)	.292	10.0 (9.0-11.3)	11.5 (9.0-13.0)	.151
Admission category, No. (%)			.630			.051
Medical	3 (30)	3 (33)		3 (30)	15 (68)	
Surgical	7 (70)	6 (67)		7 (70)	7 (32)	
Primary EICU diagnosis, No. (%)			.443			.343
Cardiovascular or vascular disorder	0 (0)	1 (11)		1 (10)	3 (14)	
Respiratory disorder	1 (10)	2 (22)		0 (0)	3 (14)	
Gastrointestinal disorder	0 (0)	0 (0)		2 (20)	1 (5)	
Neurologic disorder	8 (80)	5 (56)		4 (40)	8 (36)	
Sepsis	0 (0)	1 (11)		0 (0)	4 (18)	
Trauma	0 (0)	0 (0)		2 (20)	3 (14)	
Metabolic disorder	1 (10)	0 (0)		1 (10)	0 (0)	
Nutritional characteristics						
Time to initiation of EN or PO, h; median (IQR)	54.6 (29.0-75.4)	26.0 (16.9-39.4)	.018	64.2 (45.1-74.7)	14.6 (3.4-23.1)	.001
Time to initiation of any nutrition support, h; median (IQR)	51.6 (29.0-71.4)	26.0 (16.9-39.4)	.018	61.3 (37.9-70.8)	14.6 (3.4-23.1)	.000
Average energy intake during first week, kcal/kg/day; median (IQR)	10.8 (6.9-12.7)	18.8 (17.7-24.7)	.000	10.9 (7.4-14.8)	21.8 (19.5-27.0)	.000
Average protein intake during first week, g/kg/day; median (IQR)	0.3 (0.2-0.4)	0.9 (0.6-1.0)	.000	0.3 (0.2-0.6)	1.1 (0.8-1.3)	.000

Table 1. Demographics, Clinical Characteristics, and Nutritional Characteristics of Four Groups APACHE II, The Acute Physiology and Chronic Health Evaluation II; BMI, body mass index; EICU, emergency intensive care unit; EN, enteral nutrition; IQR, interquartile range; SOFA, Sequential Organ Failure Assessment, PN, parenteral nutrition; PO, per-oral intake.

	Initial SOFA score ≤8			Initial SOFA score >8		
	Group M-1 < 16 kcal/kg/d n=10	Group M-2 ≥ 16 kcal/kg/d n=9	P Value	Group S-1 < 16 kcal/kg/d n=10	Group S-2 ≥ 16 kcal/kg/d n=22	P Value
All-cause mortality, No. (%)						
In EICU	0 (0)	0 (0)	1.000	0 (0)	0 (0)	1.000
In hospital	0 (0)	0 (0)	1.000	0 (0)	2 (9)	.466
Length of stay, days; median (IQR)						
In EICU	4.6 (3.9-6.9)	7.5 (4.6-10.5)	.121	6.7 (3.8-12.1)	9.6 (6.7-14.6)	.167
In hospital	33.6 (20.6-54.8)	43.3 (26.0-69.4)	.624	60.0 (41.4-73.4)	46.4 (32.1-69.1)	.403
Mechanical ventilation						
Duration of mechanical ventilation, days; median (IQR)	2.7 (1.0-5.7)	9.2 (4.2-17.4)	.040	3.1 (0.7-6.0)	8.8 (6.1-23.1)	.013
Requirement of mechanical ventilation at hospital discharge, No. (%)	0 (0)	2 (22)	.211	1 (10)	6 (27)	.272
Tracheostomy, No. (%)						
In EICU	3 (30)	5 (56)	.255	0 (0)	11 (50)	.005
In hospital	4 (40)	7 (78)	.115	2 (20)	18 (32)	.002
Duration of antibiotics, days; median (IQR)	9.0 (6.0-27.3)	20.0 (9.0-33.5)	.204	27.5 (15.5-50.0)	21.0 (12.5-33.0)	.281
Highest CRP during EICU stay, mg/dL; median (IQR)	12.5 (7.2-27.9)	9.8 (7.6-15.9)	.624	11.4 (3.4-18.8)	16.2 (11.4-23.7)	.104
Liver dysfunction (serum bilirubin >1.2 mg/dl), No. (%)	1 (10)	1 (11)	.737	6 (60)	7 (32)	.133
Renal dysfunction (serum creatinine >1.2 mg/dl) and requirement for RRT, No. (%)	0 (0)	1 (11)	.474	5 (50)	13 (59)	.459
Hypoglycemia (<70 mg/dl) , No. (%)						
First week in EICU	0 (0)	1 (11)	.474	4 (40)	9 (41)	.636
During whole EICU stay	0 (0)	1 (11)	.474	4 (40)	10 (46)	.541
Received insulin administration, No. (%)						
First week in EICU	1 (10)	5 (56)	.050	4 (40)	11 (50)	.445
During whole EICU stay	1 (10)	5 (56)	.050	4 (40)	11 (50)	.445
Average insulin daily dose (units)						
First week in EICU	20.2 (20.2-20.2)	4.3 (1.3-12.1)	.143	3.3 (1.8-4.8)	10.0 (3.3-23.6)	.090
During whole EICU stay	20.2 (20.2-20.2)	3.7 (1.2-11.9)	.143	3.2 (2.5-6.2)	10.0 (1.2-18.7)	.308

Table 2. Clinical Outcomes EICU, emergency intensive care unit; IQR,interquartile range; RRT, renal replacement therapy.

1830674 - The Inter-rater Reliability of Bedside Ultrasounds of the Femoral Muscle Thickness in Critically Ill Patients

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Purpose: Critical illness myopathy is common complication in the intensive care units affecting 25-100% of patients and has been associated with patient morbidity, mortality and long-term loss of functional autonomy. Our previous work has shown that there is a strong inter-reliability and intra-reliability of bedside ultrasounds of the femoral muscle measuring muscle thickness (QMLT) in healthy volunteers. The objective of this study is to examine the inter-reliability of femoral ultrasounds in intensive care unit (ICU) patients with BMI <25 and ≥35 across France, Canada and the United States.

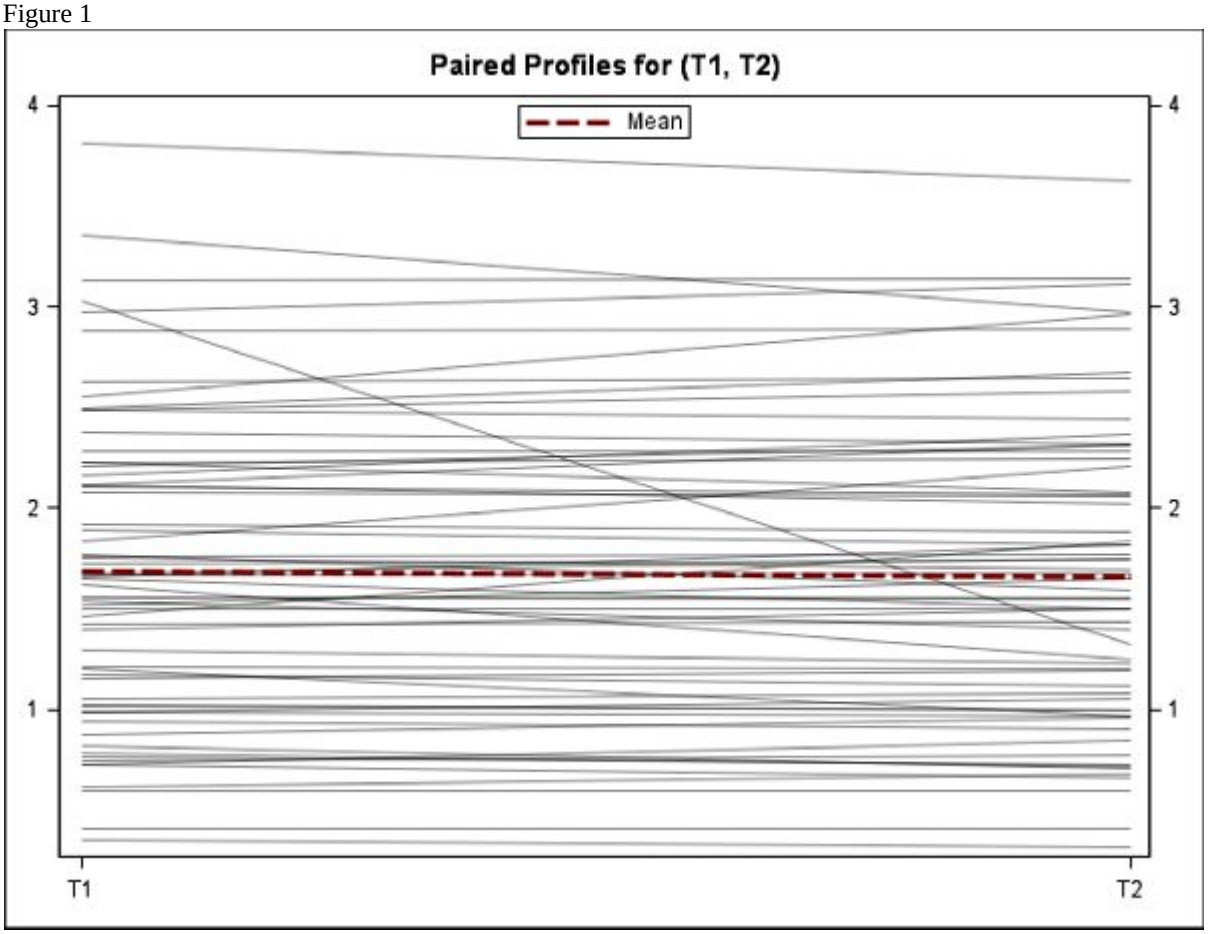
Methods: The ultrasounds were conducted as part of a multicentred randomized control trial (A Randomized Trial of Supplemental Parenteral Nutrition in Under and Over Weight Critically Ill Patients: The TOP UP Trial). Intensive care unit patients with a BMI <25 or ≥35 were randomized to a EN only arm or a EN plus PN arm. QMLT was measured weekly as well as after every CT scan up to ICU discharge or a maximum of 28 days.

Operators were instructed to perform the ultrasound according to a specified protocol and then have the measurement repeated by a second operator for each patient.

The QMLT was measured at the border between the lower third and upper two-thirds between Anterior Superior Iliac Spine (ASIS) and upper pole of the patella as well a reading at the midpoint between the ASIS and the upper

pole of the patella. The overall muscle thickness was calculated as the average across the 2/3 and midpoint readings, and then averaged over the right and left legs
The inter-class correlation (ICC) that measures how consistently two operators agreed when measuring the same subject (i.e. Inter-rater) was used. A paired t-test was used to determine the mean difference between the operators (Figure 1) and right and left legs.
Results: There were 63 patients with an overall mean age of 59.4 (+15.6) years. APACHE score of 19.9 (+7.8) and 54% females. There were 31 patients in the lower BMI group and 32 in the higher BMI group with a respective mean BMI of 20.5 (range 14-24) and 45.3 (range 36-73).
There were 63 pairs of between operator measurements with overall ICC of 0.944.
As a subgroup analysis, the results were divided into the high and low BMI groups. There were 31 pairs were in the <25 BMI group and 32 if the ≥35 BMI group with a respective ICC of 0.888 and 0.976.
Conclusions: There is strong inter-reliability of ultrasound measurements of the femoral muscle to determine overall muscle mass in critically ill patients with a BMI <25 or ≥35. Ultrasound measurements may be an effective tool to assess muscle mass in this population. Further validation studies are need and are underway.

Figure 1



1835698 - Effect of Low-Dose Insulin on Skeletal Muscle Degradation in Critically Ill Children
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Children's Hospital, University of Michigan, Ann Arbor, MI; [6]Harvard Medical School, Boston, MA; [7]Shriner's Burn Hospital, Boston, MA.
Purpose: Persistent protein loss in critically ill children is associated with increased morbidity and mortality. Insulin administered at high doses, with the aid of a hyperinsulinemic euglycemic clamp, ameliorates protein breakdown in this population. However, insulin's effect on protein catabolism when given at clinically utilized doses has not been studied.
Methods: As part of a two-center, randomized, prospective trial evaluating the effect of tight glucose control (TGC) in pediatric intensive care unit (ICU) patients, data were collected on children 0-36 months who were admitted to the ICU after cardiac surgery requiring cardiopulmonary bypass. Insulin was dosed appropriately to maintain blood glucose between 80-110mg/dL in the TGC group. Skeletal muscle breakdown was quantified using a ratio of urinary 3-methylhistidine to urinary creatinine (3MH:Cr).
Results: Primary analysis was limited to the TGC arm at one center for patient homogeneity and urinary data consistency (n=281 patients). In univariate analysis, higher 3MH:Cr correlated with younger age as well as lower weight, length, and body surface area ($P<0.005$), and lower day 3 serum creatinine ($r=-0.17$, $P=0.02$). Sex, serum albumin, and prealbumin were not correlated with 3MH:Cr. In this cohort, 245 (87%) patients received insulin: however, insulin exposure did not impact 3MH:Cr (t-test, $P=0.45$). Further, there was no dose-dependent effect of insulin on 3MH:Cr ($r=-0.03$, $P=0.60$).
Conclusions: Though high-dose insulin has an anabolic effect in experimental conditions, at clinical doses, insulin appears to have no impact on skeletal muscle degradation in critically ill pediatric surgical patients.

NUTRITION AND METABOLISM PAPER SESSION: GI & OTHER METABOLIC-RELATED TOPICS

Abstract of Distinction

1835792 - Fecal Metabolomic Profile in Patients with Food Hypersensitivity and Healthy Controls

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Purpose: Food hypersensitivity (FHS) is characterized by intolerance to certain food items. Reactions to food items include abdominal discomfort, nausea, bloating, diarrhea, and constipation. The cause of these aberrant responses to certain foods is unknown. A potential mechanism may relate to abnormal metabolism of certain food items with production of metabolites that trigger symptoms. The current pilot study aimed to identify differences in fecal metabolite profile in patients with FHS and Healthy Controls.
Methods: Fecal samples were obtained from subjects with self-reported FHS symptoms and healthy controls. Fecal metabolite extracts were analyzed for fatty acid and metabolite content using gas chromatography-mass spectroscopy (GC-MS). Metabolites were identified using in-house metabolite library National Institute of Standards and Technology (NIST) library, and Human Metabolome Database (HMDB) resources. Significant differences between the groups were determined using Variable Importance in Projection (VIP) and Student's T-test. A partial least squares discriminate analysis (PLS-DA) was used to characterize trends between FHS and healthy groups. Interactive pathways analysis (IPA) of complex omics data by Ingenuity systems was used for metabolites.
Results: A total of 12 subjects were examined (6- FHS and 6- HC). The FHS group included 4 male and 2 female subjects (mean age= 33.3). The HC group consisted of 1 male and 5 females (mean age= 34.3). A total of 325 metabolites were identified with significant differences observed in 36 in metabolite concentrations when accounting for a VIP >1 and a p-value lower than 0.1 (18 of the 36 metabolites with $p<0.05$). Xanthine, a-Sitosterol, a-Aminoadipic acid, a metabolite in the pathway of lysine, and Picolinic acid, a metabolite of L-tryptophan (TRP) were among this group of metabolites ($p<0.02$). PLS-DA analysis revealed a distinct separation in the metabolite profiles between FHS and HC groups (Figure 1). Pathways analysis showed that most of these metabolites (33/36) including pyruvate, norepinephrine, and ornithine, were involved in cell signaling, molecular transport, vitamin and mineral metabolism. Seven of the 36 significant metabolites, including L-cysteine, prostaglandin E2, and GMP were specifically related to gastrointestinal disease bio functions.

Conclusions: The significant differences in metabolite concentrations and the clear separation of metabolite composition between FHS and control groups suggest an important role for altered intraluminal metabolism in the pathogenesis of FHS symptoms. Further research to identify the specific metabolic pathways associated with these metabolite differences may improve our understanding of the pathomechanisms of FHS and lead to devising treatments for FHS symptoms.

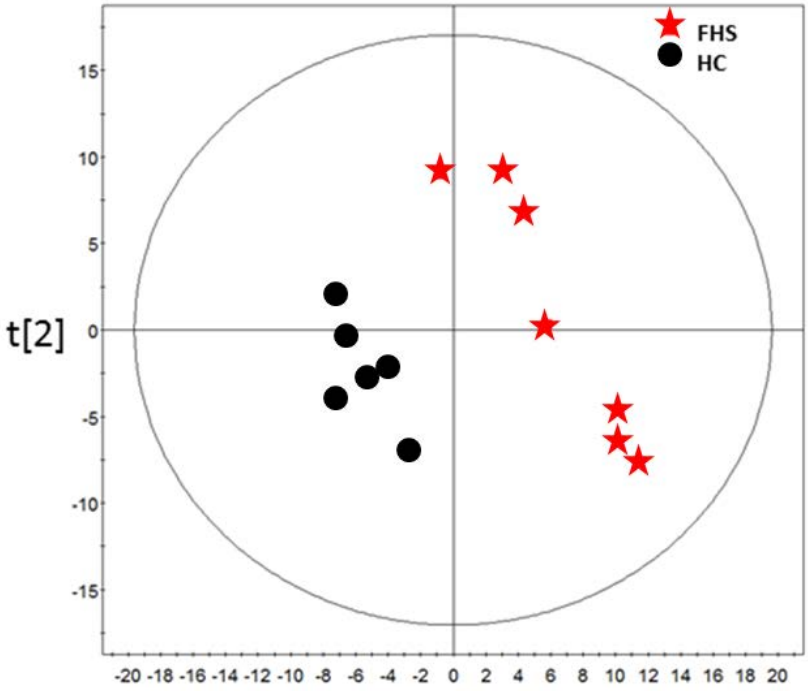

Fig. 1. PLS-DA scores plot of FHS and HC samples

Abstract of Distinction

1834030 - Factors Affecting Spontaneous Closure of Gastrocutaneous Fistulae After Removal of Gastrostomy Tubes in Children With Intestinal Failure

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Purpose: Children with intestinal failure (IF) frequently require gastrostomy tubes (GT) for long-term nutritional support. Simple removal of GT in adults results in spontaneous closure of the gastrocutaneous fistula (GCF) in >98% of patients. Spontaneous GCF closure in children is substantially lower (55-76%), thus frequently necessitating operative closure. Risk factors for
persistent GCF in pediatric IF patients are unknown, but may include prolonged duration of GT, nutritional status, and other factors.

Methods: After IRB approval, records of 296 patients followed by a multidisciplinary intestinal rehabilitation program between July 1996 and February 2013 were reviewed to identify those who had undergone GT removal and allowed a trial of spontaneous closure. Those undergoing immediate operative closure were excluded. Nonparametric continuous variables were analyzed using the Wilcoxon rank sum test and categorical variables were

compared using the Fisher's exact test. Receiver Operating Characteristic (ROC) Curve analysis was performed to identify the optimal threshold model for time duration of indwelling gastrostomy tubes predicting probability of spontaneous closure. Kaplan-Meier Curves using Greenwood's formula for 95% confidence intervals were used to compare incidence of spontaneous closure in patients stratified into groups using the 18-month threshold identified by the Youden index in the ROC analysis. (Fig.1)
Results: 59 patients undergoing GT removal were identified. 36 (61%) sites spontaneously closed (between 1-287 days); of these, 30 (83%) closed within 7 days, 1 (3%) at 14 days, and 5 (14%) persisted beyond 30 days. Operative fistula closure was required in 23 patients (39%). There were no statistically significant differences between the spontaneous and operative closure groups in terms of age, weight at insertion, sex, technique of insertion, age at removal, weight-for-age Z-score, or history of local wound complications. The duration of indwelling GT was significantly longer in those who underwent operative GCF closure (median 21 vs. 11.5 months, P<0.002). Of 33 GT indwelling for ≤ 18 months, 28 (85%) closed spontaneously, compared to only 9/26 (35%) with duration >18 months (P<0.001). The odds of operative closure are estimated to be 8 times higher in children with GT duration >18 months (odds ratio=8.5, 95% confidence interval:2.5-21.2). Although 79% of GCFs persisting beyond 7 days underwent
operative closure (22 of 28), median time to surgery was 67 days. The probability of spontaneous closure was lower at all time intervals from removal in the group with GT duration > 18 months. (Fig.2)
Conclusions: Spontaneous GT site closure rate in children with IF was noted to be at par with what is generally reported in the literature (61%). Nearly 80% of GCFs that were not closed after 7 days required operative closure. Despite the low rate of spontaneous closure in this subgroup, operative closure was delayed for more than 2 months on average. Of the risk factors evaluated, only longer GT duration was associated with an increased likelihood of operative
closure. Children with GT duration > 18 months are significantly more likely to require operative closure. Early closure of GCFs persisting beyond 7 days in this group should be considered.

Abstract of Distinction

1835617 - Final Results of STEPS-2, a 2-Year, Multicenter, Open-Label Clinical Trial: Safety and Efficacy of Long-Term Teduglutide 0.05-mg/kg/day Treatment for Intestinal Failure Associated With Short Bowel Syndrome

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Purpose: Treatment with teduglutide (TED) enhances absorptive capacity of the intestine and enables reduction in parenteral support (PS; parenteral nutrition/intravenous volume requirements) and number of infusion days in patients with intestinal failure associated with short bowel syndrome (SBS-IF). TED was most recently evaluated in 2 studies (STEPS, which was a 6-month, placebo (PBO)-controlled study, and an open-label 2-year extension study known as STEPS-2). The primary objective of STEPS-2 was to further assess long-term safety and effect of TED in PS-dependent patients with SBS-IF.
Methods: STEPS-2 enrolled patients who completed 24 weeks of treatment with TED (TED/TED) or PBO (PBO/TED) in STEPS or qualified for STEPS but were not treated because target enrollment was met (NT/TED). For safety analysis, PBO/TED and NT/TED were combined (PBO + NT/TED). The TED/TED group was exposed to TED for up to 30 months; their baseline was considered to be the time of enrollment in STEPS. PBO/TED and NT/TED were exposed to TED for up to 24 months; their baseline was considered to be the time of enrollment in STEPS-2. Clinically meaningful response was defined as a 20%-100% reduction from baseline in weekly PS volume.
Results: 88 patients were enrolled in the study (TED/TED, n=37; PBO/TED, n=39; NT/TED, n=12). 65 (74%) patients completed the study. Of patients who completed the 2-year treatment period in STEPS-2, clinical response was achieved by 93% (28/30) of patients who received TED/TED, 55% (16/29) of patients who received PBO/TED, and 67% (4/6) of patients who received NT/TED. Mean PS volume reduction from baseline was 7.6 (66%), 3.1 (28%), and 4.0 (39%) L/week in the TED/TED, PBO/TED, and NT/TED groups, respectively. Overall, TED resulted in additional days off PS per week, with 38/65 (58%) patients achieving an additional ≥1-day/week reduction (TED/TED, 21/30 [70%]; PBO/TED, 14/29 [48%]; NT/TED, 3/6 [50%]) compared with their baseline; 25/65 (38%) patients achieved an additional ≥3-day/week reduction (TED/TED, 18/30 [60%]; PBO/TED, 5/29 [17%]; NT/TED, 2/6 [33%]) compared with baseline. 13 patients achieved total independence from PS; of these, 10

were in the TED/TED group. These patients achieved independence from PS after 24-114 weeks of TED treatment. Treatment-emergent adverse events (AEs) occurred in 84/88 (95%) patients; the most common were abdominal pain (34%), catheter sepsis (28%), and episodes of decreased weight (25%). 64% of patients experienced serious AEs. 23 patients discontinued treatment (16/51 [31%] in PBO + NT/TED and 7/37 [19%] in TED/TED groups).
Conclusions: TED resulted in clinically meaningful reductions in PS requirement. No unexpected safety signals were detected compared with STEPS. The predominantly gastrointestinal AEs are in line with the pharmacologic effect of TED and condition of SBS. These data suggest that long-term TED treatment is associated with sustained response in the form of continued reductions in PS, as well as independence from PS for some patients.

Abstract of Distinction

1830037 - Common Variants in LIPC Gene Modify the Effect of Dietary Fat Intake on Changes in Serum Lipid Levels During a Weight-Loss Intervention: The Preventing Overweight Using Novel Dietary Strategies (POUNDS LOST) Trial

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Purpose: Hepatic lipase (HL) plays a pivotal role in the metabolism of high-density lipoprotein (HDL) and low-density lipoprotein (LDL) cholesterols. Recent genome wide association studies have identified common variants in HL gene (LIPC) associated with HDL cholesterol. We aimed to test the effects of the common variants in LIPC gene on changes in blood lipid levels in a 2-year diet intervention trial.
Methods: We genotyped rs1800588 and rs2070895 in the promoter of LIPC gene in 743 overweight or obese adults who were randomly assigned to one of four diets varying in macronutrient content.
Results: At 2 years of intervention, we observed that dietary fat significantly modified genetic effects of rs2070895 on changes in serum total cholesterol (TC) and LDL_cholesterol (P for interaction was 0.0009 and 0.004, respectively). In the low-fat diet group, the A allele carrier had a greater decrease of TC and LDL_cholesterol levels as compared to the G allele (TC: AA, -23.5; AG, -14.4; GG, -10.7 mg/dl, p=0.09; LDL_c: AA, -20.7; AG, -10.7, GG, -8.2 mg/dl, p=0.07). While an opposite genetic effect was found in the high-fat diet group. The A allele carrier had a greater increase of TC and LDL_cholesterol levels (TC: AA, 7.4; AG, 1.3; GG, -6.2 mg/dl; p= 0.009; LDL_c: AA, 10.3; AG, 4.7; GG, 1.1 mg/dl; p=0.07). We found similar results for rs1800588. The P values are after adjustment for age, sex, race, baseline body mass index, baseline measurements for the respective outcomes. P values less than 0.008 (0.05/6) after correction for multiple comparison were considered statistical significant. We did not find any significant gene-diet interactions at 6 months of intervention or gene and dietary protein intake interaction.
Conclusions: Common variants in LIPC gene significantly modified the effects of dietary fat intake in a long-term of weight loss intervention.

1835334 - Is the Use of Metformin Associated With Vitamin B12 Deficiency in Hospitalized Patients?

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Purpose: As of 2009, 2.4 million Canadians were diagnosed with diabetes and this number is increasing. The 2013 Canadian Diabetes Association Clinical Practice Guidelines recommend metformin as the initial hypoglycemic agent of choice for the treatment of type 2 diabetes. Metformin, which is widely used, has been shown to result in vitamin B12 (B12) malabsorption in approximately 10-30% of users. B12 deficiency can lead to serious complications including anemia and neurological changes and if not treated, may result in irreversible nerve damage. B12 deficiency can go undiagnosed as a result of mandatory folate fortification, which can mask deficiency by correcting macrocytosis. The purpose of this study was to examine the association between metformin use and B12 deficiency and to determine prevalence of B12 deficiency among metformin users in high-risk patients.
Methods: Charts from 710 patients admitted from January 2010 and December 2012 to the emergency, critical care

& trauma, neurology, and spinal cord & stroke rehabilitation units of 3 university-affiliated hospitals in Southwestern Ontario, were reviewed. Data collection included: admission serum B12 concentration, metformin use, gender, age, hospital site, reason for admission, clinical signs of B12 deficiency, and documented in-hospital B12 supplementation. Due to the unavailability of supplementary serum methylmalonic acid, a more sensitive marker of true B12 status, a cut-off value of ≤258pmol/L was used to indicate deficiency. Differences in mean vitamin B12 concentrations and in the proportion of patients who were deficient between metformin users and non-users, were estimated.
Results: There were no differences in age and gender distribution between metformin users (n=108) and non-users (n=602). B12 values were documented for 80 (74%) of the metformin users. Mean (±SD) age of metformin users was 73.3 ±13.3 years and 49% were female. There were no differences in mean serum B12 concentrations between metformin users and non-users (430.2 ±296.5 vs. 403.2 ±252.1 pmol/L, p=0.776), although more than half (54%) of metformin users exhibited at least one clinical sign of B12 deficiency. Thirty-seven percent of patients who were deficient were supplemented with B12. Among patients who were B12 deficient, there was no difference in the percentage who were metformin users vs. non-users (39% vs. 22%, p=0.077). Metformin users with B12 deficiency were more likely to receive B12 supplementation compared with non-users (p=.025).
Conclusions: Despite the potential for metformin use to result in B12 deficiency, not all patients in this study were screened. Although there was no association between B12 deficiency and metformin use, more than a third of metformin users were B12 deficient. Of these patients, more than half exhibited at least one clinical sign of deficiency and 63% were not supplemented with B12. Results from this study warrant a broader discussion regarding the need for B12 screening and supplementation in diabetic patients using metformin. Further research is needed.

Abstract of Distinction

1835670 - Increases in Prehospitalization Serum 25(OH)D Are Associated With Improved Mortality Following Hospitalization

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Purpose: At present it is not clear if hypovitaminosis D is a modifiable marker for mortality and morbidity risk in hospitalized patients. We hypothesized that an increase in serum 25(OH)D level during the year prior to hospitalization would be associated with a decrease in mortality following hospitalization.
Methods: Our retrospective cohort study focused on 4,404 adult patients from two Boston teaching hospitals between 1993 and 2011. The exposure of interest was the change in prehospital serum 25(OH)D concentration obtained 7 to 365 days prior to the date of hospital admission. Patients were included who had at least two 25(OH)D serum levels drawn and had vitamin D inadequacy (<20 ng/mL) in their earliest serum sample obtained within the 7 to 365 day time frame. The primary end point was all cause 30-day mortality following hospital admission. Information on vital status for the study cohort was obtained from the Social Security Administration Death Master File. Propensity scores were calculated utilizing logistic regression for each cohort subject to estimate the probability for the presence or absence of an increase in 25(OH)D>10 ng/ml.
Adjusted odds ratios were estimated by multivariable logistic regression models with inclusion of covariate terms thought to plausibly associate with both 25(OH)D change and 30-day mortality.
Mixed-effect models containing both fixed and random effects were used for analysis of the association between the change in pre-hospital 25(OH)D and outcome by use of the xtmelogit command in STATA software and with the dates of 25(OH)D draw within individual patients as the random effect. Confounders were selected by analyzing the maximum model and then conducting backward elimination of variables of no value (P>0.05). The model had an independent covariance structure of the random effects and gaussian-distributed random intercepts and slopes.
Results: Most patients were women (60%), white (74%), and had medically related DRGs (62%). The mean age was 58 (SD 17) years. 30-day mortality rate was 3.0% The crude odds of 30-day mortality in patients with an increase of 25(OH)D prior to hospitalization by ≥10 ng/mL was half that of patients with <10 ng/mL increase in 25(OH)D (OR 0.49 95%CI 0.34,0.71 p <0.0001). After adjustment for age, gender, race, patient type, Deyo-Charlson index, and season of final 25(OH)D draw, OR for 30-mortality in the 25(OH)D ≥10 ng/mL group was 0.47

(95%CI 0.32-0.68; p <0.0001) that of the group with <10 ng/mL increase in 25(OH)D.

In a mixed-effect logistic regression model adjusted for the patients' age, gender, race, type (medical/surgical), calcium, propensity score, ICU admission and Deyo-Charlson index, the actual 30-day mortality rate decreased by 25% (95%CI 11 to 38) compared with the average 30-day mortality rate for each 10 ng/ml increase in pre-hospital 25(OH)D (P = 0.001).
We also assessed the odds of death in a smaller cohort of propensity score matched patients (n = 2,754). Propensity score matched on baseline characteristics including baseline 25(OH)D (Increase in 25(OH)D ≥ 10 ng/ml n = 1,377, Increase in 25(OH)D < 10 ng/ml n = 1,377). Crude all-cause 30 day mortality rates were 1.76% (95% CI, 1.0 to 2.5; 24 deaths) in patients with an increase in 25(OH)D ≥ 10 ng/ml and 4.0% (95% CI, 3.0 to 5.0; 55 deaths) in patients with an increase in 25(OH)D < 10 ng/ml. The odds of 30-day mortality in patients with an increase in 25(OH)D ≥ 10 ng/ml was half that of patients with an increase in 25(OH)D < 10 ng/ml (OR 0.43 95%CI 0.26,0.70; p = 0.001).
Conclusions: In patients with vitamin D inadequacy, a subsequent increase in serum 25(OH)D ≥ 10 ng/ml during the year prior to hospital admission is associated with improved 30-day mortality following hospitalization.

NUTRITION AND METABOLISM PAPER SESSION: PEDIATRIC/NEONATAL

Abstract of Distinction

1835708 - Transitioning the Preterm Infant from Parenteral to Enteral Nutrition: A Comparison of Two Nutritional Protocols on Growth Outcomes

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Purpose: We previously showed that growth in preterm infants was compromised during the transition phase of parenteral nutrition (PN), the time frame when PN volumes were weaned with advancement of enteral feeds (EN). This was likely related to suboptimal nutrient intakes in a volume-based weaning protocol since PN solutions contain more calories and protein per milliliter as compared to unfortified breast milk. We implemented new PN guidelines specific to the transitional phase, designed to maintain optimal nutrient intakes during this time, and aimed to compare growth outcomes of this cohort to historical controls.
Methods: A retrospective chart review was conducted on infants born <32 weeks gestation, after a new transitional PN protocol was implemented (Group 1) and compared to historical controls (Group 2). PN volumes were weaned to maintain prescribed fluids allowance, usually 140ml/kg, when EN volumes exceeded 20ml/kg/day. When EN volumes reached 50ml/kg/day, the PN solution under the new protocol was written to provide a higher concentration of amino acids so that protein provision was maintained at >3gm/kg/day throughout the transition phase. In formula-fed infants, 24 calorie preterm formula was used instead of 20 calorie preterm formula used in Group 2. A full description of the two protocols is outlined in Table 1. Weight parameters during the transitional phase and at 35 weeks corrected gestational age (CGA) were recorded.
Results: Growth outcomes of 63 infants were recorded for Group 1 and compared to 153 infants from Group 2. Demographic and clinical characteristics of the two groups were comparable (Table 2) except for a higher rate of sepsis in controls (p<0.02). Z-scores at birth, at one week of life, and at the start of the PN transition phase were similar between the two groups; however, at the end of the transitional phase, infants in Group 1 had significantly higher z-scores (-1.1 + 0.55 vs. -1.3 + 0.52, p<0.009), which remained significant even when corrected for sepsis, and persisted at 35 weeks CGA (-1.2 + 0.73 vs. -1.5 + 0.65, p<0.004; Figure 1). During the transition phase, infants gained an average of 16.1 + 4.6 gm/kg/day in Group 1 compared to 13 + 5.7 gm/kg/day in Group 2 (p=0.0003). The incidence of NEC and the time to reach full feeds, calculated as the mean duration of the transition phase (9.7+ 3.5 vs.10.3 + 5.4 days in Groups 1 and 2, respectively; p=0.48), did not differ between groups despite the use of higher calorie formula feeds in Group 1.
Conclusions: Optimizing nutrition during the transitional phase to maintain appropriate nutrient intakes improves growth rates in preterm infants.

Table 1. Description of PN guidelines during transition phase. EBM, expressed breast milk; EN, enteral feeds.

Transitional Guidelines	Group 1	Group 2
EN volume at start of PN weaning	20 ml/kg/day	20 ml/kg/day
PN order during transition	At EN volumes of 50ml/kg, full kcal and protein orders concentrated in 100ml/kg; run at adjusted rate to maintain 140ml/kg/day.	Written for 140ml/kg (as if infant is NPO); run at adjusted rate to maintain 140 ml/kg/day
EN volume at discontinuation of PN	100-120 ml/kg/day	80-100 ml/kg/day
Guidelines if feeds held during transition	Run PN at full volume and add additional D5% at 40ml/kg to maintain 140ml/kg/day	Run PN at full volume (140ml/kg)
Preferred feeds	Unfortified EBM	Unfortified EBM
EBM alternate	Preterm formula 24kcal/oz	Preterm formula 20kcal/oz

Table 2. Demographic and clinical characteristics. BPD, bronchopulmonary dysplasia; BW, birthweight; CPAP, continuous positive airway pressure; IVH, intraventricular hemorrhage; NEC, necrotizing enterocolitis.

Demographic/Clinical Factors	Group 1 (n=63)	Group 2 (n=153)	
	n (%)	n (%)	*p-value*
Males	43 (68)	79 (52)	0.025
Gestational age (week $\pm$ SD)	29$\pm$ 2.03	28.8$\pm$2.1	0.462
BW (grams $\pm$ SD)	1331$\pm$339.8	1273$\pm$342.6	0.256
Postnatal steroids	2 (3.2)	4 (2.6)	0.82
IVH $\geq$ Stage 3	0 (0)	8 (5.2)	0.064
BPD	5 (7.9)	11 (7.2)	0.859
Sepsis	4 (6.3)	29 (18.9)	0.019
NEC $\geq$ stage 2	2 (3.2)	10 (6.5)	0.327
Respiratory support on DOL 1: mechanical ventilation	14 (22.2)	42 (27.5)	0.425

CPAP	45 (71.4)	100 (65.3)	0.388
room Air	5 (8.1)	11 (7.2)	0.825

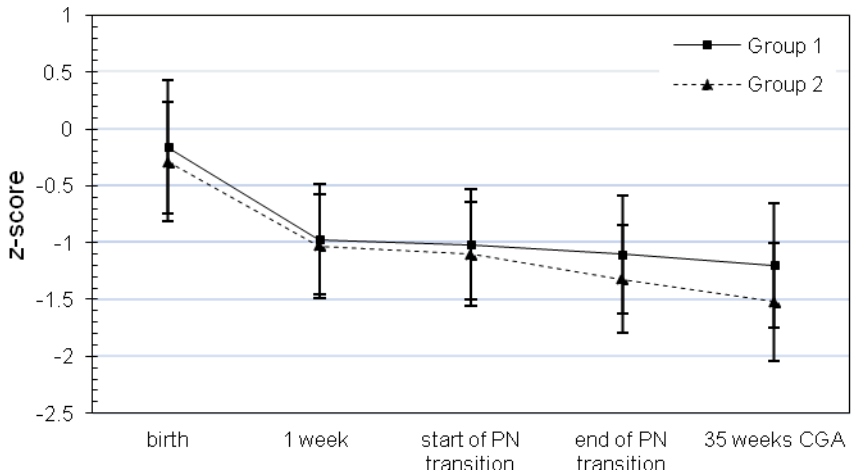

Figure 1. Trends in z-score. *p<0.01.

Abstract of Distinction

1834488 - Prevalence of inadequate vitamin D status and associated factors in children with cystic fibrosis

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Purpose: Vitamin D is important to the cystic fibrosis population who are at risk for inadequate 25-hydroxyvitamin D [25(OH) D] levels due to impaired absorption of fat soluble vitamins. The objective of this study was to determine the prevalence of inadequate serum 25(OH) D levels in a pediatric Canadian CF population and to assess effectiveness of a vitamin D supplementation protocol on improving vitamin D status. A secondary aim was to analyze factors that may be associated with inadequate vitamin D status.

Methods: 25(OH)D levels, amount of vitamin D supplemented and factors that may be associated with vitamin D status were collected for two consecutive years (2010 and 2011) through a retrospective chart review of 96 patients aged 1-18 years at a single pediatric CF clinic in northern Canada. Adequacy of 25(OH)D was set at ≥ 75 nmol/L. Subjects identified as having inadequate 25(OH)D levels in 2010 were supplemented with an additional 400 IU/day for levels between 60 nmol/L to 75 nmol/L or by 1000 IU/day for levels < 60 nmol/L.

Results: Inadequate 25(OH) D levels were observed in 26% of patients in 2010 and 23% in 2011 (table 1). Reported mean intake of vitamin D supplementation was 1100 IU in 2010 and 1127 IU in 2011 (table 2). After supplementation was increased for those with inadequate Vitamin D status in 2010 (n=20), a significant increase in 25(OH) D levels was observed (P=0.03). Adequate status was achieved in 50% of these patients (n=10) (figure 1). Of the factors studied (tables 2 and 3), there was a significant negative association between age and 25(OH) D levels in both years (P=0.002) (figure 2). A significant positive association was also observed between Forced Expiratory Volume in one second, and 25(OH) D levels in 2011 (P=0.03) (table 2).

Conclusion: While vitamin D supplementation was effective at increasing serum 25(OH)D levels in some patients, the current supplementation protocol was unable to achieve optimal serum 25(OH) D levels in a quarter of the patient population. Of the factors studied, increasing age had the strongest association to

inadequate 25(OH) D levels. Current supplementation protocols may require re-evaluation based on emerging evidence and revised CFF guidelines.

Table 1. Demographics.

Parameter	2010 (n=82)	2011 (n=87)
Age [a]	8.5 ± 5.1	8.8 ± 5.0
Gender (%)		
Female	53.7	56.3
Male	46.3	43.7
BMI percentile [a]	51.6 ± 27	51.1 ± 28

[a] Mean ± standard deviation

Table 2. Continuous variables associated with serum 25(OH)D concentration in a pediatric cystic fibrosis population.

Continuous variables	2010			2011		
	N	Mean [a]	P value	N	Mean [a]	P value
Vitamin D Supplementation, IU	82	1100 ± 789	N/A	87	1127 ± 860	N/A
Age, years	82	8.5 ± 5.1	0.002[b]	87	8.8 ± 5.0	<0.0001[b]
BMI percentile	82	51.6 ± 27	NS	87	51.1 ± 28	NS
DEXA						
Lumbar 1-4, g/cm^2	35	0.795 ± 0.18	0.065	11	0.809 ± 0.20	NS
Total BMD, g/cm^2	35	0.955 ± 0.13	0.044[b]	10	0.910 ± 0.15	NS
BMD z-score	34	0.156 ± 0.98	NS	9	0.056 ± 0.98	NS

FEV1%	53	100 ± 39	NS	57	97 ± 26	0.029[b]
25(OH) D, nmol/L	82	88 ± 25	N/A	87	89 ± 26	N/A

BMD= Bone Mineral Density; DEXA= Dual X-ray Absorptiometry scan; FEV1%= Forced Expiratory Volume in one second; IU= International Units; N/A= Not Analysed; NS= No Significance; [a] Mean ± standard deviation; [b] statistically significant results (P<0.05).

Table 3. Categorical variables associated with serum 25(OH)D concentration in a pediatric cystic fibrosis population.

Categorical variables	2010				2011			
	N	<75nmol/L (%)	≥75nmol/L (%)	P value	N	<75nmol/L (%)	≥75nmol/L (%)	P value
Residence				**0.87**				**0.25**
≤ 52nd degree	52	13(25)	39(75)		53	10(19)	43(81)	
> 52nd degree	30	7(23)	23(77)		34	10(29)	24(71)	
Pancreatic enzyme				**0.42**				**0.71**
Yes	74	18(24)	56(76)		80	18(23)	62(77)	
No	8	3(38)	5(62)		7	2(29)	5(71)	
Steroids				**0.68**				**0.86**
Yes	50	12(24)	38(76)		61	13(21)	48(79)	
No	32	9(28)	23(72)		26	6(23)	20(77)	
CFRD				**0.42**				**0.43**
Yes	2	1(50)	1(50)		2	0(0)	2(100)	
No	80	20(25)	60(75)		85	20(24)	65(76)	
Hospital days				**0.27**				**0.02**[a]

≥1 days	10	4(40)	6(60)	7	4(57)	3(43)
No days	72	17(24)	55(76)	80	15(19)	65(81)

CFRD= Cystic Fibrosis Related Diabetes; [a] statistically significant results (P<0.05).

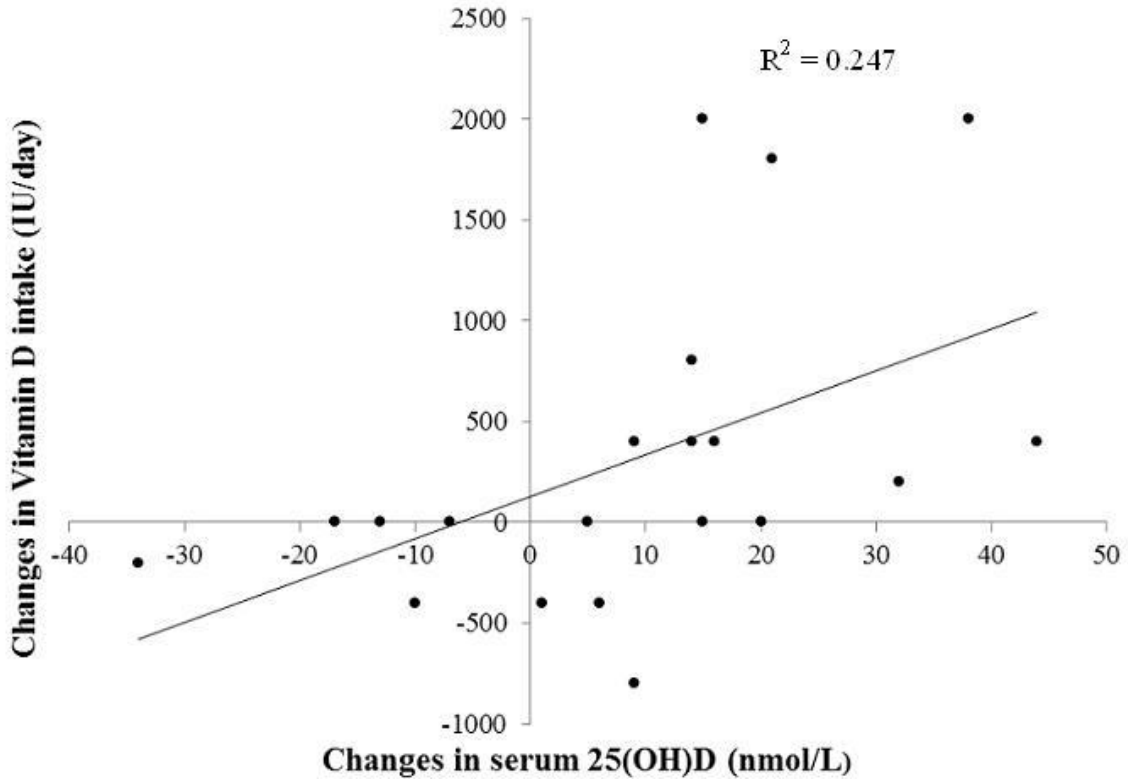

Figure 1. A change in serum 25(OH) D and supplementation over on eyear in a subgroup of CF patients with inadequate vitamin D status in 2010 (n=20). A positive correlation (P=0.03) between an increase in supplementation and serum levels in 2011 was observed, with 50% of the patients reaching concentrations of __75nmol/L.

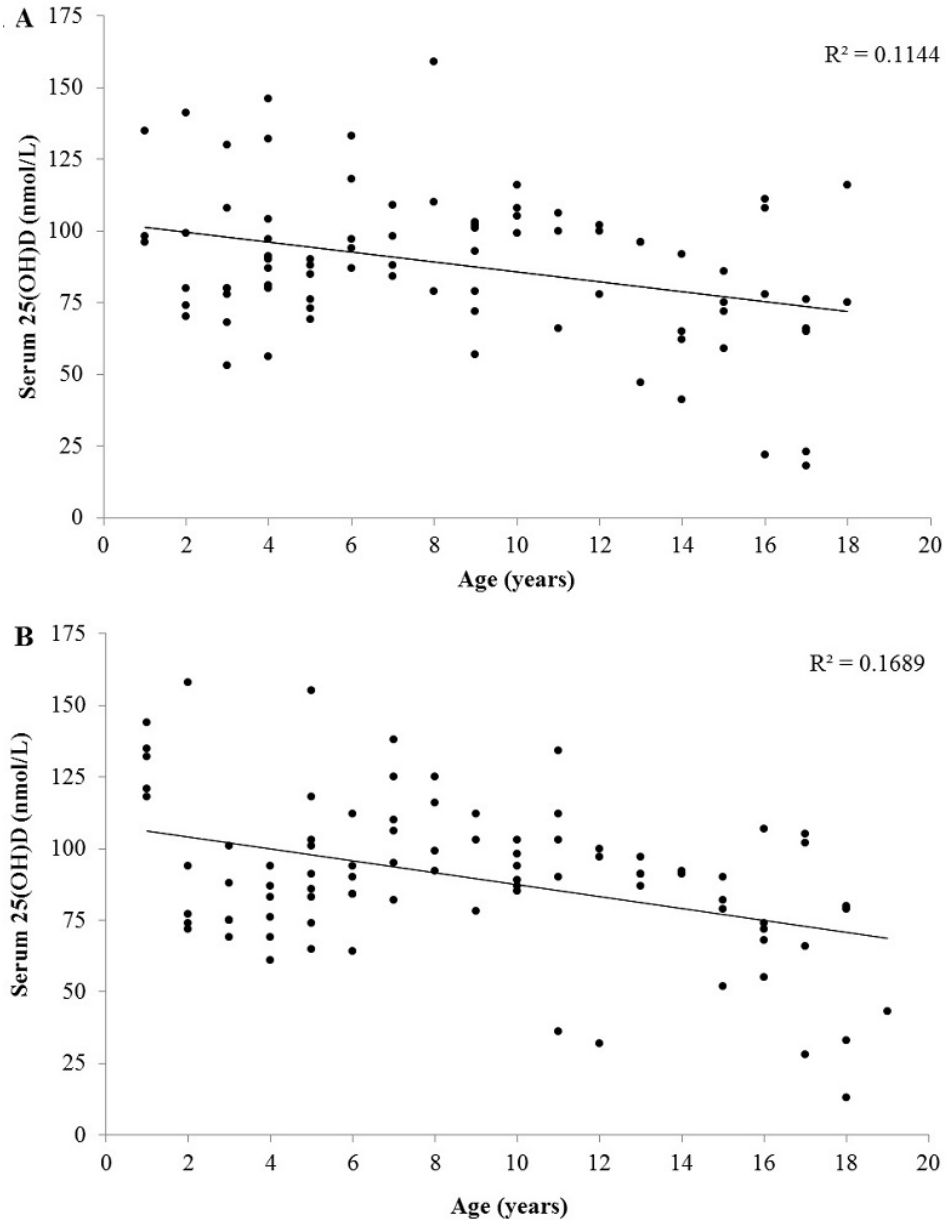

Figure 2. Serum 25(OH) D levels and their association with age in patients in subsequent years: A) 2010 and B) 2011. An increase in age was significantly associated with a decrease in serum 25(OH) D concentrations in both 2010 (P=0.002) and 2011 (P<0.001).

1832535 - Calcium Chloride in Neonatal Parenteral Nutrition: Compatibility Studies Using Laser Methodology

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Purpose: Use of calcium chloride (CaCl) instead of calcium gluconate (CaGlu) as the calcium additive to neonatal parenteral nutrition (PN) has been shown to reduce aluminum (Al) exposure to near recommended levels. We have previously reported results of precipitation studies for PN solutions containing CaCl and sodium phosphate (NaPhos) using visual methods to determine compatibility. The purpose of this study was to do further testing of compatibility for solutions containing CaCl using more sensitive methods.
Methods: Solutions of Trophamine® (Braun Medical Inc, Irvine, CA) and Premasol® (Baxter Pharmaceuticals, Deerfield, IL) in concentrations of 1.5-3.5% amino acids (AA) were compounded with increasing concentrations of CaCl and potassium phosphate (KPhos). Due to the shortage of NaPhos limited studies of compatibility were performed using CaCl and NaPhos. Control solutions for each concentration of Trophamine and Premasol were compounded without adding calcium (Ca) or phosphate (Phos). After incubation at 37^0 solutions were visually inspected in a dark room using a bright beam of light to look for evidence of precipitation. Solutions without visual precipitation were then analyzed to determine mean particle size (range: 3.8-50,000 nm) with a laser particle size analyzer (Zetasizer, Malvern Instruments Ltd, Worcestershire, UK) which utilizes dynamic light scattering. Solutions were also analyzed for mean particle size (range: 10-2000 nm) and particle counts with a NanoSight microscope (NanoSight Ltd, Wiltshire, UK) which utilizes a laser light source and computerized video recording. Ten solutions which precipitated visually were also analyzed with the Zetasizer and the microscope. Means of Z-average particle size and particle counts were compared to controls using Student-t tests after entering data into an Excel spreadsheet (Microsoft Corp, Redmond WA).
Results: : Results of particle size analyses comparing control solutions to solutions with mean particle size > 1000 nm or < 1000 nm (determined by the Zetasizer) are shown in Table 1. Distributions of particle size were similar for controls with no Ca or Phos and those with mean particle size < 1000 nm. Using these results, compatible solutions were defined as those with no visual evidence of precipitation and mean particle size <1000 nm. Based upon limited data, amounts of CaCl that could be added to solutions with similar concentrations of AA and Phos were about 2.5 mmol/L less when adding NaPhos vs KPhos to Trophamine. There were minor differences in compatibility when adding CaCl and KPhos to Premasol vs Trophamine. Maximum amounts of CaCl that could be added to PN solutions containing Trophamine or Premasol with KPhos are listed in Table 2.
Conclusions: Compared to our previous study using visual methods to determine compatibility, less Ca and Phos can be added to neonatal PN solutions when using laser methodology to determine compatibility. Based upon our results, compatible neonatal PN solutions containing CaCl and Phos will not provide intakes of Ca and Phos that meet recommended levels for preterm infants. There is no Ca additive available in North America that meets the need to limit Al intake and provide adequate intakes of Ca and Phos.

Table 1. Z-Average particle size for solutions with and without precipitation (mean+SD; median [25-75%ile]).

Group	N	Zetasizer (nm)	Microscopic (nm)	Microscopic Particle Count[a]
Control No Ca or Phos	14	303±94 203[83-364]	276±94 261[198-332]	205±157 167[92-273]
Control Visual PPt	10	6997±4773[b] 5663[4335-9804]	246±68 218[205-271]	452±309[c] 392[209-693]
Zetasizer >1000 nm	41	3531±3535[d] 1878[1448-3977]	217±85 197[171-239]	141±101 119[73-185]
Zetasizer <1000 nm	96	323±259 222[141-455]	230±106 198[172-240]	183±129 181[84-238]

Abbreviations: Ca, calcium; Phos, phosphate; PPt, precipitate. [a]$x10^6$/mL; [b]$p<0.001$ compared to No Ca Control; [c]$p<0.02$ compared to No Ca Control; [d]$p<0.01$ compared to No Ca Control

Table 2. Maximum concentrations (mmol/L)[a] of elemental calcium (as CaCl) allowable without precipitation in trophamine or premasol with added potassium phosphate.

Amino Acids g/L (%)	KPhos 5 mmol/L	KPhos 7.5 mmol/L	KPhos 10 mmol/L	KPhos 12.5 mmol/L	KPhos 15 mmol/L
15 (1.5%)	12.5	2.5	2.5	0	0
20 (2%)	12.5	7.5	5	0	0
25 (2.5%)	12.5	10	5	2.5	0
28 (2.8%)	12.5	10	5	2.5	2.5

30 (3%)	12.5	10	5	2.5	2.5
35 (3.5%)	12.5	10	7.5	5	2.5

CaCl, calcium chloride; KPhos, potassium phosphate; [a]1 mmol of calcium=40 mg or 2 mEq.

1834799 - Does Current Chromium Supplementation Affect Glucose Tolerance and Parenteral Nutrient Intake in Infants With Early Neonatal Hyperglycemia?

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Purpose: Early neonatal hyperglycemia is a common metabolic complication especially in very low birth weight infants (birth weight <1500 g) during the first week of life. It is also associated with increased morbidity and reduced ability to administer adequate calories of parental nutrition (PN). Chromium is a trace mineral that increases insulin sensitivity; however, recent reviews have queried the need for its supplementation during PN therapy in infants. The aim of this study was to examine the effect of PN supplemented with chromium on glucose tolerance and parenteral calorie intake in infants who required PN during the first week of life.
Methods: Prior to 2011 the nutrition support practice at our institution was to add trace minerals (Multi-trace 4, American Regent) on the seventh day of PN therapy. After 2011, there was policy change to add trace minerals starting on the first day of PN therapy. Hyperglycemia (serum glucose >125 - 150 mg/dL) was managed by reducing the glucose infusion rate (GIF, mg/kg/min) until normalization of the serum glucose. This study compared the rates of hyperglycemia (serum glucose >125 mg/dL), mean tolerated GIR and mean daily parenteral calorie intake (kcal/kg/d) during the first week of life in infants on PN therapy without chromium supplements (Group A) and those who received PN supplemented with chromium starting on the first day (Group B).
Results: There were 348 infants in Group A and 358 infants in Group B. The proportion of infants who received PN for a duration of one week or longer, and very low birth weight (VLBW) infants was similar in the two groups (N and percentage): 209 (60%) vs. 201 (59%), p = 0.705 and; 145 (42%) vs. 129 (36%), p = 0.114 respectively. The prevalence of hyperglycemia was similar in the two groups: 44% vs. 47%, p = 0.468, respectively. For the same rates and level of hyperglycemia, the infants in group B tolerated higher GIRs (mean±SD): 7.9±1.5 vs. 8.4±1.5 mg/kg/min, p <0.001; and greater daily parenteral calorie intake: 71.5±11.7 vs. 74.7±22.7 kcal/kg/d, p = 0.017 respectively. Among VLBW infants the mean GIR and daily PN caloric intakes were higher in the group that received chromium: 7.6 vs. 8.2 mg/kg/min, p <0.001 and; 72.4 vs. 76.4 kcal/kg/d, p = 0.009 respectively.
Conclusions: In these two cohorts of infants with early neonatal hyperglycemia, the group supplemented with chromium showed better glucose tolerance and received more parenteral calories during the first week of life. These findings indicate benefit from current chromium supplementation of PN therapy in infants during the first week of life.

1833634 - A Cognitive Aid "Central Line Care Card" for Central Line–Associated Bloodstream Infections in Pediatric Home Total Parenteral Nutrition Patients

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[1]Stanford University School of Medicine, Stanford, CA; [2]Division of Pediatric Gastroenterology, Hepatology, and Nutrition, Lucile Packard Children's Hospital, Stanford University Medical Center, Stanford, CA; [3]Lucile Packard Children's Hospital, Palo Alto, CA.

Purpose: Catheter associated bloodstream infections (CABSIs) are associated with serious morbidity, mortality, and economic costs. Despite progress in recent prevention efforts, management and outcomes of CABSIs in pediatric home total parenteral nutrition (TPN) patients have been inadequately studied. We propose a novel cognitive aid containing information for both medical professionals and patient families, a "Central Line Care Card," as an intervention for pediatric home TPN patients. This prospective, open-label, cohort pilot study of long term TPN patients at Lucile Packard Children's Hospital (LPCH) Gastroenterology Clinic examines if the cognitive aid can improve management of CABSIs and patient family satisfaction with central line associated medical encounters.
Methods: 28 long term TPN patients ages 0-25 were given personalized care cards that indicated the patient's diagnosis, details about the central line, and instructions for the parents and medical providers when a patient presented to a medical facility with a fever and potential CABSI (Fig. 1). We then tracked the medical management of care when a patient presented with a fever and potential CABSI.

Results: 16 healthcare visits due to fever were analyzed and trended toward decreased breaches in care of potential CABSIs after implementation of the care card. Pre- and post-intervention, LPCH had no breaches in care, while outside hospitals (OSH) breached care in 36% of visits pre-intervention. Out of 4 visits to OSH, care was breached in 25% of visits. Qualitative parent surveys post-intervention indicated positive, enthusiastic response to the personalized Care Cards (Fig. 2). When the card was shown to a healthcare professional, parents reported that the card impacted their experience "extremely" or "a great deal" positively (out of "1-extremely," "2-a great deal," "3-moderately," "4-slightly," or "5-not at all").
Conclusions: The data trend toward reducing breaches in care of potential CABSIs suggests that this extremely low-cost intervention may quickly improve management of potential CABSIs at lower-level healthcare centers that rarely encounter children on home TPN. With an estimated attributable mortality of 12% to 35% per CABSI, and 1-3 CABSIs/1000 catheter days, this may amount to a significant reduction in mortality, morbidity, and healthcare costs, all the while improving patient family satisfaction. Further studies are needed to test the generalizability of these findings to other geographic regions. The Care Card may also improve central line management for other indications such as chemotherapy.

Figure 1. Central Line Care Card

Card Front:

Name:_____DOB:__/__/__Issued:__/__/__.
Primary MD: _____ Phone:_____
Subspecialty MD: _____ Phone:_____
Drug allergies:_____
Primary diagnosis:_____
Reason for line: TPN /_____Placement date:__/__/__.
Line type: Broviac / Hickman / Port / PICC /_____
Size (Fr):____Brand:_____Cat #:_____
Material: Silicone / Polyurethane /____Ok for EtOH locks? Y / N

For Parents: If patient has fever over 100.4F or 38.0C
- GO TO NEAREST ED, Urgent Care, or Primary MD
- CALL PEDS GI at Stanford: 650-723-5070 or 650-723-6661

Card Back:

For MDs: If patient presents to an ED or urgent care facility with T>100.4F or >38.0C:
- Please obtain cath UA, UCx, and blood culture, CBCD, CRP, COAG panel (if worried about DIC), +/- CHEM panel **from central line before starting antibiotics.**
- Start empiric broad spectrum antibiotics (vancomycin/ ceftazidime) through central line unless other allergy/ contraindication/resistant organism: _____
_____
- CALL PEDS GI at Stanford: 650-723-5070 (transfer center) or 650-723-6661 (peds GI fellow on call) for **admission**. Per LPCH policy, **ALL** patients with fever and a central line require at least **48hr admission** to rule out line infection.

Figure 2. Qualitative Parent Surveys

Themes From Responses To The Question:
"Please explain how the Care Card impacted your experience, if at all."

Information For Medical Staff

- *"When we got here, the nurse didn't know what to do. Then I showed the card, and she knew what to do."*

Quicker Responses

- *"It sped things up."*
- *"It made things easier, doctors work a little faster, make a few calls to LPCH."*

Less Explanation From Parents & Older Patients

- *"It saved me a lot of breath."*
- *"They asked what's wrong with me, how come I have my line, so I gave them the card. I can't explain myself with words well so I gave them the card."*
- *"It's nice that it's small, easy, can pull it out in an emergency. My husband has no idea…what meds, etc. The card would be very helpful for him."*

Parents Feel Empowered

- *"It gives us power, more of a voice…so we don't have to start from scratch."*
- *"They listened to me. I'm not just another parent saying, 'My doctor told me so-and-so,' but I had proof from my doctor."*

Parents Feel Comforted

- *"When I first received it, I started crying; it felt like someone else was looking out for [my son]."*

1834574 - Plasma Citrulline Concentrations in Neonates/Infants With or Without Gastrointestinal Disease and Bowel Loss

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Purpose: Citrulline is a non-essential aminoacid, synthesized exclusively in the enterocytes. Various studies have shown a role for citrulline as a gut mass marker in the setting of pediatric short bowel syndrome. Recently, Stultz et al. conducted a retrospective analysis of serial plasma citrulline levels from infants with critical illness requiring parenteral nutrition (PN) with or without bowel loss. Plasma citrulline concentrations were low in both groups initially; however, as enteral feedings were advanced in the no bowel loss group, concentrations increased compared to the bowel loss group where values often times remained undetectable. Our hypothesis is that plasma citrulline is both a functional as well as a gut mass marker. The aim of this study was to validate previous research done at our institution, by analyzing differences in plasma citrulline concentrations in a cohort of patients with GI disease and variable degrees of bowel resection, compared to patients without GI disease.

Methods: Plasma samples from predominantly PN-fed neonates and infants up to 6 month of age were included in this analysis. Data collected included age, diagnoses and surgical documentation of bowel resection, if any. They were classified into 3 main groups: patients without GI disease nor resection (Group 1), patients with GI disease but no resection (Group 2), and patients with GI disease and resection (Group 3). The study was approved by the UTHSC Institutional Review Board. Plasma was analyzed by ion-exchange chromatography on a Prominence HPLC system (Shimadzu, Houston, TX), two buffer (lithium citrate), two temperature program with post-column ortho-phthalaldehyde (OPA) derivatization and fluorescence (λEXC = 335 nm, λEM = 450 nm) detection. Data were described as median with ranges. Nonparametric statistical analyses used to compare group medians included Kruskal-Wallis ANOVA.

Results: Eighteen samples were evaluated. Five in Group 1 corresponding to patients with: congenital heart disease (CHD, n = 2), respiratory failure requiring extra-corporeal membrane oxygenation (ECMO, n = 2) and tracheo-esophageal fistula (TEF) repair (n = 1); six in Group 2 corresponding to patients with: autoimmune enteropathy (n=2), duodenal atresia (n = 3) and megacystis-microcolon intestinal hypoperistaltic syndrome (MMIHS, n = 1); and seven in Group 3 from patients with necrotizing enterocolitis (NEC). Patients in Group 3 were older compared to patients in Groups 1 and 2; mean age (in months) 5 vs. 1.5 vs. 1.6 respectively. Median plasma citrulline concentrations were 20.9 (14.9-29.0) µmol/L, 10.2 (0.5-20.0) µmol/L and 8.2 (5.9-30.3) µmol/L for Groups 1, 2 and 3 respectively. There were significant differences between Groups 1 and 2 ($p = 0.036$), and between Groups 1 and 3 ($p = 0.003$), none observed between Groups 2 and 3. In addition, the sample distributions were significantly different between Groups 1 and 2 ($p = 0.013$), and between Groups 1 and 3 ($p = 0.046$).
Conclusions: Patients without GI disease nor resection had significantly higher plasma citrulline concentrations than patients with GI disease with and without resection, at the time of assessment. Further work is underway at our institution evaluating plasma citrulline concentrations longitudinally in these same 3 categories of patients, during both a period of predominant parenteral nutrition and subsequent transition to enteral nutrition.

PARENTERAL NUTRITION POSTERS - Numbers 1 – 31

1 - Does the Use of Premixed Starter Parenteral Nutrition Decrease Therapy Delay?

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Purpose: In 2006 we discontinued all PN compounding on site and began to outsource PN compounding. This requires a cutoff time of 1200 daily for all PN orders to allow adequate compounding and delivery time by the outside compounding facility. In 2010, the difference in therapy delay between in-house compounded PN and outsourced PN was quantified. Following the change to outsourced compounding, approximately 34% of patients consulted for PN had a delay in therapy greater than 24 hrs compared with approximately 19% when PN was previously compounded in-house. As a result of these findings, in 2011, our institution implemented a Premixed Starter PN for adults in those patients consulted to begin PN but missed the 1200 cutoff time.
Our aim was to determine if the period of delay between a physician's consult for PN and start of PN therapy was decreased with the implementation of Premixed Starter PN for Adults.

Methods: IRB approval for exempt status was obtained. Patient monitoring profiles were reviewed. The electronic medical record was used to obtain consult and PN initiation dates and times for 2012 data. Data collected included date and time PN consult was received and date and time PN or starter PN was initiated. Patients were excluded if the physician requested a start time of the following evening or if the PN was never initiated. Data from 2005 - 2006 (pre-outsourced PN compounding) and 2010 - 2011 (post-outsourced PN compounding) were compared. Delay in therapy greater than 24 hours was defined as the threshold for unacceptable delay. Descriptive statistics were calculated.

Results: A total of 105 patient profiles were reviewed from June through December 2012. A total of 10 patients were excluded: 4 of which the physician requested a start time of the following evening; 5 where PN was never initiated (due to cancellation of the consult, loss of intravenous access, consult for enteral nutrition); and 1 due to hyperkalemia. Of the remaining 95 patients, 22 (23%) had a therapy delay > 24 hours. This was lower than the 2010-2011 comparative data demonstrating a 34% delay but not as low as the 2005-2006 in-house PN compounding data with an 18.8 % delay greater than 24 hours. 32 received starter PN and 63 patients did not receive starter PN. In patients who received starter PN, a therapy delay occurred in 4 (12.5%) compared to 18 (28.6%) patients who did not receive starter PN.

Conclusions: Implementing a premixed "starter" PN for adults reduced our period of PN delay when compared to the delay identified following the change from in house to outsourced PN compounding. When initiated, starter PN decreased the delay in PN therapy to less than that of previous in-house compounding, however, when starter PN was not used, delay in PN therapy greater than 24 hrs was similar to the previous findings from 2010-2011. Developing a protocol for using premixed starter PN might aid in further decreasing the therapy delay experienced in PN consulted patients who miss the early order deadline.

2 - Thinking Outside the Box: Alternative Ways to Navigate the Parenteral Nutrition Shortages

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Purpose: Parenteral nutrient shortages have complicated the clinical management and compounding of parenteral nutrition (PN) solutions and affect all care settings. Only dextrose and water have been consistently available while all other PN products have been in short supply at some point since spring of 2010.
Product unavailability has necessitated alternative compounding methods that provide prescribed nutrients while conserving inventory resources. Current injectable electrolyte shortages have resulted in utilization of pre-compounded amino acid products that contain sodium, potassium, magnesium, phosphorus, chloride and acetate; some also contain calcium. This retrospective survey compares the laboratory values of patients who received base solutions of commercially prepared amino acid/electrolyte products as a replacement for customized PN admixtures containing individually added electrolytes.

Methods: Data was reviewed on 24 home infusion pharmacy patients receiving PN from September 2012 through July 2013. Each PN formulation was evaluated upon refill by a registered dietitian, a registered dietitian with nutrition support certification and a pharmacist. If the individual PN components exceeded the amount that could be

reasonably given, the base formulation was then converted to a pre-mixed solution composed of amino acids, dextrose and electrolytes (ADE) or a product containing only amino acids and electrolytes (AE). Both products provided sodium, potassium, magnesium, phosphorus, chloride, and acetate. The ADE product also provided calcium. The dietitians and pharmacist assessed the original prescription then determined the volume of base needed to approximate the prescribed content. Additional protein, dextrose, lipids and/or electrolytes were added to make the final desired formulation. Blood chemistry results of patients receiving alternatively compounded solutions were reviewed; high/low levels were identified. These ranges were then compared to the serum assays of the same patient while receiving custom PN solutions.
Results: Twenty-four patients received alternatively compounded PN. Of these, eleven existing patients (46%) were converted to PN made with ADE or AE as their base solution. Thirteen (54%) received PN made with ADE or AE immediately upon hospital discharge. Of the 24 patients reviewed, five (21%) had a diagnosis of intestinal issues (short bowel syndrome, Ulcerative colitis, Crohn's, malabsorption) four (17%) had pancreatitis/pancreatic cancer, three (13%) had intestinal fistulae, and three (13%) were diagnosed with gastric cancer. Twenty patients (83.3%) were 18 years of age or older, four patients (16.7%) were under the age of 18. The average length of home PN therapy was 80 days. PN solutions containing ADE were provided for an average of 13 days, AE for an average of 28 days, and custom non-standard TPN solutions for an average of 53 days. When comparing the results of blood chemistry testing, it was found that the serum values did not differ significantly and remained relatively within normal limits while receiving the alternatively compounded solutions.
Conclusions: Blood chemistry assays can be maintained within normal limits and patients can receive the desired amount of macronutrients and electrolytes during the parenteral drug shortages by utilizing commercially prepared ADE or AE solutions as a base for PN admixtures.

3 - Medication Errors With Parenteral Nutrition: A Closer Look at IV Fat Emulsions
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Purpose: The use of intravenous fat emulsions (IVFE) constitutes considerable risk for medication errors because of the route, formulation complexity, and treated patient populations. A previous study investigating parental nutrition (PN) errors found that the majority of the errors reported were related to IV fat emulsions. The purpose of the current study is to determine the frequency of IVFE related errors by node, severity, patient subpopulation, and type. This study also proposes improvements to reduce these errors by correlating errors to gaps in "Safe Practices for Parenteral Nutrition (SPPN)."
Methods: Errors involving PN that were reported to the national, anonymous MED-MARX database (The Institute for Safe Medication Practices, Horsham, PA, www.ismp.org) between May 2009 and April 2011 were categorized by node, severity, and subpopulation. Error severity was rated using the National Coordinating Committee-Medication Error Reporting Program (NCC-MERP) Index. Experts in medication safety and PN validated the categorization of the reported events. The cause of each error was described as having occurred secondary to either a definite gap or suspected gap in SPPN.
Results: Unique errors (N=256) related to IV fat emulsions were identified. Some errors occurred at multiple nodes in the process (ordering, transcribing, compounding, dispensing or administration), therefore 281 total errors were identified. The node, severity, and subpopulation most frequently associated with errors were administration and transcribing, "C" severity, and adults, respectively (Table 1). No significant relationships were found between errors within subpopulations and severity (Table 1)($p>0.05$, Fischer's Exact Probability). Across all nodes and subpopulations, the most common type of error resulted from improper dosing (N=119), (Table 2). Fifty-seven of these errors were secondary to incorrect pump programming and 26 were secondary to a mix-up of PN product rates. Forty-six errors were associated with definite gaps in practice and 85 were associated with suspected gaps in practice. The most common definite gap in SPPN was related to verification of the patient identity and PN label against original order prior to administration. The SPPN recommending standardized order forms (or order entry screens) was the most frequent reason for a suspected gap. Most errors (N=114) were not applicable to gaps in safe practices because they were related to performance issues (i.e. incorrect pump programming).
Conclusions: The most frequent IVFE errors are related to performance issues in the administration node. Performance issues are not addressed in SPPN. This suggests that in addition to the systems issues included in A.S.P.E.N. SPPN, tools to assist with performance such as improved use of standardized order forms (or order entry screens) as well as education on programming the infusion pumps need to be developed.

Table 1: Errors categorized by node, severity, and subpopulation										
Node	Frequency	Severity*					Subpopulation			
		A	B	C	D	E	Neonate (≤30 days) N=54	Infant (≤1 yr) N=20	Child (≤18 yrs) N=19	Adult (>18 yrs) N=105
Ordering	38	2	15	18	3	0	3	4	4	9
Transcribing	64	0	26	35	3	0	8	4	2	19
Compounding	12	1	4	6	1	0	2	0	1	3
Dispensing	26	0	9	16	1	0	3	0	4	11
Administration	141	0	0	127	13	1	42	15	8	73
Total	**281**	**3**	**54**	**202**	**21**	**1**	**58**	**23**	**19**	**115**

*Severity rated using NCC-MERP Index

Table 2: Errors described by type per subpopulation				
Type of Error	Subpopulation			
	Neonate (≤ 30 days)	Infant (≤1 yr)	Child (≤18 yrs)	Adult (>18 yrs)
Improper dose	40	17	16	46
Omission	7	1	3	36
Wrong administration technique	3	0	0	3
Wrong time	2	0	0	0
Wrong patient	1	0	0	6
Expired product	1	0	0	2
Wrong drug	0	1	0	2
Prescribing error	0	1	0	0
Extra dose	0	0	0	6
Drug prepared incorrectly	0	0	0	2
Deteriorated product	0	0	0	1
Wrong time	0	0	0	1
Total	**54**	**20**	**19**	**105**

4 - Molybdenum and Boron Content in Individual Components Used to Prepare Total Parenteral Nutrition Mixtures: Preliminary Study

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Purpose: Boron (B) and molybdenum (Mo) are considered essential ultra trace mineral elements for humans. Boron is involved in major mineral metabolism but it is not added in pharmaceutical products used to prepare Total Parenteral Nutrition mixtures (TPN). Molybdenum deficiency is associated with parenteral nutrition, showing symptoms such as stunted growth, reduced appetite, tachycardia, tachypnea, blindness and coma. However, molybdenum is present in different pharmaceutical products used in Europe and Latin America to prepare TPN mixtures but it is not added in the U.S. Previous studies showed that TPN could be contaminated with molybdenum and boron, but it is unknown what the level of contamination is in current. Even though, there are few significant data due to the analytical difficulties to warrant recommending routine molybdenum supplementation in TPN

formulas. Therefore, the objective of this study was:1) to determine B and Mo levels in individual components used to prepare TPN mixtures.
Methods: B and Mo were determined in 33 individual solutions, from different laboratories and lots. They belong to 11 individual component solutions available in Argentina, used to prepare TPN mixtures. Three replicates of each sample were analyzed by Argon Inductively Coupled-Plasma- Optical Emission Spectrometry (ICP/ OES). Perkin Elmer 5100 DV, provided with segmented coupled charge device (SCCD) and autosampler. Samples containing organic substances were digested in a laboratory microwave oven, using concentrated nitric acid. Adequate dilutions were carried out with ultrapure water. Samples (3-6 of each product) were analized by triplicate. Analysis were carried out according to the guidelines provided by ISO/ IEC 17025: 05 Standard and include method validation and uncertainty evaluation.
Results: Results for each individual solution were: mean value ± SD (μg/mL): Boron: Potassium chloride: 0.36 ± 0.03; Sodium chloride 20%: 0.46 ± 0.03; Magnesium sulfate 25%: 1.18 ± 0.15; Sodium glicerophosfate: 1.12 ± 0.07; Calcium gluconate: 4.75 ± 0.6; Zinc sulfate: 4.75 ± 0.60; Sterile water: 0.07 ± 0.01B was not detected in solutions of Dextrose 50%, Dextrose 70% and Amino acids 10%.
Molybdenum mean value ± SD (μg/mL); Calcium gluconate: 0.023 ± 0.003; Sterile water ampoules: 0.108 ± 0.004, but was not detected in Dextrose 50%, Dextrose 70%, Amino acids 10%, Potassium chloride (3 mEq/ mL), Sodium chloride 20%, Magnesium sulfate 25%. Sodium glicerophosfate and Zinc sulfate (1mg/ mL) solutions.
One solution of Multitrace elements (containing iron, zinc, chromium, copper, manganese, selenium, iodide and molybdenum) presented (μg/mL): B: 4.35 (non declared) and Mo: 0.79 vs 1.0 declared in the label.
Conclusions: It would be advisable that TPN manufacturers declare the content of Mo, B in the labeling of the parenteral nutrition products to determine the amount administered to patients receiving TPN and stablish the actual requirements of these ultra trace elements.

5 - Management of Home Parenteral Nutrition Patients During a National Shortage of IV Lipids
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Purpose: Industry-wide drug shortages in the U.S. continue to be a challenge, and many key ingredients for home parenteral nutrition (HPN) remain in limited supply. The IV lipid shortage in early 2013 triggered the need to conserve IV lipids and therefore reduce the lipid dose in HPN solutions. IV lipids are an important source of calories and are necessary to prevent essential fatty acid deficiency (EFAD), which can develop within two weeks when no lipid source is provided. The purpose of this study was to evaluate patient response to a reduction in IV lipid dose.
Methods: A prospective, observational study was conducted to evaluate HPN patients who had a reduction in weekly IV lipid dose. Data was collected and trended on 105 adult HPN patients during a 6-week IV lipid dose reduction. IV lipid doses were reduced based on the A.S.P.E.N. guidelines for minimal amount of IV lipids required to prevent essential fatty acid deficiency (EFAD). Registered dietitians tracked several parameters, including macronutrient changes, total calorie changes, weights, laboratory values, and physical signs and symptoms of EFAD. Fifty-six patients remained in the study at the 6-week mark. Patients were dropped from the study for a variety of reasons, which included discontinuation of therapy, hospitalization, and death.
For the study patients, the average length of time on HPN was 30 months, but ranged from 1 week to 30 years. Prior to the change in IV lipid dose, the average HPN total calories was 1,629 kcal/day, with an average of 292 grams of IV lipids per week, or an average of 26% of calories from lipids. With the IV lipid dose reduction, HPN patients were provided an average of 129 grams of IV lipids per week, or an average of 12.5% of total calories from lipids. The majority of patients received IV lipids 3 times per week. Most of the patients consumed some oral nutrition.
Results: Of the 56 patients still included in the study at week 6, 24 consumed less than 500 calories/day orally, while the other 32 patients had a more substantial caloric intake. This intake ranged from 500 calories/day to 3,200 calories/day; however, absorption was likely limited in patients with short bowel syndrome and/or intestinal failure. The average percentage change in weight was a 1.8% increase at week 6. Lipid calories were replaced by dextrose and protein calories. Despite the changes in dextrose, blood sugars remained within normal range throughout the study. There was also little change in liver function test results. Less than 18% of patients (10) responded "yes" to EFAD screening questions about skin changes (scaling, thinning, dryness) related to the more common linoleic acid deficiency. Far less responded "yes" to screening questions about the rare potential neuropathy or immune dysfunction related to EFAD, with 9% (5 patients) responding "yes" to the neuropathy-related question, and 11% (6 patients) responding "yes" to the immune-related question. None of the remaining 56 patients responded "yes" to all three screening questions used to evaluate EFAD.
Conclusions: This study indicated that HPN patients safely tolerated a reduction in IV lipid dose. None of the

patients involved in the study experienced multiple signs/symptoms signifying EFAD, and weight and laboratory values related to liver function and blood glucose were relatively unchanged. Most of the patients had some oral intake, which likely helped prevent EFAD. These results can be replicated by following A.S.P.E.N. guidelines and providing patients with approximately 10% of total calories from IV lipids, or a minimum of 100 grams of IV lipids/week.

6 - Potential Benefits of Weaning Off IV Fish Oil (IVFO): Normalization of Fatty Acid Profile and Cost Savings

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Introduction: To date we have started 16 patients on fish oil-based fat emulsion (Omegaven; Fresenius) therapy for parenteral nutrition associated cholestasis (PNAC). All have responded to treatment, as evidenced by normalization of direct bilirubin levels.

We wanted to see if, we could transition back to standard soy fat emulsion Intralipid (lipid) without evidence of cholestasis returning. We also were interested in investigating if the the fatty acid profiles of these patients would normalize following the discontinuation of IVFO. Our protocol was written to provide IVFO to a patient until they were able to wean from parenteral nutrition (PN). Based on clinical experience at our institution, the decision was made to include the option in the protocol to discontinue IVFO and to start standard lipid. Total bili, D. bili, alk phos, AST and ALT were monitored during therapy. After 6 months of values within normal limits, IVFO was stopped and standard lipid started in all but one patient who remained off fat supplementation..

IVFO has now been discontinued in 4 out of our 16 patients. Gestational age in these patients ranged from 25 weeks to 39 weeks. One of these patients had gastroschisis, one had malrotation/volvulus, and two had necrotizing enterocolitis.

Time on PN before IVFO ranged between 3 and 11 months. Time on IVFO ranged between 19 mos and 28 mos with an average of 24 mos. Of these four patients, one remains on PN for 2 days/week with standard lipid dosed at 0.7 gm/kg/day. One receives PN 3 days a week without lipid but had received standard soy lipid for 6 months post IVFO discontinuation. The other two were switched back to standard lipid when the IVFO was discontinued, and following this, subsequently transitioned off all IV nutrition therapy within 1-5 months.

The triene:tetrane ratio was monitored during and after IVFO therapy to assess for essential fatty acid deficiency. All levels were found to be non-indicative of deficiency (using definition of deficiency as >0.2) throughout therapy. The fatty acid profiles however, were found to be abnormal while using IVFO. Abnormal levels improved following the discontinuation of IVFO; with an overall trend towards achieving normal fatty acid profiles. None of these patients had recurrence of their cholestasis off IVFO.

While IVFO as monotherapy may not provide an ideal balance of fatty acids, it may provide time for adaptation of bowel. Enteral feeds were able to be increased while PN was concurrently decreased on these patients. Reintroducing standard lipid, if successful, carries with it a reduction in cost and labor. IVFO continues to be non FDA approved and requires a study protocol and all the related work to import the product and remain in compliance with the FDA and IRB. While insurance companies have agreed to pay for outpatient use only, the cost is significantly more than standard soy fat emulsion.

Until new lipid products become available in the US, IVFO continues to have a role in treating PNAC. The improvements seen in the fatty acid profiles following discontinuation of IVFO therapy is promising. Provision of adequate essential fatty acids to prevent deficiency may be achieved during IVFO therapy, however it is of concern that the long term effects on neurodevelopment using IVFO as monotherapy are not known.

Encore: Previously presented at the XIII International Small Bowel Transplant Symposium. Published with permission of the authors.

7 - Ethanol Locks Decrease Catheter-Related Bloodstream Infection (CRBSI) Admissions in Home Parenteral Nutrition (HPN) Patients

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Purpose: Catheter related bloodstream infections (CRBSI) necessitate hospital readmissions and is a potential indication, if recurrent or severe, for small intestinal transplantation. We present our experience using ethanol locks

to prevent tunneled cuffed catheter infections in HPN patients.
Methods: A prospective clinical management database is maintained by the Nutrition Support Team for the management of patients on HPN at the Cleveland Clinic. Readmissions and reasons for readmission to the hospital are entered into the system and maintained for quality assurance purposes as well as patient management. We have recently began using an ethanol lock system initially for those patients with recurrent CRBSI's and most recently in 2012 for all patients discharged on HPN with a tunneled cuffed catheter. The database was queried regarding the use of ethanol locks and CRBSI's from Jauary 2010 through February of 2013. A Poisson regression model was used to assess changes in CRBSI admission rates through the years.
Results: The number of active HPN patients increased throughout the study period (Table 1). Additionally, there was a signfiicant trend towards higher percentage of discharges on ethanol locks over the years ($p<0.001$; Cochran-Armitage Trend test). Subsequently, we found CRBSI admissions per 1000 catheter days decreased with the increased use of ethanol lock (2.2 in 2010; 1.29 in 2011; 0.81 in 2012; 0.41 in 2013; 95%CI) (Figure 1).
Conclusions: The use of ethanol locks has been associated with a significant decrease in CRBSI's ($p<0.001$) in our HPN patients.

Table 1. Use of ethanol locks and CRBSI rates in HPN patients.

	2010	2011	2012	2013 (through February)
Total Patients Active with HPN	330	342	442	272
Number of New Patients Discharged on HPN	193	197	273	40
Number of New Patients Discharged with Ethanol Lock	71	58	190	26
Total CRBSI Admissions	104	74	60	6
Total Catheter Days	47256	57245	74439	14802
Percent of New HPN Patients Discharged with Ethanol Lock	36.8	29.4	69.6	65
CRBSI Admissions per 1000 Catheter Days (95% CI)	2.2 (1.78, 2.62)	1.29 (1.00, 1.59)	0.81 (0.60, 1.01)	0.41 (0.08, 0.73)

CI, confidence interval.

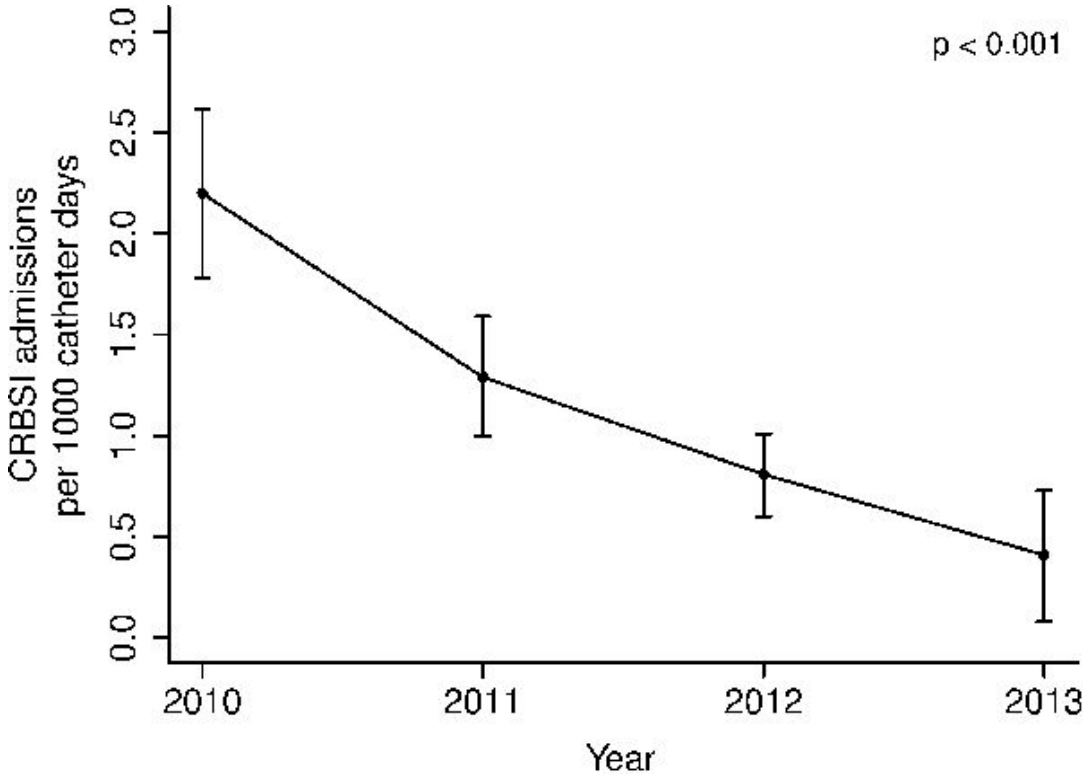

Figure 1. CRBSI admissions decreased over the study period as more patients were prophylactically prescribed ethanol locks.

8 - Cost Implications of Reducing Short Duration Parenteral Nutrition

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Purpose: Physicians are undereducated in nutrition but are responsible for nutrition management in many hospitals. Most institutions do not have a nutrition support service (NSS), and others that have a NSS have experienced reductions in resources because of cost constraints. Current A.S.P.E.N. - SCCM guidelines state that use of parenteral nutrition (PN) should be restricted to situations in which the anticipated duration of need for PN is a minimum of 7 days. At our institution, PN in some adult patients is managed in consultation with the NSS (a multidisciplinary physician-led service) and in others without NSS consultation; in some of the latter patients, PN is managed via a collaborative practice agreement between pharmacists and physician. In the present study, we investigated potential cost savings associated with reduction of short duration PN (SDPN, <7 days).

Methods: We reviewed SDPN usage in a large (1237 bed) hospital and the cost implications of reducing SDPN. PN starts were ~730 per year. We set an arbitrary goal of reducing SDPN to 20%, taking into consideration that it may be difficult to accurately estimate duration of PN need in all patients. Cost analysis was limited to charges for PN itself and for PICC (peripherally inserted central catheter) placement.

Results: The NSS saw 25% of the patients in consultation and had input on whether PN should be used, whereas PN was started without NSS consultation in 75% of the patients. The frequency of SDPN was greater in those not seen by NSS compared with those who were seen by NSS (48% vs 25%, $P < 0.001$). Mean duration of SDPN was 3.85 days. PICCs were placed solely for PN administration in 52% of PN patients. Based on these data, reduction of SDPN frequency to 20% would save an estimated 249 PN starts and 959 patient-days on PN. Overall cost savings of successfully reducing SDPN to 20% was estimated at $1.06 million.

Conclusions: These results indicate an enormous potential for cost savings if an attempt is made to adhere to A.S.P.E.N. - SCCM guidelines on PN initiation. This cost savings will have greater importance as the prevalence of

capitated hospital care increases. Possible strategies that could be employed to reduce SDPN, not investigated in the present study, include mandatory NSS consultation or a requirement that specific criteria be fulfilled before PN is dispensed. In addition to decreased costs, a reduction in SDPN would improve efficacy, quality and safety of nutritional care.

Encore: Previously published in Clinical Nutrition Supplements Volume 7, Issue1, Page 92, September 2012. Previously presented at ESPEN 2012

9 – Long-Term Insulin Requirement in Nondiabetics on Home Parenteral Nutrition Is Not Related to the Infusate

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10 - The first three months on Home Parenteral Nutrition (HPN) are crucial in preventing the first infection

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11 - A Serious Adverse Event Associated With the Current Adult Intravenous Multivitamin Shortage: A Case of Acute Thiamine Deficiency Leading to Severe Lactic Acidosis, Hyperammonemia, Cardiovascular Collapse, Acute Renal Failure, and Unnecessary Emergent Exploratory Laparoscopy

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Introduction: Thiamine (vitamin B1) is an essential vitamin, and its deficiency is often thought of in the setting of a malnourished alcoholic. The body contains stores for approximately 2-3 weeks before it will become deficient. When acute thiamine deficiency results the body cannot convert puruvate to acetyl coenzyme A. It cannot enter the Krebs cycle to go through aerobic respiration. Anaerobic metabolism then predominates causing a build up of lactic acid. In the mid-1990s, multiple cases of acute thiamine deficiency were reported in the setting of a multivitamin shortage.

Case Report: The patient is a 16-year-old male with ulcerative colitis who underwent total colectomy at an outside hospital. He was started on TPN on admission. On hospital day 32 he developed ataxia, tremor and auditory hallucinations. Over the following 2 days his bicarbonate dropped to 11 and his lactic acid rose to 16. An abdominal CT scan did not show abnormality or source of infection. He became hypotensive and was started on vasopressors and was intubated for impending respiratory failure. He was then transferred to Lucile Packard Children's Hospital's intensive care unit (PICU) for escalation of care. He received multiple doses of sodium bicarbonate en route, but his pH upon arrival was 6.8. Immediately after arrival he was taken to the operating room for emergent exploratory surgery where they found well-perfused bowel without abnormality.

He returned to the PICU where he required insulin drip, multiple units of blood products and was placed on continuous venovenous hemodialysis (CVVH) for refractory acidosis with a lactate of >30. His ammonia had risen to 608 and his creatinine to 2.3. The PICU fellow performed an online literature search looking for "TPN" and "lactic acidosis" and found multiple case reports with very similar presentations of thiamine deficiency. He called

the transferring hospital and confirmed he had been receiving TPN without multivitamin for the previous 31 days. The patient was given 400mg of IV thiamine. Two hours after administration his pH was 7.17 (up from 6.78) and bicarbonate 12.1 (up from 3.6). He was given a second dose of 400mg 2 hours after the initial dose and then dosed every 4 hours. Within 6 hours of thiamine administration he no longer required vasopressors or the insulin drip, and his pH and bicarbonate had normalized. Within 12 hours he was taken off of CVVH. His ventilator settings were weaned aggressively, and was extubated the following day. After his sedation was removed his mental status improved. His renal function has not completely recovered, which was felt to be related to hypoperfusion during his decompensation. The patient had a brain MRI 3 days after the initial decompensation which showed no abnormality, specifically no signs of Wernicke's encephalopathy.
A thiamine level was drawn prior to his first dose of multivitamin (but did not result for 3 days), which was 7 nmol/L(normal 8-30). Upon further contact with the transferring hospital they had no supply of intravenous adult multivitamin. A memorandum had been sent to their practitioners notifying them of this shortage.
Discussion: This case demonstrates the dangers associated with the current multivitamin shortage as well as the lack of education about the risk of and severe presentation of acute thiamine deficiency. It is important to recognize and educate that in a TPN dependent patient with severe metabolic acidosis, thiamine deficiency should be considered. This case demonstrates preventable morbidity that is a direct result of the current multivitamin shortage.

12 - Hyperphosphatemia With TPN: Is This Evidence for Phosphotonin?
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Introduction:
We present a case of unexplained hyperphosphatemia occurring in the absence of kidney disease while on essentially phosphorus-free Total Parenteral Nutrition (TPN) during prolonged period of no nutrition by mouth (NPO). Other similar cases have been noted and are expected to be reasonably common.
Case report:
A 38 year old obese non-pregnant white female admitted for complications related to a gastric sleeve surgery performed 6 days prior to admission. Past medical history significant for morbid obesity, lap band surgery 3 years previous with subsequent removal one year later. She presented septic with perforated viscous, peritonitis and an acute kidney injury. On hospital day 2 she underwent drainage of peritoneal abscess, suture repair of stomach, cholecystectomy, appendectomy, placement of feeding jejunostomy, drains, and wound vacuum. The acute kidney injury resolved on day 3. She had 6 further surgeries during hospital stay related to abscess and necrotic abdominal wound.
Nutritional history was notable for liquid diet for 3 weeks prior to admission. NPO days 1-71, then sips of clear liquids was allowed. TPN started on day 12 after failure of enteral nutrition (EN). Patient maintained on TPN as sole source of nutrition for 15 days with the exception of a 3-day trial of whole milk administration via the feeding tube related to suspected chyle leak. Started on trickle tube feed on day 28. She received both TPN and EN for 19 days until able to transition to EN. She continued on EN for remainder of hospital stay.
The patient's serum phosphorus began to rise after day 23 despite lack of phosphorus provision from the TPN. Serum phosphorus was elevated 15 of the remaining 21 days on TPN and continued while on EN.
Significant lab values are presented in the attached chart. Other significant measures include: Vitamin D (25-OH) 19.7 ng/mL (day 19), 21.4 ng/mL (day 29), Fractional Excretion of Phosphorus 15% (day 30), 2.0% (day 82), Parathyroid hormone 11.2 pg/mL (day 30), 9.9 pg/mL (day 41), 10.9 pg/mL (day 85) Insulin like growth Factor-1 168 ng/mL (normal 106-368 ng/mL), Fibroblast Growth Factor-23 239 RU/mL (normal < 180 RU/mL), Prealbumin 17 mg/dL (day 9).
Discussion:
This is a case of hyperphosphatemia with hypophosphaturia in the setting of prolonged NPO status. Hyperphosphatemia has been reported with kidney disease, acid-base disorders, magnesium deficiency, vitamin D toxicity, acromegaly and drugs causing spurious or actual phosphate elevation. None of these appear to be present. The patient did well and the phosphate elevation did not require clinical intervention.
The mechanism behind this hyperphosphatemia is not clear. A subtle imbalance in the homeostasis in the FGF-23, parathyroid hormone, vitamin D network may be changing the phosphorus set point. Hypoparathyroidism could explain the renal phosphate reabsorption but would be expected to cause hypocalcemia as well. The elevated FGF-23 is apparently insufficient to promote phosphate excretion. The case may be an example of a "phosphotonin" hormone communicating the lack of phosphate delivery to the proximal gut that in turn regulates renal excretion of phosphorus. We believe this previously undescribed condition is not an isolated event. We would like to query the

ASPEN nutritional science community for observations, similar cases and hypotheses.

Table 1. Significant laboratory values and nutrition support regimen.

Hospital Day	Serum Phosphate (mg/dL)	Serum Calcium (mg/dL)	Serum Albumin (g/dL)	Serum Magnesium (mg/dL)	Bicarbonate (mM)	Alkaline Phosphatase (Units/L)	Nutrition Support
1	4.4	7.4	2.5	2.6	18	112	NPO
6	5.0	7.8	2.4	1.8	25	96	NPO
8	4.6	8.3	3.1	2.0	30	131	EN
13	4.5	9.8	3.4	2.6	-	475	TPN
16	3.2	8.8	2.8	1.8	-	-	TPN
20	3.7	9.3	-	1.9	-	-	TPN
24	4.3	9.7	3.1	2.0	-	624	TPN
27	4.6	9.7	3.0	2.2	-	653	TPN
30	4.4	9.7	2.9	1.9	-	689	TPN/EN
34	4.9	9.5	3.0	1.9	-	698	TPN/EN
37	4.7	9.1	3.1	1.8	-	532	TPN/EN
41	5.0	9.7	2.8	1.9	-	432	TPN/EN
44	4.6	9.4	2.9	1.9	-	408	TPN/EN
48	4.9	9.2	3.0	1.8	-	581	TPN/EN
60	5.6	9.1	3.1	1.9	-	437	EN
61	5.7	8.9	3.3	-	-	423	EN
63	6.1	9.2	3.2	2.0	-	348	EN
67	5.6	9.3	3.1	-	-	377	EN
73	5.4	9.2	-	1.9	-	-	EN
81	5.9	9.1	-	1.9	28	-	EN
82	5.4	9.1	-	-	-	-	EN

13 - Multifactorial Issues Lead to Essential Fatty Acid Deficiency in a Long-Term Parenteral Nutrition Patient

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Purpose: A national shortage of parenteral nutrients in the setting of short bowel syndrome with dependence on parenteral nutrition (PN) complicates the management of these patients both in the hospital and in the community setting. Serum chemistries can be used as an adjunct to nutrition focused physical assessment to determine if deficiencies exist. These laboratory studies are typically reimbursed by government and private payers when the patient is hospitalized. However, when the patient returns to the community setting and care is delivered at home, many times these blood tests are not reimbursed. An increase in the need for monitoring of macro and micronutrient assays due to parenteral shortages, a possible lack of payer source and a possible gap in the continuum of care between hospital and home necessitate the development of a multi-disciplinary physical assessment tool to monitor nutrient status of patients as they navigate the health care system.

In this case study, F.S. presented for initial assessment to an outpatient intestinal rehabilitation program. The patient had short bowel syndrome with 100 cm of small bowel to ileostomy, history of colorectal cancer with total colonic

resection and dependence on PN seven days per week. She was referred to this program for management of the PN therapy. Physical assessment by the team revealed small, flat, red spots covering her arms and legs. Medical record review indicated that her local care providers had discontinued IV lipids for the prior 18 months due to elevated liver function tests, liver needle core biopsy results, and due to sporadic availability of I.V. lipid emulsion. Essential fatty acid (EFA) levels were not evaluated after halting the inclusion of lipids in her PN.
When the rash was discovered by the rehabilitation team, a full set of vitamin assays and EFA levels were drawn. Results indicated EFA deficiency. Home parenteral lipids (50g) were added back to the PN three days per week and follow up assessments were completed by the home nurse. The home nurse saw the patient on a weekly basis and reported improvements in the rash after two weeks on this therapy. After four weeks on intravenous lipids the rash resolved.
There is a lack of understanding by patients and community care givers of the consequences of nutrient deficiencies. The development of an assessment tool to aid in the identification of signs and symptoms of nutrient insufficiencies would benefit clinicians across all health care settings. Community care providers not skilled in nutrition focused physical assessment could employ such a tool to track the progress of patients referred to their healthcare system. A check list of the physical indications of nutrient deficiency and a decision tree for oral nutrient supplementation could assist healthcare providers when monitoring patients receiving PN therapy. A diagram of the digestive system identifying sites of nutrient absorption could also be used as a teaching tool for the patient. Such tools would aid in the early detection of PN -related nutrient inadequacies.

14 - Initiation of Parenteral Nutrition in the Home—Achieving Safe Outcomes

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Purpose: Can patients requiring Parenteral Nutrition (PN) safely start in the home rather than the hospital? PN is a very complex therapy. Some patients requiring PN are at risk of refeeding syndrome (RS), which further complicates initiation of this therapy. Adverse events requiring hospitalization may include electrolyte abnormalities, fluid overload, or sentinel events within the first two weeks of Home PN (HPN) initiation. Evidence-based protocols for initiating HPN are lacking in the literature. Existing practice starts the patient with 50% of estimated carbohydrate needs, checking laboratory values in 24 hours and again in 72 hours, and remixing the PN if electrolyte adjustment is required. However, many factors in home care preclude the practical flow of this model.
Conservative initiation of HPN, beginning with 25-35% of estimated carbohydrate needs along with extensive caregiver training of signs and symptoms of electrolyte abnormalities, has previously been published (2012). This current outcome study expounds on the 2012 data, and includes a much larger patient data base.
Methods: An experienced home infusion company with a Home Nutrition Support Team (HNST) developed conservative guidelines for initiating HPN. All potential HPN starts were first screened to identify those at risk of RS. All patients had baseline CMP, magnesium and phosphorus drawn within 48 hours of starting HPN. Any patient with severe electrolyte abnormalities was hospitalized and excluded as a candidate for initiating HPN . Moderate electrolyte abnormalities were corrected (outpatient) prior to HPN initiation. Mild electrolyte abnormalities were either corrected prior to initiation of HPN or were corrected with the first HPN infusions.
HPN for those identified at risk of RS was started at 25-35% of total estimated dextrose needs, one liter of volume, along with 100 mg/day thiamine for one week. All others were started at 50% of estimated dextrose needs, along with 75% of estimated volume needs. The guidelines included advancement of PN components dependent on labs and the patient's clinical picture. All were continuous infusions but were eventually cycled after PN formula goal was met.
Data on HPN initiations was collected September 2009 to June 2013 in one office of a large home infusion company. The percentage of HPN start patients deemed to be at risk of RS was evaluated, as well as the number of hospitalizations/reasons for such hospitalizations within 2 weeks of HPN start.
Results: A total of 50 patients were started in the home on HPN with 37 (74%) of the 50 considered to be at risk of RS. None(0%) were hospitalized within 2 weeks of starting HPN for reasons of fluid overload, electrolyte imbalance, nor sentinel events and 9 (18%) were hospitalized within 2 weeks of starting HPN for reasons including hip fracture, pelvic abscess, drain placement, fevers, abdominal pain, GI bleed, broken IV line, transition to hospice, and scheduled surgery.
Conclusions: Safe outcomes related to HPN were observed in all 50 patients analyzed. Accordingly, PN patients can safely be started in the home. Required are a conservative process, extensive training and support for caregivers, excellent monitoring skills, and a knowledgeable HNST.

15 - Home Initiated Parenteral Nutrition: One Company's Comprehensive Approach Toward Improved Outcomes

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Purpose: Initiation of Parenteral Nutrition (PN) in the home setting is often a choice preferred by physicians and patients. Primary advantages include avoidance of a hospitalization, hospital acquired infection and overall lower cost. However, home initiated PN has potential risks and complications including refeeding syndrome, electrolyte imbalances and infection which could ultimately require hospitalization. Evidence based practice guiding the initiation process is lacking and currently there is limited data published demonstrating the avoidance of hospitalizations and complications when PN is initiated in the home setting. Initiation by a skilled multidisciplinary home nutrition support team (HNST) is supported in the literature. The use of appropriate patient selection criteria, education of clinicians and processes to avoid adverse events would thus seem to improve outcomes. These factors must be evaluated before the benefits of home initiated PN can truly be demonstrated. The intent of this quality improvement study is to review outcomes of home initiated PN patients before and after instituting a comprehensive companywide HNST education program and process. Components included clinician education, standardized patient selection criteria, an initiation process, and clinical support tools.

Methods: A retrospective sample review of 118 patients receiving home initiated PN from a national home infusion company (70 locations) was completed. Data from patients receiving PN prior to instituting a clinical education program and process (Group I, December 2009-February 2011) and after the education program and process was launched (Group II, March 2013-August 2013) were compared. Patient data included diagnosis, age, gender, history of disease, and unplanned hospitalizations (including discharge from service due to hospice care or death) within 14 days of initiation of home PN.

Results: Unplanned hospitalizations (including unplanned discharge to hospice or death) that occurred within 14 days of initiation totaled 17 of 80(21%) patients in Group I compared to 5 of 38 (13%) in Group II. Examples of reasons for unplanned hospitalizations in both groups included low phosphorus (1), fistula management (2), feeding tube placement (2) and infection (2). Five of these patients were discharged off service due to hospice care or death within 14 days of initiation. Four of these five were in Group I and all 5 had terminal diagnosis at start of care. Patients in both groups were predominately female (60%). Average age was 52 years. Most frequent diagnoses included cancer (47%), malabsorption/fistula/motility disorder (16%), Crohns/colitis (11%) hyperemesis gravidarum (6%).

Conclusions: Improved outcomes in home initiated PN can be achieved by instituting processes and clinical education programs that ensure appropriate patient selection, a standard approach to clinical care, and the use of an experienced HNST. A noted improvement was observed in unplanned hospitalizations (and discharge due to hospice or death). In addition there was a decrease in the use of home initiated PN in patients with a terminal diagnosis. Continued collection of ongoing data to further this study is recommended. Suggestion is made that future studies are warranted within the home infusion industry to demonstrate improvement of patient clinical parameters, correction of malnutrition and home initiated PN's use in disease recovery.

Encore: Previously presented at DDW 2013 in Orlando, Fl. Published with permission of the authors.

16 - Intravenous Fish Oil Reverses Cholestasis in Children With Parenteral Nutrition Associated Liver Disease When Substituted for Soybean Oil-Based Lipid Emulsion

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Purpose: Parenteral nutrition (PN) with soybean oil-based intravenous lipid emulsion is often necessary in the treatment of children with short bowel syndrome (SBS). PN associated liver disease (PNALD) is a known complication with high morbidity and mortality. Substitution of parenteral fish oil for soybean oil-based intravenous lipid emulsions has shown promise in the treatment of PNALD.

Methods: The Institutional Review Board approved this study to evaluate parenteral fish oil as a substitution in parenteral nutrition for pediatric patients who developed PNALD while receiving standard PN with a soybean oil-based lipid emulsion. We identified 30 subjects who completed a course of parenteral fish oil lasting at least 7 days. Cholestasis was defined as serum direct bilirubin >2 mg/dL. Laboratory markers of liver dysfunction including albumin, platelet count, international normalized ratio (INR), and direct bilirubin were evaluated.

Results: The mean (range) age at enrollment was 139 (37-451) days. The mean (range) duration of parenteral fish oil therapy was 125 (25-482) days. Cholestasis improved in 29/30 patients and resolved completely (final direct

bilirubin ≤2.0 mg/dL) in 27/30 patients (Figure 1). Over the course of treatment, direct bilirubin decreased significantly from 5.1 to 0.7 mg/dL ($p < 0.001$). Among the responders, direct bilirubin fell by an average of 0.12 mg/dL/day with cholestasis resolving in an average of 37 days. Albumin, platelet count, and INR did not change significantly. At the completion of parenteral fish oil therapy 53% of patients remained on PN, while at a mean follow up of 27 months only 26% of patients still required PN. Three deaths occurred. Only one patient demonstrated worsening cholestasis; he became coagulopathic and succumbed to multisystem organ failure. Two other patients were categorized as non-responders, because, although their hyperbilirubinemia improved, the direct bilirubin value was never recorded as ≤2.0 mg/dL. One of these non-responders was discharged home after a complete clinical recovery without repeat serum direct bilirubin values, and the other patient died of cardiac arrest secondary to a presumed septic event while still on therapy. The final death was attributed to pulmonary failure in a patient on full enteral feeds whose parenteral fish oil was discontinued 6 months prior after his cholestasis had resolved. There were no significant differences between responders and non-responders with respect to age and initial direct bilirubin value.

Conclusions: The results of this study support the role of parenteral fish oil for pediatric patients with PNALD. We observed resolution of cholestasis in 90% of subjects with PNALD after substitution of parenteral fish oil for conventional intravenous lipid as well as continued improvements in nutritional status after completion of therapy.

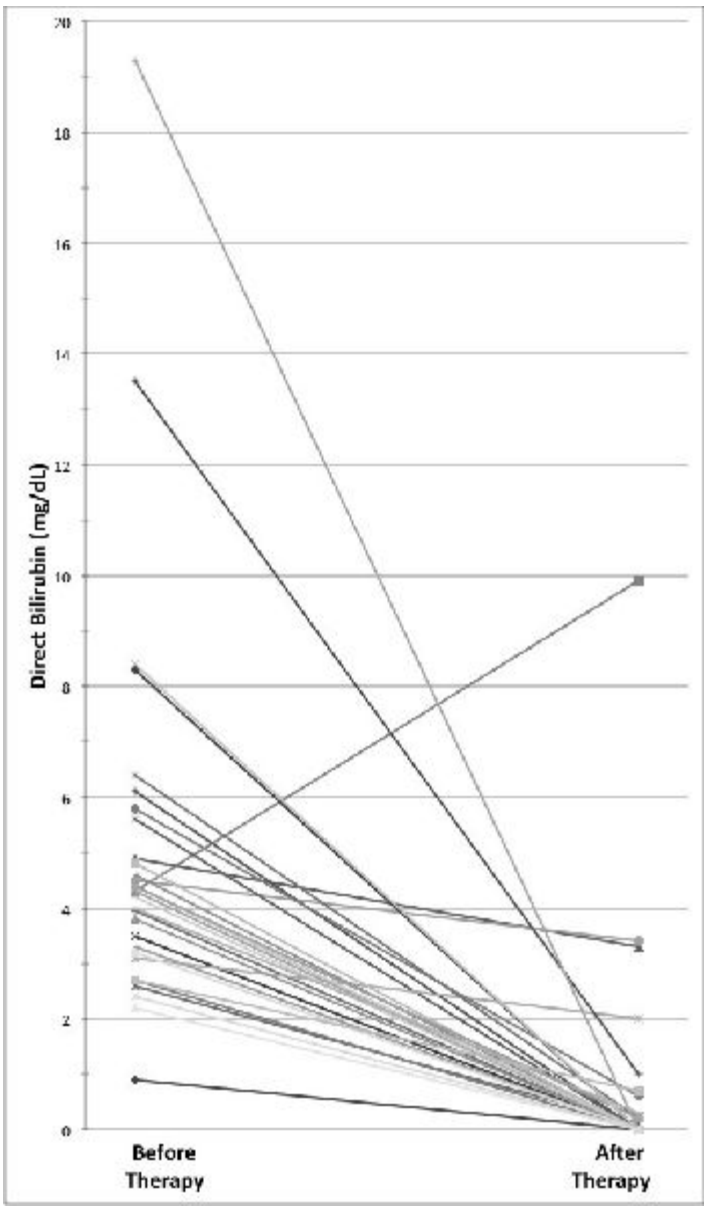

Figure 1. Cholestasis improved in 29/30 patients and resolved completely (final direct bilirubin ≤2.0 mg/dL) in 27/30 patients. Over the course of treatment, direct bilirubin decreased significantly from 5.1 to 0.7 mg/dL ($p < 0.001$).

17 - Resolution of Cholestasis in an Adolescent Following Replacement of Soy-Based Lipid Emulsion With Omega-3 Fish Oil: A Case Report

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Purpose: Soybean oil based intravenous lipid emulsion is thought to contribute to parenteral nutrition associated liver disease (PNALD), a complication that increases mortality in children with short bowel syndrome (SBS). Substitution of fish oil based Omegaven® (hereafter referred to as intravenous fish oil, IVFO) for soybean oil based lipid emulsion in parenteral nutrition (PN) has been shown to reverse cholestasis in infants with PNALD, most commonly using a dose of 1g/kg/d. IVFO has been reported to be effective at reversing PNALD in case series mostly in infants. There have been few reports of its use in older children and adolescents.

Methods: There have been few reports of Omegaven® use in older children and adolescents. We describe a case of

reversal of cholestasis in an adolescent with PNALD and SBS treated with IVFO.
Case Description
The patient is a 17-year-old female with megacystis microcolon-intestinal hypoperistalsis syndrome (MMIH syndrome, also known as Berdon syndrome). At age 9, she underwent isolated small bowel transplantation for functional short gut syndrome due to bowel dilatation and hypomotility. In the subsequent 5 years she experienced two episodes of acute rejection, post-transplant lymphoproliferative disorder, gastroparesis, and chronic rejection that ultimately led to transplant enterectomy. She remained on PN with intravenous soybean lipid emulsion (SLE) following transplant enterectomy and cessation of oral intake at age 14. After 3 years, she developed hyperbilirubinemia and jaundice secondary to PNALD, with a peak direct bilirubin of 6.9mg/dL (total bilirubin 11.9mg/dL). Needle biopsy of the liver demonstrated portal fibrosis with bridging fibrosis and cholestasis with bile plugs, consistent with PNALD. At this time, SLE was discontinued and IVFO was started at 0.2g/kg/day.
Results: At 1 year follow up, there has been no evidence of essential fatty acid deficiency with this therapy. Plasma DHA and EPA levels are higher on IVFO (428nmol/mL and 284nmol/mL respectively) than on PN with SLE (249nmol/mL and 58nmol/mL respectively.) Overall nutritional status continues to improve, with prealbumin levels of 13.4, 9.6, and 21.9mg/dL 5 months before, 1 day before, and 5 months after IVFO initiation.Hyperbilirubinemia resolved (direct bilirubin below 2mg/dL) after 5 months of IVFO administration. There was no significant change in serum hematocrit, platelets, or prothrombin time, and markers of nutritional status have improved. There were no bleeding episodes or other side effects. The patient remains on IVFO and maintains a direct bilirubin <2mg/dL.
Conclusions: We report a case of rapid resolution of hyperbilirubinemia in an adolescent with SBS and PNALD following replacement of soy based intravenous lipid emulsion infusion with low dose intravenous fish oil (0.2 g/kg/d). Fish oil based lipid emulsion in PN dependent children and adolescents may be therapeutic when cholestasis develops, and a lower dose per kg body weight than has been typically given in infants may suffice.

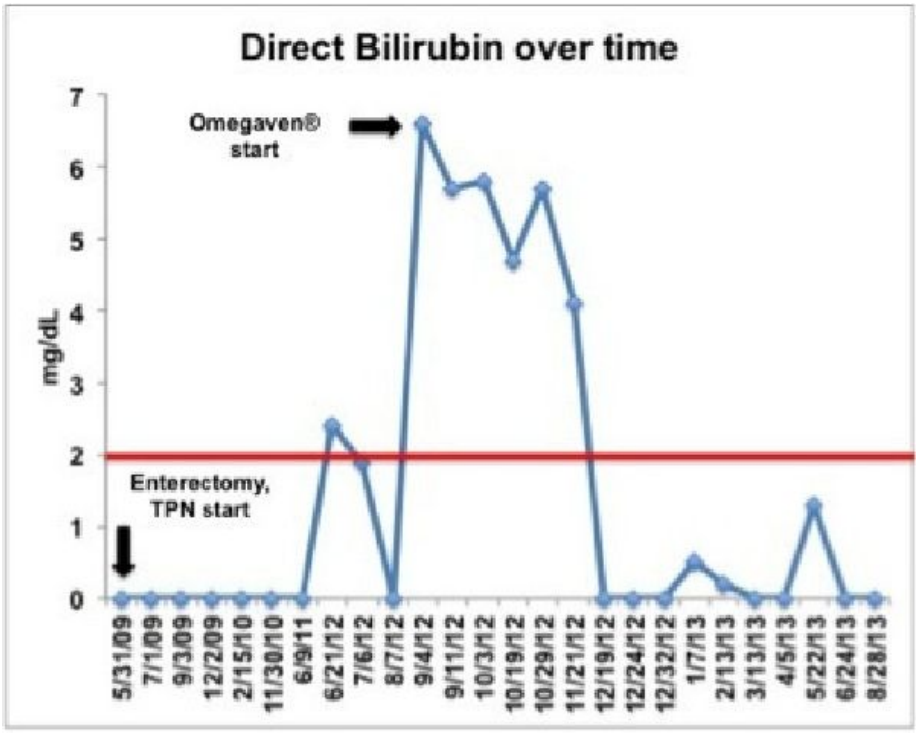

Figure 1: Serum bilirubin with Omegaven® therapy. Hyperbilirubinemia developed over the 3 years following graft enterectomy and TPN/SLE use. Omegaven® was started when bilirubin peaked at 6.7mg/dL. Bilirubin normalized (fell below 2mg/dL, marked by red line) within 5 months of therapy.

18 - Liver Function Tests: Needed for Every Inpatient Initiated on Parenteral Nutrition?
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Purpose: Unnecessary laboratory testing in hospitalized patients is an acknowledged source of increased costs for patients and healthcare institutions. Although many barriers to change exist, even small efforts to reduce unnecessary tests have been effective in cost reduction in previous studies. The purpose of our quality improvement project was to evaluate cases of inappropriate ordering of laboratory testing in patients initiated on parenteral nutrition (PN) in our hospital. We have focused our efforts on liver function tests (LFT) due to a noted disconnect between the automatic process in place for ordering a baseline LFT and the actual patient need for LFTs at the time of PN initiation.
Methods: In accordance with national standards, LFTs are obtained at baseline upon PN initiation at our institution by way of an electronic orderset following approval of therapy by the PN physician.
The "PN Initial Orderset" includes an LFT panel, which includes AST, ALT, ALP, total and direct bilirubin, and albumin. On October 9, 2012, LFTs were removed from the orderset. A retrospective review of one month preceding and following the change was completed to assess 1) inappropriateness of an LFT order at time of PN start and 2) to calculate LFT associated charges. An inappropriate order of LFTs was defined as one ordered in the setting of an already resulted normal LFT during hospital admission or in the previous 4 weeks with no concern for liver dysfunction, biliary obstruction or other hepatobiliary pathology that required repeat evaluation. Current patient charge information for LFTs was obtained for the cost analysis ($354 each). Patients were included if PN was initiated between 9/8/2012 and 11/9/2012. Patients who were on PN as an outpatient were excluded from the review.
Results: A total of 67 patients were identified during the study period. Forty patients were included in the analysis, 22 in the month preceding and 18 in the month following changes to the orderset. The majority of patients excluded (21/27) were PN-dependent as outpatients. Most of the patients were admitted to a surgical service with common indications for PN including small bowel obstruction, ileus, and fistula in conjunction with inadequate or anticipated inadequate enteral intake for > 7 days. The median length of PN administration in the study sample was 9 days (range 1-112 days) and PN was administered continuously in all cases. During the month preceding the orderset change (9/8/2012 - 10/8/2012), all patients had LFTs ordered and resulted via the orderset pathway. This resulted in associated patient charges of $7788 for the month. For 45% of these patients (10/22), the LFT order upon PN start was characterized as inappropriate, with a calculated aggregate avoidable charge of $3540 for the month. During the month following the orderset change (10/9/2012 - 11/9/2012), only 11% of patients (2/18) had inappropriate LFTs drawn, with an associated charge of $708 for the month. Based on our data, a savings of $2832 in patient charges may be realized monthly. On an annual basis this would amount to nearly $40,000.
Conclusions: Targeting the electronic ordering process provided an opportunity to reduce healthcare costs related to parenteral nutrition. Removal of LFTs from the orderset lead to a significant reduction in unnecessary laboratories and healthcare costs. All patients who required baseline LFTs at PN start continued to receive necessary labs after the change. Quality improvement and cost efficiency in parenteral nutrition is an ongoing pursuit at our institution. Further efforts may individualize the approach to laboratory monitoring, such as creation of separate ordersets for chronic PN users versus new starts.

19 - Taurolidine Antimicrobial Lock Solution Prevents Recurrent Catheter-Related Infections Reducing Admissions and Cost of Care in a Home Parenteral Nutrition Patient

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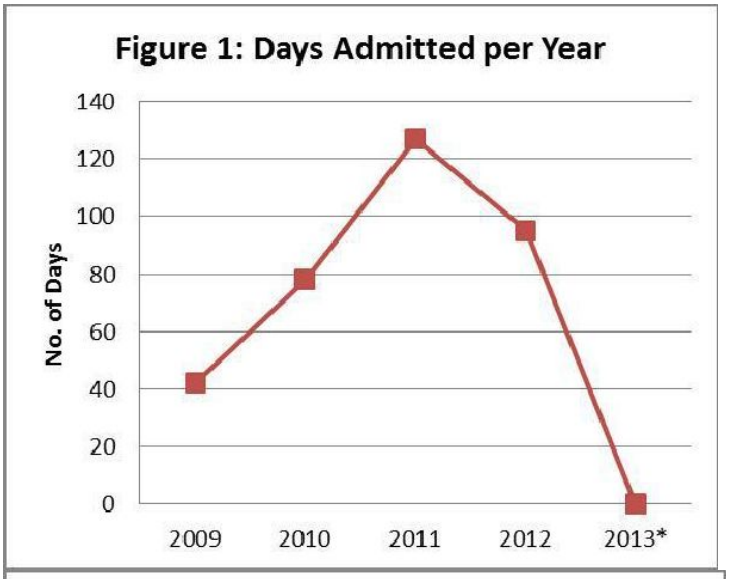
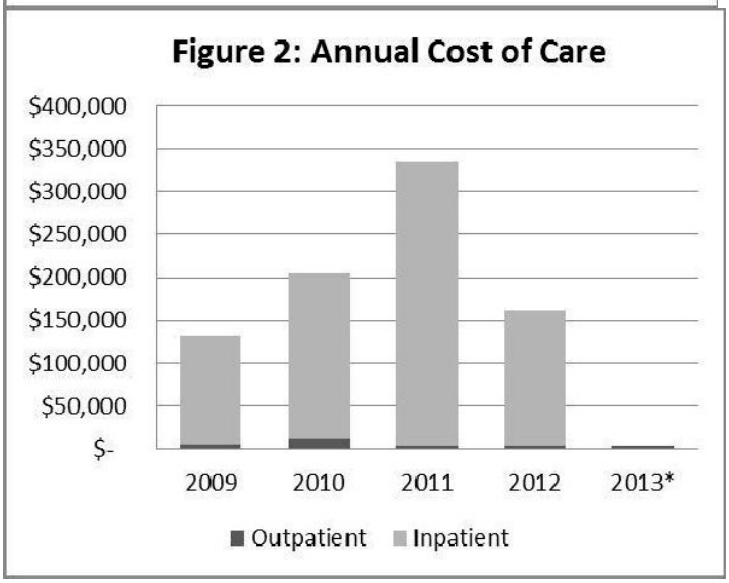
Introduction: Catheter-related bloodstream infections are the most common serious complication of long-term parenteral nutrition. There is increasing evidence that the use of taurolidine (available throughout Europe) as an antimicrobial lock solution reduces the rate of infection.
Case Presentation: We report the case of a 52 year old woman who presented to our institution with refractory Crohn's enterocolitis and intractable small bowel, colon, and perianal disease. She has required multiple surgeries ultimately leaving her with an ileostomy and Hartmann's pouch. Since 2006 her care has been complicated by increasingly frequent CVC infections leading to many prolonged hospitalizations. In 2009, she was diagnosed with acquired common variable immunodeficiency (CVID), a rare but known cause of phenotypic Crohn's disease. She now receives monthly IV gamma globulin but continues to have intractable, high volume secretory diarrhea requiring home TPN for nutrition and hydration.
Over 4 years from 2009 to 2012, she was hospitalized an average of 86 days per year with multiple line infections and numerous associated complications. In 2012, we obtained a single patient IND with FDA and IRB approval for the use of taurolidine-citrate (Taurolock Hep100®) as an antimicrobial lock solution. Since starting therapy in November 2012 she has not had a CVC infection or hospital admission and reports no other complications or

adverse events. This simple intervention dramatically decreased the rate of CVC infection and thus the cost of care reducing the average annual cost of care from $208,154 to just $4,060.
Discussion: Taurolidine is a broad spectrum antiseptic used throughout Europe as an antimicrobial lock solution. It is effective against a variety of bacteria and fungi through an irreversible reaction of metholyl taurinamide with bacterial cell walls but non-toxic to humans because of its rapid degradation to water, CO2 and the amino acid taurine. Taurolidine is combined with citrate and heparin to minimize thrombus formation. One case series1 and two prospective trials reported a significant reduction in CVC bacteremia using taurolidine lock solution. One study reported a nearly 50% reduction in the rate of bacteremia2 while a second randomized trial of 30 patients reported a dramatic increase in infection-free days from 175 to 675 days ($p < 0.0001$) without side effects or catheter occlusions.3
Conclusions: Combined with mounting evidence from retrospective reviews and clinical trials in Europe, there is strong support for the use of taurolidine-citrate for the prevention of CVC infection. Additional prospective trials aimed at better defining the risks, benefits and impact on cost and quality of care are needed. Many patients in the United States are at risk for infection from long-term catheter use and may benefit from less frequent infections and hospitalizations with reduced cost of care.





20 - Micronutrient Status of Patients Receiving Home Parenteral Nutrition (HPN): A Four-Year Review

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Purpose: To evaluate serum levels of micronutrients in long term HPN patients.

Methods: A retrospective review of HPN patient's medical records was conducted at a single site office of a large home infusion company. Patients were on parenteral nutrition from 5 months to 11 years. Sixty percent of the patients had a diagnosis of short bowel syndrome or obstruction. Monitoring of vitamin A, vitamin D, vitamin E, selenium, zinc, copper, chromium, manganese, carnitine and iron were collected at least every 6 months or more frequently if indicated. Fifteen out of the 27 patients studied had repeat samples drawn for each nutrient. Changes in nutrient supplementation were made based on lab results and therefore could have affected subsequent lab draws.

Results: The medical records of 27 patients were reviewed (Table 1). Vitamin D deficiency was found in at least 80% of patients. These results were consistent with previous studies. Chromium, the trace element most often elevated, was reported above normal in 67% of patients. Manganese, the nutrient expected to be elevated was normal in 80% of those sampled. Serum levels of selenium, zinc and vitamin E remained consistently within normal limits in >95% of the patients.

Conclusions: Fluctuations in micronutrient serum levels were observed in all 27 patients. Vitamin D was the most common nutrient deficiency. Supplementation of vitamin D may need to be considered in deficient patients. To prevent toxicity, MTE may need to be discontinued and individual trace elements added separately according to the lab results. Further research is needed to determine the protocol for frequency of labs, disease state influence on micronutrient levels as well as appropriate supplementation.

Table 1. Micronutrient Laboratory Results in 27 Long-Term HPN Patients

Nutrient	Total # lab draws	# Patients	% of pts with normal	% of pts with low	%f pts with high
Iron	51	21	70	38	0
Selenium	99	27	100	15	15
Zinc	104	26	96	15	27
Manganese	44	19	79	26	26
Copper	81	24	83	17	30
Chromium	51	24	50	0	67
Vit A	73	24	83	38	4
Vit D	99	26	46	80	0
Vit E	64	20	100	15	0
Carnitine	55	19	79	53	16

Note: Patients may have had multiple lab draws for the same nutrient with varying results.

Encore: Previoulsy published in Hepatology International, Volume 7, Issue 1, Supplement, June 2013. Previously presented at the Asian Pacific Association for the Study of Liver Diseases (APASL) 2013, Singapore. Reference original publication for abstract text.

21 - Long-Term Parenteral Nutrition Does Not Result in Progression to Cirrhosis: Role of Liver Biopsy in Evaluating Persistently Abnormal Liver Chemistry

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22 - Electrolyte Shortages: Finding the Cloud Without an Aluminum Lining

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Purpose: Long term parenteral nutrition patients are at risk for developing adverse effects related to aluminum inherent in parenteral nutrition (PN) components. Metabolic bone disease and acute liver injury have both been attributed to aluminum contamination of PN. Current ASPEN guidelines recommend aluminum content of PN be

maintained below 5 mcg/kg/day. Products used to compound PN are labeled with maximum potential aluminum content which allows calculation of the total amount of aluminum per day. The labeled aluminum content of calcium gluconate 10% solution in use during the study period was no more than 9400 mcg/L. When the product became unavailable and an alternate calcium source was used, the calculated total aluminum content of the PN was significantly decreased.
Objective: To review calculated amounts of aluminum in individual PN solutions and determine the effect of substitutions in PN components on overall aluminum content.
.**Methods:** A retrospective review of PN patient medical records was conducted within a single location of a national home infusion company. The review period included seven months during a nationwide shortage of calcium gluconate. TPN Electrolyte Solution® (Hospira, Lake Forest, IL) was substituted as the source of calcium and magnesium, with additional electrolytes adjusted accordingly. Patients were selected for inclusion if they received at least one PN dose containing calcium gluconate and one PN dose containing the mixed electrolyte additive solution. Data collected during the review period: aluminum content of PN, duration of home PN therapy, diagnosis, outcomes, and patient demographics.
Results: Data was collected from nine patient medical records. Average total PN aluminum content before substitution was 520 mcg (range 136.05 to 903.25) or 8 mcg/kg/day (range 1.5 to 14.7). Average aluminum content after substitution was 165.4 mcg (range 55.73 to 623.14) or 2.4 mcg/kg/day (range 0.6 to 6.7). Patients received an average of 67 percent (range 30.1 to 91) less aluminum after the substitution with mixed electrolyte additive solution. Prior to the change, only two patients were below the recommended aluminum concentration of 5 mcg/kg/day (both 1.5 mcg/kg/day). After the conversion, only two patients exceeded the recommended limit (5.1 and 6.7 mcg/kg/day). Laboratory values remained stable for all patients. Of the nine patients included in the study, four continue chronically on home PN. Four patient's clinical condition improved significantly and they resumed an oral diet. One patient expired due to disease progression (pancreatic cancer). Associated patient data: patients were all female, ages range from 15 to 64, average duration of PN therapy was 865.4 days (range 27 to 4015).
Conclusions: Use of an alternate electrolyte solution enabled one location of a national home infusion company to reduce aluminum concentrations in custom PN formulation to below recommended concentrations of aluminum in a majority of patients (78%). Utilizing traditional sources of electrolytes, only 22% of patients were below the recommended concentration. The change may have significant clinical impact, especially for chronic home PN patients; mixed electrolyte additive solution will be the calcium and magnesium source of choice at this location going forward

23 - Muscle Cramping Survey in Long-Term Home Parenteral Nutrition Consumers
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Purpose: A survey was conducted to examine the occurrence of muscle cramping in long-term Home Parenteral Nutrition (HPN) consumers. Information on the frequency, site, pain intensity, and treatments was collected. We were especially interested in determining if there were any differences in muscle cramping associated with HPN infused intermittently (less than 7 days per week) versus daily.
Methods: The survey shown in Image 1 was mailed in 2013 to approximately 2000 HPN consumers. The survey included check boxes for reporting the occurrence, frequency, and site of muscle cramping. Additionally, respondents were asked to rate muscle cramping pain intensity on a scale of 1-10 and report treatments they found effective. Information including diagnosis, HPN volume, infusion time, and frequency was also requested.
The occurrence of muscle cramping in the daily and intermittent HPN groups was compared using Fisher's Exact Test.
Results: From the 63 complete surveys received the following demographics were observed. The daily HPN group comprised 40 consumers infusing an average HPN volume of 2100ml over 12.1 hours 7 days per week. The intermittent HPN group comprised 23 consumers infusing an average HPN volume of 1800ml over 11.1 hours 4.7 days per week. The reported cramping occurrences are summarized in Table 1: 52 (83%) reported muscle cramping associated with their HPN therapy; whereas 11 (17%) reported no muscle cramping. Of the 40 respondents receiving daily HPN, 31 (78%) reported muscle cramping while 9 (22%) reported no muscle cramping. Of the 23 respondents receiving intermittent HPN, 21 (91%) reported muscle cramping, while 2 (9%) did not. Applying Fisher's Exact Test, no significant difference was found in cramping occurrence between the daily and intermittent HPN groups ($p=0.112$).
In the 52 respondents reporting muscle cramping, 47 (90%) experienced the cramping in the ankle or calf area. The pain intensity on a 1-10 scale ranged from 3 to 10 with an average intensity of 7.4. In 80% of cases, the muscle

cramping occurred during the HPN infusion.
The muscle cramping frequencies reported are summarized in Table 2. The majority of respondents (46%) reported a muscle cramping frequency of 1-3 times per week regardless of daily or intermittent HPN administration. Of those experiencing muscle cramping in the daily HPN group, 42% reported muscle cramps 1-3 times per week, 22% reported muscle cramps less than once per week, 22% reported muscle cramps 4-7 times per week, and 13% reported muscle cramps more than 7 times per week. Among those experiencing muscle cramps In the intermittent HPN group, 52% had a muscle cramping frequency of 1-3 times per week, 19% reported less than once per week, 14% reported 4-7 times per week, and 14% reported more than 7 times per week.
A combination of walking and stretching was the most common (84%) effective treatment reported in respondents with muscle cramps. Extra hydration was reported in 17% of respondents.
Conclusions: From prior observation, we felt that the incidence of muscle cramping in HPN consumers was widespread and tended to occur more frequently in those consumers receiving HPN intermittently as opposed to daily. Our survey results confirmed muscle cramping is widespread among HPN consumers (83%) and can be quite uncomfortable (pain 7.4 out of 10). We were not able to associate muscle cramping with intermittent HPN infusion as we had expected. We plan to further study muscle cramping related to HPN therapy.

Table 1. Muscle Cramping Occurrence

	Cramps - Yes	Cramps - No	Total
Daily HPN	31 (78%)	9 (22%)	40
Intermittent HPN	21 (91%)	2 (9%)	23
Total	52	11	63

Fisher's Exact Test p=0.112

Table 2. Muscle Cramping Frequency

	Less than 1x per week	1-3x per week	4-7x per week	More than 7x per week	Total
Daily HPN	7 (22%)	13 (42%)	7 (22%)	4 (13%)	31
Intermittent HPN	4 (19%)	11 (52%)	3 (14%)	3 (14%)	21
Total	11	24	10	7	52

24 - Intravenous Lipid Minimization Strategy in a Long-Term Parenteral Nutrition (PN) Population
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Purpose: In 2012, the U.S. experienced a national Intravenous Fat Emulsion (IVFE) shortage. In response, the American Society of Parenteral and Enteral Nutrition (ASPEN) issued guidelines for lipid use to maximize lipid supplies while maintaining patient health. Suggestions for long-term PN patients included: maximize oral lipids, prioritize pediatric patients and, administer at minimum 100 g. IVFE per week. Due to stringent manufacturer allocation and anticipated extended shortage duration, we developed a lipid reduction strategy with customization beyond the ASPEN guidelines.
Methods: Lipid criteria were based on patient age, diagnosis and ability to take oral nutrition. All pediatric patients were maintained on their prescribed IVFE. Adult patients with a diagnosis of short bowel syndrome who were able to take oral nutrition and had documented adequate lipid stores as reflected in normal Triene:Tetraene (T:T) Ratios and Linoleic Acid levels, were included in the minimization group. Essential Fatty Acid (EFA) needs were calculated for each patient as 2-4 percent of total intravenous calories provided. We hypothesized that additional EFA requirements would be provided by diet. Each patient was instructed on inclusion of high EFA fats into their diets as soy, safflower and sunflower oil sources. Patients were followed on a monthly basis for diet reinforcement and monitoring. T:T Ratios and Linoleic Acid levels were drawn within three months of protocol implementation to monitor for EFA deficiency risk.
Results: All nine patients entered in the lipid minimization protocol, were diagnosed with short bowel syndrome. Four patients had an underlying diagnosis of Crohn's Disease, four resulted from vascular ischemia and one was due

to surgical complications. Two patients had their ileocecal valve (ICV) and colons intact, one had a colon but no ICV and six had no ICV or colon. Lipid doses ranged from 33 to 50 g. IVFE per week. After three months on protocol, four of the nine patients had high T:T Ratios averaging 0.046 and low Linoleic Acid levels averaging 1149 nmol/ml, consistent with EFA deficiency. Five of the nine patients had normal T:T Ratios and Linoleic Acid levels averaging 0.021 and 2932, respectively. Bowel length ranged from 75 to 122 cm in the EFA deficient group and 120 to 230 cm in the non-EFA deficient group.
Conclusions: Our IVFE protocol goal was: to customize lipid doses based on calorie needs, to maximize oral sources of EFA and to conserve IVFE supplies. Our data showed variable response to lipid minimization. As expected, bowel length appears to be related to EFA deficiency, requiring further exploration in a larger sample size. Volume of stool output and health of the remaining bowel would be of interest. Also of question is the patient's understanding and compliance to the EFA-rich diet. Four of five patients in the non-EFA deficient group were enrolled in our Intestinal Rehabilitation program incorporating 6-weeks of intensive diet education and intake monitoring, suggesting that education may be a factor. It appears from this small study, that there may be opportunity for IVFE conservation with customized EFA requirement assessment in some short bowel patients, with frequent monitoring. Longer duration at this lower level of supplementation also needs further research.

25 - Preferred Medical Information Sources for Enteral and Parenteral Nutrition Consumers
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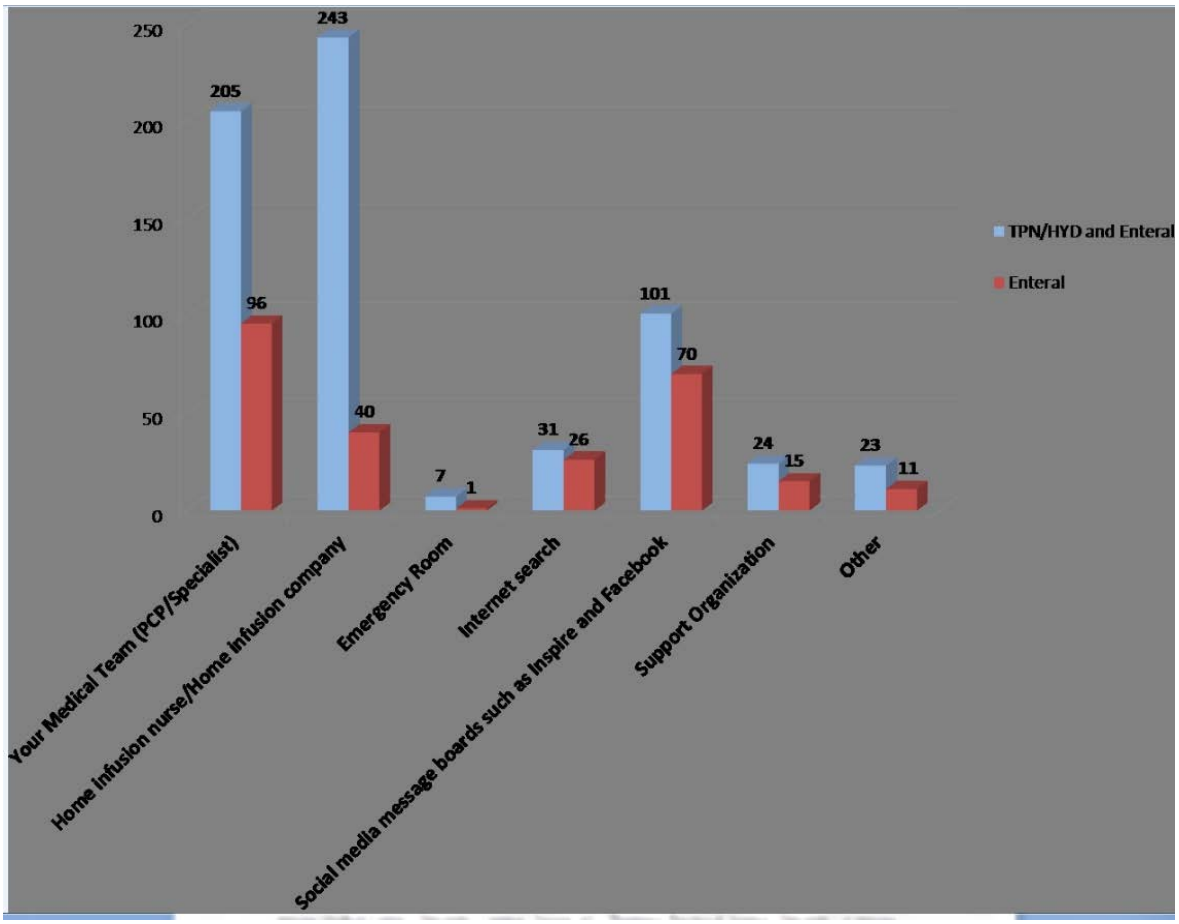
Purpose: Consumers on Home Parenteral (HPEN) and Enteral Nutrition (HEN) are often in search of clinical information, resources and support to effectively manage their care. Frequent questions and concerns revolve around line and tube care, diet, hydration, output, and managing life on nutrition support. Prior research into preferred sources for medical information for the general and disease specific populations has revealed that consumers often look beyond their medical team for information and support.
Methods: To better understand where HPEN consumers obtain medical information an online survey was created. The link to the survey was distributed to HPN and HEN consumers. This survey asked, "Who do you turn to first for information" about various aspects of their care and why. The options included Your Medical Team (PCP/Specialist), Home infusion nurse/Home infusion company(HHC), Emergency Room, Internet search, Social media message boards such as Inspire and Facebook or, Support Organization. Additionally respondents were queried as to the primary reason they would and would not turn to PCP/Specialist or HHC when they have questions or concerns.
Results: Over 130 surveys were completed. Among HPEN respondents the primary choice was their HHC, with PCP/Specialist selected as the second most popular choice. The leading reason consumers access their HHC was "Information is reliable." "Ease of obtaining information", "Speed of obtaining information" and "Information is useful" were all represented in close range as a second choice. The most common reason HPEN respondents accessed their PCP/Specialist, was that "the information was reliable." Among HEN respondents PCP/Specialist was the most common response chosen with the second most popular choice being "Social media". The primary reason HEN respondents turned to "PCP/Specialist" was "Information is reliable." The primary reason respondents turned to "Social media" was "Ease of obtaining information" followed closely by "Speed of obtaining information". "Emergency Room" was chosen the least across all therapies with only 8 responses. Respondents on all therapies indicated that the primary reason they DO turn to their PCP/Specialist when they have questions or concerns was that they were "able to help". The primary reason they DO NOT turn to their PCP/Specialist was they "lacked a perspective of home life" followed closely by "Difficult to get in contact with them." Respondents indicated that the primary reason they DO turn to their HHC was they were "able to help" followed closely by "Easy to get in contact with them." The primary reason they DO NOT turn to their HHC was that they were "unable to help."
Conclusions: Despite the popularity of the internet and other social media as a source of information exchange, , HPEN and HEN consumers continue to report they are most likely to turn to their HHC and PCP/Specialist first for information regarding their care due to the reliability of the information.. This data supports the importance of the expertise and knowledge of the HHC as a first responder to consumer questions and suggests that consumers and caregivers may turn to their PCP/Specialist first if accessibility was improved. The data also highlights the importance of integrating a consumer advocacy program with traditional PCP/Specialist care to impart a consumer-centered perspective to care provided.



Preferred Medical Infomation Sources for Parenteral and Enteral Nutrition Consumers

26 - Peripherally Inserted Central Catheter Infections Associated With Parenteral Nutrition

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Purpose: Parenteral nutrition (PN) is an intravenous form of nutrition which requires central venous access for administration due to its high osmolarity. Although PN is essential and life saving in patients who cannot be fed via the gastrointestinal tract, it has been associated with an increased risk of central catheter related blood stream infections. The incidence of infection with PN varies throughout the literature and is confounded by the type of central line, glucose control and catheter care. Most data on PN-associated infection risk precedes implementation of protocols for glycemic control that are now common in the hospital setting and many of the infection control products and protocols now routinely used for catheter care. Current guidelines recommend the use of tunneled catheters or peripherally inserted central catheters (PICC) for central access due to the lower risk of infection. However, data for infection risk with PICCs is not specific to patients receiving PN. The objective of this study is to assess the incidence of PICC infections associated with PN infusions compared to PICCs not receiving PN in the inpatient setting with the current standard catheter care at an academic medical center.

Methods: Adult patients admitted to University of Arizona Medical Center - University Campus between January 1, 2011 and June 30, 2012 who received PN were included in the study. Patient's were excluded if they were under the age of 18 years, received PN through a line other than a PICC or had a documented PICC infection prior to PN administration through PICC. The incidence of PICC infection for patient's not receiving PN was provided by the Infection Prevention group at the University of Arizona Medical Center - University Campus. The CDC definition of healthcare-associated, central line-associated bloodstream infection event was utilized to define infections in both groups. Data was collected through a retrospective review of patients' medical records. Information was gathered to

further characterize the PN population including demographic data, PN information including caloric and lipid provisions, glucose control and outcomes.
Results: Of the 350 adult PN patients screened, 279 were included in the study. The median age was 59 and 52% of subjects were female. A total of 26 central line associated blood stream infections (CLABSI) were identified in PN patients during the study period. The CLABSI incidence was 5.5 infections per 1000 catheter days in PN patients compared to 4.5 infections per 1000 catheter days in patient's not receiving PN (CI: - 0.0012 to 0.0031).
Conclusions: The incidence of PICC infections was not statistically significantly different between the two study groups. This data suggests that there is not an increased risk of central line infections associated with PN administered through a PICC in the in-patient setting. The difference in infection risk from previous studies may be due to improvements in catheters themselves, catheter care protocols, and routine use of glycemic control protocols.

Poster Abstract of Distinction

27 - Vitamin E Added to Intralipid Positively Impacts Hepatic Bile Acid and Fatty Acid Homeostasis in TPN-Fed Preterm Pigs

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Purpose: Prolonged total parenteral nutrition (PN) may lead to cholestasis and parenteral nutrition associated liver disease (PNALD). The etiology of PNALD is unknown, but constituents of lipid emulsions may positively or negatively impact nuclear receptors involved in bile acid homeostasis (BAH) and steatosis. Plant phytosterols present in soybean oil-based lipid emulsions (e.g. Intralipid) have been suggested to negatively impact BAH by antagonizing the bile acid sensing farnesoid X receptor (FXR) and in turn its downstream targets. The fish oil-based lipid emulsion Omegaven, abundant in vitamin E and docosahexaenoic acid (DHA) yet devoid of phytosterols, may positively impact the nuclear receptors pregnane X (PXR) and peroxisome proliferator-activated receptor-alpha (PPARα) and their downstream targets thus protecting hepatocytes against bile acid and fatty acid homeostatic dysregulation. We investigated the serum and hepatic tissue bile acid biomarkers of liver injury, as well as target genes involved in BAH and fatty acid metabolism in TPN-fed preterm pigs given 4 different lipid emulsions.
Methods: Preterm pigs were assigned to receive 14 d of either, 1) TPN + Intralipid (100% soybean oil)(IL); 2) TPN + Intralipid + Vitamin E (ILE); 3) TPN + Omegaven (100% fish oil)(OV); or 4) TPN + Omegaven + Phytosterols (PS). The final vitamin E concentration in the ILE group equaled the concentration in Omegaven. The three principal phytosterols found in Intralipid (campesterol, β-sitosterol, & stigmasterol) were added to Omegaven in the PS group.
Results: Serum levels of direct bilirubin, ALT, GGT, triglyceride, LDL and hepatic triglyceride content were significantly lower ($P<0.05$) in the ILE, OV, and PS compared to IL pigs. CYP7A1 (bile acid synthesis) expression was lower ($P<0.05$) in the ILE, OV, and PS groups vs. IL. CYP3A29 and MRP2 expression (bile acid oxidation and canalicular bilirubin export, respectively) were higher in ILE, OV, and PS groups vs. IL. OSTα (bile acid efflux transporter) expression was lower ($P<0.05$) in the ILE, OV, and PS groups vs. IL. BSEP (canalicular bile acid export) was slightly lower in the ILE, OV, and PS pigs vs. IL. CPT1A and CYP2E1 (mitochondrial and microsomal fatty acid oxidation) were higher in ILE, OV, and PS vs. IL pigs. Addition of phytosterols to Omegaven did not induce evidence of liver injury. The findings suggest that supplemental vitamin E and DHA are associated with up-regulated expression of PXR and PPARα downstream target genes involved in bile acid and fatty acid metabolism andoxidation. These changes resulted in decreased bile acid synthesis and increased bile acid breakdown and canalicular bilirubin export; this triggered a compensatory down-regulation of the alternative bile acid export pathway (OSTα). Increased mitochondrial and microsomal fatty acid oxidation protects against hepatic triglyceride accumulation and steatosis.
Conclusions: Vitamin E and DHA found in greater quantities in fish-oil vs. soybean oil-based lipid emulsions may provide hepatocyte protection via activation of bile acid as well as fatty acid metabolic and oxidative pathways. Importantly, the supplemental vitamin E in the ILE group may have prevented the detrimental effects of abundant phytosterols.

28 - Implanted Infusion Port Experience in a Home Parenteral Nutrition Population

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Purpose: A central venous catheter (CVC) is required to infuse home parenteral nutrition (HPN). Non-tunneled, tunneled, and implanted CVC devices are all appropriate for HPN administration. Each device type has individual

characteristics and advantages. CVC selection should be determined by the therapy to be delivered and lifestyle of the patient. Infusion ports are placed under the skin in a subcutaneous pocket and accessed with a Huber needle for therapy administration. The infusion port is completely internal, providing a less altered body image compared to other CVCs. The aim of this study is to examine infusion port use and complications leading to infusion port failure in an HPN population.
Methods: Medical records from one home infusion pharmacy were reviewed from January 2006 - August 2013 for documentation of infusion port insertion, complications, and reasons for removal. Demographic data, HPN diagnosis, port lumens, placement location, dwell days, HPN infusion days, and number of accesses and by who, were also collected. A total of 54,159 infusion port days were included.
Results: Thirty five HPN patients had experience with 77 infusion ports. The majority were single lumen devices (88%) placed in the chest location (95%). Total infusion port dwell days were 54,159 ranging from 19 days to 3980 days. The average port dwell was 703 days, or about 2 years. The average patient age was 45 years and 51% were female. Short bowel syndrome accounted for 63% of all HPN diagnoses. Other diagnoses were dysmotility/pseudo-obstruction (31%), radiation enteritis (3%), and scleroderma (3%). HPN infusion days ranged from 3 - 7 per week, and most patients (73%) accessed once weekly and left the Huber needle in place with a securing dressing. Seven patients accessed 2 - 4 times weekly, and only 2 patients accessed the infusion port daily. Self accessing was done by 66% of the patients, otherwise a caregiver or nurse inserted the Huber needle. The overall complication rate associated with eventual removal was 1.05/1000 catheter days. These complications included: 27 catheter related bloodstream infections(CRBSI) at 0.5/1000 catheter days, 9 skin erosions, 7 occlusions, 6 subcutaneous pocket infections, 4 venous thromboses, and 4 septum leaks. In addition, ports were discontinued for other reasons, such as, discontinuation of HPN, death, dislike, and 2 unknown reasons. At the completion of this study period,12 infusion ports remained in place.
Conclusions: Infusion ports offer an option to HPN patients who have lifestyle considerations. In this group, 34% required a caregiver for Huber needle insertion. This is an important point for patients and families to explore prior to infusion port placement. The average infusion port lifespan in this group was only about 2 years compared with reports of tunneled catheters lasting 10 years and beyond. The overall complication rate requiring port removal was low at 1.05/1000 catheter days. CRBSI was the most frequent complication, but at a lower rate compared to other reports of CVCs used for HPN delivery. Infusion ports are an appropriate choice for HPN administration after a thorough evaluation is done with the medical team and patient. In this cohort, they offer a low complication rate, especially for CRBSI, but a shorter length of time in place.

29 - A Single Center Experience of Teduglutide for Intestinal Failure
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Purpose: Patients with intestinal failure (IF) survive with adherence to complex medical therapies including parenteral nutrition (PN) support; multiple medications to slow intestinal transit, reduce intestinal fluid losses, and vitamins/mineral supplements; and specialized diet plans. For many with IF life revolves around these therapies, but in particular the burdensome process of PN infusion. Until now there were few alternatives to PN, but the recent Food and Drug Administration approval of teduglutide creates potential for reduction of PN support. Teduglutide, a glucagon-like peptide 2 analogue, promotes intestinal villi growth, slows gastric emptying, and reduces intestinal secretions which results in increase of fluid and electrolyte absorption. The largest clinical trial with teduglutide showed 68% of patients who received teduglutide had a > 20% reduction in PN support and >1 day independence from PN infusions. However, "real world" experience using teduglutide outside of clinical trials is sparse. Also, criteria for teduglutide use is relatively undefined. The purpose of this study is to describe the experience of using teduglutide for the management of IF from the perspectives of patients and clinicians at a single academic tertiary referral center.
Methods: All patients who were assessed for initiation of teduglutide due to IF at The University of Chicago Medicine (UCM) were eligible to enroll in a Teduglutide Registry. Criteria used at UCM for teduglutide initiation are listed in Table 1. Patients agreeing to enter the Registry were included for analysis. Data was retrospectively collected from the medical chart of enrolled patients and included: anthropometric and laboratory data; PN volume, nutrient density and infusion data; and potential side effects from teduglutide. Practitioner and patient experiences related to initiation of therapy were summarized.
Results: A total of 28 patients with IF were assessed for teduglutide. Four of 28 (14.3%) patients were initiated on teduglutide and enrolled into the Registry (Table 2). Four other patients (14.3%) are in the screening phase with

intent to start teduglutide and 20 patients (71.4%) were not started due to active disease, malignancy, or declined therapy. The initial teduglutide dose was 0.05 mg/kg/d for all patients. On average, patients on teduglutide had a 68% decrease in weekly PN volume and a 72.8% decrease of weekly calorie input. Two patients were completely weaned off PN within the first 10 weeks of therapy. All patients experienced initial rapid weight gain with an average of 2.2kg in the first week of therapy that stabilized at an average of 1.3 kg gain with reduction of PN support. One patient experienced achy abdominal pain that resolved by the end of four months on teduglutide. One patient experienced stomal hyperplasia; the teduglutide was held for two days and resumed at a dose of 0.025 mg/kg/ without improvement. All patients willingly complied with weekly lab draws and urine collections. Clinician workload increased considerably during the screening period and first 12 weeks of therapy due to the need for close coordination of care.

Conclusions: The positive results of teduglutide therapy are likely the result of strict selection criteria at UCM. The screening and induction phases of teduglutide are labor intensive for both patients and clinicians, though the frequency of data collection and medication/PN adjustments lessen with time and ease the burden of care. Overall all patients in the teduglutide Registry report feeling well and are enjoying reduction/elimination of infusion therapy despite some physical side effects of therapy.

Table 1. UCM screening for eligibility to receive teduglutide.

	Criteria
Medical	PN dependence > 6 months Low volume and/or frequency of PN infusions Prefer those with some colon in continuity with the small bowel
Financial	Insurance approval Assistance with co-payment
Patient	Measure and report to clinician - weight and 48 hours urine output Agree to weekly blood draws and 48 hr collection or urine for at least 12 weeks, then monthly Willingness to receive daily injections
Clinical Coordinator	Coordinate eligibility between ordering provider, insurance payor, dispensing pharmacy, and the patient Schedule and record clinical data - laboratory results (CMP, CBC, Amylase, Lipase, Uric Acid, Vitamin/trace mineral levels), EKG, colonoscopy, and weight/ 48 hr urine output Communicate plan of care with other medication-prescribing physicians

Table 2. Clinical features and response of patients initiated on teduglutide.

Subject	Age	Gender	Underlying Disease	Remaining Bowel	Years on PN	Weeks on Teduglutide	Weight Change Week 1 (kg)	Total Weight Change (kg)	% Baseline PN Volume	Δ Infusion days/week
1	45	M	Crohn's disease	Partial small bowel & partial colon	32	26	1.4	2.3	0	-5
2	47	F	Ulcerative colitis + multiple small bowel surgeries	Small bowel to jejunostomy	5	17	2.3	0.9	33	-1
3	47	F	Crohn's disease	Small bowel to jejunostomy	3	16	0.9	2.3	0	-4
4	71	F	Ulcerative colitis + complicated ventral hernia repair	Small bowel with ileostomy	0.58	13	4.1	-0.5	40	-1

30 - Heparin Induced Thrombocytopenia in Hyperemesis Gravidarum

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Purpose: To assess the effect of heparin flushes on platelet counts in a Hyperemesis Gravidarum (HG) patient on Parenteral Nutrition (PN).

Methods: The term Heparin Induced Thrombocytopenia (HIT) refers to a decrease in the platelet count shortly after the start of treatment with heparin. HIT is underdiagnosed due to the following factors: clinically significant thrombocytopenia may not be present in all patients with HIT, thrombocytopenia in HIT is paradoxically associated with thrombosis, not bleeding, and thrombocytopenia may arise from many other causes in the hospitalized patient (1). The actual platelet counts in patients with HIT may not be as important as the occurrence of a platelet count of 30% to 50% from the patients baseline count.

Hyperemesis Gravidarum (HG) is a more severe form of morning sickness that results in dehydration, electrolyte imbalance, and a loss of > 5% of body weight. PN may be indicated in the following patients:

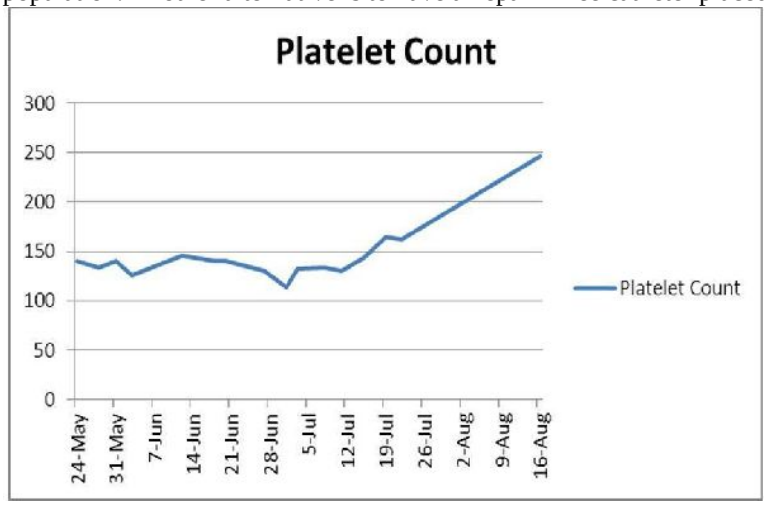
- severe HG persists and the patient loses weight over a period of 4 weeks or greater
- the patient has failed attempts of conservative therapy and enteral feeding
- persistent laboratory findings such as electrolyte abnormalities and hypoalbuminemia occur (2).

PN is often administered via a Peripherally Inserted Central Catheter (PICC). The protocol for caring for the PICC line requires that the catheter is flushed using normal saline and 3 ml of Heparin 10 units/ml after each catheter use, at least every 24 hours (3). The protocol used to care for the PICC was adjusted due to product availability to be Heparin 100 units/ml 3ml after each catheter use.

Results: A 25 year old female diagnosed with Hyperemesis Gravidarum who required PN was found to have decreasing platelet counts while undergoing therapy. The patient was referred to a home infusion provider for home PN therapy during her first trimester of pregnancy.

Upon admission to the home infusion agency, the patient's platelet counts were 140 thousand platelets per microliter. Hospital records indicate that heparin flushes were used while the patient was hospitalized prior to initiating home therapy. Over the next ten weeks, platelet counts continually decreased. On week 10 of therapy, platelet counts decreased to a low of 114 thousand per microliter. Heparin flushes were discontinued, only normal saline was used to flush the PICC line. Within one week of the discontinuation, platelets rose to 143 thousand per microliter, which translates to a 22% increase from lowest value obtained. After week 15, the patient's PN was stopped and nutrition was solely oral. The central line was then discontinued. Labs received on August 15th revealed a platelet count of 246 thousand per microliter, a 54% increase from the lowest value.

Conclusions: This case study displayed a probable connection between the use of Heparin flushes and low platelet counts. After the heparin flush was discontinued, platelet counts continued to rise well into the normal range, indicating a suspicion for HIT. A confirmed diagnosis for HIT could be obtained via a blood test, which would likely be at the expense of the patient. As an alternative, a heparin re-challenge to monitor platelet counts could be performed. Research into the cost versus benefit of eliminating heparin could support testing in this patient population. Another alternative is to have a heparin-free catheter placed, such as a Groshong.



31 - The Effect of Lipid Shortages and the Development of EFA Deficiency in Inpatient and Outpatients on Parenteral Nutrition

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Purpose: Our department was informed that all adult patients receiving PN would be lipid free for an unknown period of time. The ASPEN CORE Curriculum states that Essential Fatty Acid (EFA) deficiency may develop in 1-4 weeks of lipid free PN and that home patients may be at increased risk. The objective of this project was to assess EFA deficiency and adequacy of the current minimum lipid recommendations (500 ml of 20% lipids per week or 4%-10% of kcals).

Methods: Initial Red Blood Cell (RBC) and Plasma EFA panels were ordered on three inpatients that received lipid-free PN over a two month time period. An allotment of 250 ml of 20% lipids was procured to be infused twice a week for patients on lipid-free PN. A minimum of 5% of caloric needs from lipid was provided using hypocaloric, cycled CPN (when possible) to allow for release of endogenous fat stores. One patient advanced to a fat containing diet was not given ongoing lipid infusions in order to preserve the lipids for the NPO pts.

Results: All the initial RBC EFA panels were negative, indicating that any EFA Plasma deficiency developed short term. All Inpatients became EFA deficient as early as day 10. The minimum lipid recommendations were not enough to improve the EFA deficiency. The patient who was advanced to a fat containing diet showed a more pronounced EFA deficiency on recheck.

Conclusions: It appears that EFA deficiency may develop sooner than current literature suggests. Of the three Inpatients that had their plasma EFA panel repeat tested following therapy none showed improvement. These patients received from 5% to 8.9% of total calories from lipid or were advanced to fat containing diets. This indicates that the current recommendation of 4-10% of total calorie needs from lipid may be too low. The plasma EFA deficiency of the patient on the oral diet became more pronounced on recheck indicating that a diet ordered does not ensure adequate intake. All patients were on hypocaloric, cycled CPN, except the one advanced to an oral diet. This may indicate that cycling CPN and underfeeding may not be as helpful as previously thought. Alternatively, due to the malnutrition on admission, this patient population may not have had adequate endogenous stores available. To assess and contrast the relevance of this data on home patients, a further analysis of a small cohort of home patients is underway.

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32 - Nutrition Challenges of Technology-Dependent Children Admitted to Technology-Dependent Intensive Care Unit (TICU) at Children's Health Care of Atlanta

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Purpose: The main purpose of the study is to identify nutrition challenges of technology-dependent children admitted to Technology-Dependent Intensive Care Unit (TICU) at Children's Health Care of Atlanta.

Methods: The study comprised retrospective chart review of all patients admitted from May 2013-July 2013 in TICU after IRB approval. All patients admitted to Children Health Care of Atlanta undergo nutrition screening process by the RN/nutrition technician within 24 hours of admission. This information is documented in the electronic medical record (EMR) system. The nutrition screening criteria included nutrition history,medical diagnosis, growth parameters such as BMI greater than 95% with underlying co morbidities, weight/age less than 5% , BMI less than 10% on appropriate growth chart and unintentional weight loss. A positive response to any of these identifiers automatically triggers a nutrition intervention by a dietitian. Physicians also order nutrition consults in the EMR through several mechanisms. Nutrition consults are built into a number of standing order sets. When the order set is initiated by the MD, the nutrition consult is automatically sent to the clinical nutrition staff. The MD may also select a nutrition consult as a stand-alone order in the EMR. A drop-down box with reasons for the consult appears when the nutrition consult order is selected. The physician has the opportunity to select a reason from the list provided, type in a specific reason of their choosing or simply not select any reason for the consult.
The chart review goals were to: 1) quantify the patients receiving alternate route of nutrition support 2) determine what types of nutrition challenges TICU patients have to establish enteral feeds tolerance during hospital and 3) determine the average cost of enteral formula access at home for TICU patients. The inclusion criteria was all

patients admitted to TICU for three months May 2013-July 2013. Exclusion criteria included patients discharged in less than 48 hours of admission
Results: Sixty patients were admitted to TICU during three months. Four patients were readmitted during these three months period. All patients were screened for nutritional risk by RN and nutrition technician according to hospital screening policy, however only 39% of patients were consulted by MD for nutrition intervention by dietitian. The 86% of patients admitted to TICU were receiving enteral nutritional support. The 40% of patients were assessed as obese, 13% of patients were underweight and 47% of patients were appropriate when plotted using appropriate growth chart. Out of these 86% patients, majority (48%) of patients were receiving pediatric formulas, and 38% were receiving infant formulas.More than 50% of population was receiving elemental and home brew feeds due to feeding tolerance issues. The average length of stay of patients was 18 days in TICU. Majority (50%) of the patients had Medicaid, private insurance (16%) or both (34%) . On average monthly cost of the enteral formula was $377 ± 45 for infants, $594 ± 133 for pediatric and $290 ± 34 for older children. (Demographic data of study population will be presented at CNW 2014)
Conclusions: Discharging technology dependent children to their families includes careful monitoring of their nutritional needs. Nutrition health professionals need to collaborate with interdisciplinary members such as social workers and case managers to ease the financial burden of enteral feeds to patient's families. Nutritional professionals need to be trained about appropriate community resources available to support the families.

33 - High Volume "Bolus" Jejunal Feeding Infusion? No Way! Way!
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Introduction: "Bolusing," or high enteral nutrition (EN) infusion rates into the jejunum is not an accepted practice, yet there are early reports in the literature that counter this conventional wisdom. In fact, it is unclear where this clinical prohibition originated. Presented here are 4 cases of "pump bolus" or high jejunal infusion rates that were well tolerated by all patients.
Methods: Observational recording of 4 EN regimens of patients with PEG/J access devised of their own accord at home or with guidance of the author.
Case 1: 62 y/o M with necrotizing gallstone pancreatitis found to have esophageal CA at the time of ERCP. Esophageal resection followed by PEG/J placement was performed. Dysphagia persisted, and the patient required continued EN after discharge. Over time, to suit his lifestyle, he has arrived at the following regimen: 0600-0800: 1.3 cal/mL product @ 300mL/hr x 2 cans w/ 120mL water; 1000-1100 and 1300-1400 @ 300mL/hr x 1 can w/ 60mL water; 0700-2000 @ 210mL/hr x 3 cans.
Case 2: 43 y/o M with persistent encephalopathy of unknown etiology. A PEG/J was placed, due to emesis and aspiration pneumonia. The patient experienced periods of significant movement resulting in loss of multiple j-arms; it was determined that the patient would need short feeding "bursts" to meet nutrition and hydration needs. EN regimen: 1 can, 2 cal/mL product w/ 240mL water at 0500, 0930, 1400 & 1 can 1.5 cal/mL product with 240mL water at 1830 and 2300 @ 350 mL/hr; 75 mL water before and after each of the 5 feedings.
Case 3: 46 y/o M w/ Chiari malformation, quadriplegia, and tracheostomy (home ventilated). Pt did not like using a feeding pump, so he began the following gravity drip EN regimen: 1 can 2 cal/mL w/ 240mL water infused over 1.5 hours @ 390mL/hr at 0900, 1300, 1700, and 2100 with 150mL water at 390 mL/hr after each feeding.
Case 4: 35 y/o M w/ severe acute pancreatitis due to hypertriglyceridemia/EtOH abuse complicated by AKI, mechanical ventilation and ultimately PEG/J placement for a period of home EN. Patient advised he could increase his EN rate as tolerated to suit the hours he wanted to run. When he was seen in clinic for follow-up, the EN regimen he had developed was: 2 cans of 1.3 cal/mL product @ 275mL/hr from 1300 until all infused; then 6 cans @ 225mL/hr from 2200 overnight w/ 200mL water 5x/day.
Conclusion: Presented are 4 patients who successfully used high jejunal infusion rates to achieve nutritional and hydration requirements as well as weight goals. Bolusing the jejunum may be a viable option for select patients, although some may need to transition to this over time. Notably, while jejunal boluses are not common practice, patients who have undergone total gastrectomy in effect bolus their jejunum every meal; hence, why not bolus enteral feeding? It is an area ripe for study.

34 - Quality Indicators in Nursing Nutrition Therapy- Series of 5 Years in Brazilian Hospital
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Purpose: To ensure the effectiveness of decision-making process, organizations must have structured systems of reliable information, relying on the analysis of data to enable comparisons. The implementation of quality indicators in Nutritional Therapy (TN) is essential for the nurse's role, requiring continuous monitoring of processes in addition to providing data for the evaluation of care and ensure the human resource optimization and cost reduction. The objectives of this study were to compare the results of the 4 quality indicators of nursing in TN over the past 5 years and see if there was variation between sectors and causes major interference in the data.
Methods: A prospective and quantitative study was performed in a cardiology private hospital in the São Paulo city. We used information management tool called DocNix SCORE CARD for data collection and analysis of the results patients with Enteral and Parenteral Nutrition Therapy in the period 2009-2013.
Results: In this period were followed 49.034 patients. The " Index of Enteral Nutrition Infused " had global average of 78 % in 2009 with an increase to 86.6 % in 2013 and the Intensive Care Unit (ICU) was the sector with the greatest number of hours break. Regarding the indicator "Index Parenteral Nutrition Infused" in ICU and Pediatric Intensive Care Unit there was an average of 93 % in 2009 and 96 % in 2013, attributing improvements in the sector of the Pediatric ICU due to use intravenous access unique. Through the implementation of strategies to guide the preparation of medicines and enhancement of institutional training and on-site training, the "Loss Index Enteral Access" of 3.1 % in 2009 was reduced to 1.7 % in 2013. The "Rate Satisfaction regarding Educational Planning", newly created, remains with an annual average of 97 % between the years 2012 and 2013.
Conclusions: The use of quality indicators in Nursing Nutrition Therapy shows that the establishment of action plans were directed to the area of Pediatrics and product evaluation demonstrating its complexity and lack of specific materials. The actions implemented to manage risk in TN identified opportunities for improvement, being a dynamic and ongoing process to ensure the safety of those who receive and that administers therapy. The results showed is necessary revision of care protocols and readjustment strategies to one of the indicators that was below target. Through this study it was possible to verify the importance of quality indicators for the provision of information to improve nursing practice in nutritional therapy.

35 - The Use of an Enteral Nutrition Discharge Checklist to Enhance Patient Care and Help Streamline the Discharge Coordination Process
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Purpose: Discharge planning should begin at the time of admission. For patients on home enteral nutrition, coordination of care is multidisciplinary and requires clear communication between the hospital and the home care company providing the therapy. Ideally, enteral discharge orders should be comprehensive and detailed. When they are not, delay in discharge or service failure can result.
This study was done to evaluate the use of an enteral nutrition discharge checklist (ENDC) in helping to ensure a more seamless and timely discharge through the provision of detailed patient information. A retrospective review was used to compare and contrast the effectiveness of patient discharges to home with and without the use of the checklist. The goal of the checklist is to ensure that all critical details to complete seamless home enteral nutrition referral processing are sent to the home enteral provider from the referrer. Complete medical record information aids the provider to efficiently obtain payer authorization, coordinate home delivery, and initiate care in the home.
The ENDC also requires detailed treatment information that can be relayed to the home care provider. This information includes patient demographics, medical insurance details, enteral formula prescription with method of administration and estimated length of need, history and physical, and nutrition assessment. It also includes swallow evaluation if appropriate and available, product delivery information if different from home address, and enteral tube type and size.
Methods: A retrospective review was done of records for 100 random patients who were initiated on enteral care by a national home care company between May and July 2013. The 100 records were reviewed to assess whether discharge was delayed due to incomplete enteral orders, leading to inability of the home care company to service patients. Of the 100 patients, 51 were referred with the use of the ENDC, and 49 were referred without the use of the ENDC.
Results: For the 51 patients referred with use of the ENDC, 67% of the records were complete, and 33% were incomplete. For the 49 patients referred without use of the ENDC, 45% of the records were complete and 55% were incomplete. With regard to delay in discharge as a result of insufficient information, the ENDC group experienced a 6% delay, while the non-ENDC group experienced a 34% delay.
Conclusions: Due to a more complete record at the time of referral, the use of the ENDC to coordinate referral to a home enteral provider can promote a smooth and timely transition of care from an inpatient setting to the home, and

potentially prevent delay in discharge to home. Additional study needed to support the use of the ENDC includes analysis of the amount of time a referrer would spend to complete the tool, as compared to the amount of time a referrer would spend submitting insufficient documentation to a provider and then receiving multiple calls for additional information.

36 - Timing and Initiation of Enteral Nutrition Support and the Impact on Clinical Outcomes in Critically Ill Children: A Retrospective Single Center Case Review

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Purpose: To examine current practice with initiation and advancement of nutrition support within a single center, tertiary PICU for quality improvement and future development and implementation of enteral feeding protocols. The relationship to mortality and clinical outcomes with provision of nutrition support will also be examined.

Methods: We conducted a single center, retrospective chart review of infants and children (Ages 1 day to 18 years) with a PICU length of stay greater than 4 days. Nutrition support practices (equations, target calorie goals, and percent target calorie goals) were monitored for the first 4 days of PICU admission. Analysis included use of descriptive and comparative statistics including parametric and non-parametric analysis for continuous and dichotomous variables. For statistical significance, a p-value of 0.05 was selected a priori. This study was intended as an observational, retrospective analysis and no attempt to identify adequate sample size was performed prior to data collection. We used a convenience sample of all pediatric ICU admissions who met the inclusion criteria over a 12-month period. A total of 357 ICU patients were selected as part of the initial cohort. One hundred twenty one (121) patient were subsequently excluded from our analysis cohort for various reasons (nutritional support initiated prior to ICU admission n=101, patient > = 18 years of age at time of admission n=7, patient with Do Not Resuscitate orders present on admission n=3 and other n=10).

Results: After exclusions, 234 patients with a mean age 5.6 (SD 5.58, range 0.03-18) years and average weight of 23.2 kg (SD 22.1, range 2.5-120) were included in the study. Admission heights were only available for 45 of the 235 patients (19%) with a mean of 107 CM. (SD 42, range 52.1-183). Enteral nutrition (EN) was utilized in ~88% of all admissions with total parenteral nutrition (TPN) use of 12.9%. Nutrition support was initiated in 24% of patients on PICU day 1 and increased to 82% by PICU day 4. Of those who received nutrition support, 21% of target estimated intake was achieved on day 1 increasing to 71% on both days 3 and 4. Mortality was impacted most when patients were subdivided into cohorts receiving <34% of predicted target intake compared to those receiving > 34% target intake over the first 4 PICU days. Although not significant, results showed a possible association of greater odds of survival in those who received greater caloric intake over the first 4 days of admission with a decrease in mortality from 6.2% in the lower fed group to 2% in the higher fed group (OR 0.307, CI 0.05-1.453, P 0.207).

Conclusions: Early initiation and advancement of enteral nutrition has been shown to impact mortality and length of stay as well as improve clinical outcomes. Intake of a higher percentage of predicted target caloric intake was associated with a non-significant decrease in mortality. Further research is needed to develop standardized enteral feeding protocols for quality improvement and to optimize nutrition therapy in critically ill children.

37 - Impact of an Enteral Nutrition Protocol and Tutorial on Adherence to Nutrition Guidelines and Correlation with Outcomes

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[1]Intermountain Medical Center, Murray, UT; [2]LDS Hospital, Salt Lake City, UT; [3]MD Informatics, LLC, Carmel Valley, CA.

Purpose: The study aims were to assess the effectiveness of educational interventions on knowledge and adherence to nutrition guidelines; and evaluate if increased guideline adherence correlated with improved medical outcomes.

Methods: After IRB approval, this study was conducted within 6 intensive care units (ICUs) at 2 Utah hospitals. Study subjects were ICU clinicians, nurses, pharmacists and dietitians. Student's t-test was used to detect a mean difference in pre vs. post-test scores after viewing a tutorial that included guidelines to initiate early enteral nutrition [EN] (within 24-48 hours of ICU admission) and advance to goal within the subsequent 48-72 hours. Behavior change was indirectly measured by time to initiate and advance EN to estimated basal energy expenditure (BEE) using the Harris Benedict equation. ICU staff was blinded to the study of patient electronic medical record data, which was collected retrospectively for Phase 1 (baseline), and prospectively for Phase 2 (early EN protocol implementation) and Phase 3 (online tutorial). All enterally-fed patients were enrolled unless participating in another nutrition study or receiving an oral diet or parenteral nutrition. Although each ICU served as its own control, data

were combined by phase for statistical analysis that included generalized linear regression and multivariate logistic regression analyses to evaluate associations between independent variables and outcomes (nosocomial infection, mortality, and ICU and hospital length of stay [LOS]) while controlling for other factors when significant (age, APACHE, study phase, glycemic control [41-179 mg/dL], and use of nutrition supplements [IV antioxidant cocktail, oral glutamine and immune-enhancing formulas]).
Results: Of 526 ICU staff recruited, 235 volunteered to participate (63% were nurses, 19% MD/mid-level providers, 11% pharmacists, 6% dietitians and 1 unknown). There was a significant increase in knowledge gained from the tutorial with mean pre vs. post-test scores 56.3% ± 15.1% and 90.3% ± 19.0% respectively (one-sided p< 0.0001). Of 1,432 ICU patients enrolled, 1,222 were eligible after 210 were excluded due to inaccurate EN start time data. Mean time to initiate EN decreased from 46.5 hrs (baseline) to 41.4 hrs (protocol) to 34.5 hrs (tutorial) (p<0.0001). The proportion of patients receiving early EN increased significantly to 75.6% during the Phase 3 tutorial compared to Phase 2 protocol 66.8% (p=<0.01) or Phase 1 baseline 61.2% (p<0.0001) but not after implementation of the protocol alone (p=0.08). There was no significant difference in the percentage of patients that achieved BEE within the subsequent 48-72 hours during any Phase (Table 1). In patients who received early EN compared to late (> 48 hours), there was no significant difference in mortality (OR=0.995, 95%CI: 0.718, 1.379); however, the odds of developing a nosocomial infection were 16.5% lower (OR: 0.718, 95% CI: 0.538, 0.960), ICU LOS was 1.9 days shorter (p<0.0001) and hospital LOS was 1.9 days shorter (p=<0.01).
Conclusions: In this study, the use of an early EN protocol and online tutorial contributed to knowledge of nutrition guidelines and sequential changes in practice behaviors and reduced morbidity. This information is useful as audit and feedback to optimize quality of care; and emphasizes the benefit of education to supplement protocol implementation.

Table 1. Time to initiate EN and reach BEE in ICU by study phases (N=1,222).

		Baseline Phase 1 (n=484)	Early EN protocol Phase II (n=410)	Online tutorial Phase III (n=328)	Phase 2 vs. 1 p-value	Phase 3 vs. 2 p-value	Phase 3 vs. 1 p-value	Overall p-value
Early EN								
Time to initiate EN (hours)	Mean +/- Std	46.5 +/- 39.6	41.4 +/- 32.6	34.5 +/- 24.1	0.02	<0.01	<0.0001	<0.0001
Received EN within 48 hours	n/%	296/61.2%	274/66.8%	248/75.6%	0.08	<0.01	<0.0001	<0.0001
Reached BEE								
During ICU stay	n/%	244/50.4%	214/52.2%	167/50.9%	0.60	0.73	0.89	0.86
Within 48 hrs after starting EN	n/%	97/20%	76/18.5%	74/22.6%	0.57	0.18	0.39	0.45
Within 72 hrs after starting EN	n/%	165/34.1%	148/36.1%	128/39%	0.53	0.41	0.15	0.15
Hours to reach BEE	Mean +/- Std	66.5 +/- 50	65.3 +/- 44.3	60.9 +/- 49.5	0.78	0.38	0.25	0.50

38 - Enteral Nutrition Documentation: Manual Reporting Versus Automated Pump Tracking
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Purpose: The target Enteral Nutrition (EN) goal for calories and protein should be determined upon initiation of nutrition support therapy. While it is often difficult to provide 100% of the macronutrient goals by the enteral route, accurate reporting of EN delivery is necessary to assess adequacy of the nutrition support being provided.

Methods: The Registered Dietitians compiled data for patients receiving EN for at least 24 hours from January - March 2013. The adult inpatients studied were from many areas of practice, including critical care, trauma, medical, surgical, and inpatient rehab within a multi-hospital system. A retrospective analysis of the following data was completed: amount of EN ordered, amount of EN received, and method of data retrieval.
Results: A total of 287 patient days were included in the analysis. Data was retrieved by the feeding pump in 190 patient days (pump method). Data was retrieved by nursing documentation in 97 patient days (I&O method). In the 190 patient days analyzed using the pump method, the average amount of EN ordered was 1472 ml per day and the average amount actually received was 1318 ml per day (90% of goal). In the 97 patient days analyzed using the I&O method, the average amount of EN ordered was 1342 ml per day and the documented average amount received was 1010 ml per day (75% of goal).
Conclusions: In order to achieve the clinical benefit of EN, adequate calories and protein must be provided. Precise documentation of EN administration is needed to assess the impact of nutrition support. The use of automated pump tracking was shown to record higher amounts of EN delivery compared to manual reporting. Utilizing the automated pump data either directly or imported into the I&O record is warranted to accurately record EN delivery.

39 - A Justification for Early Enteric Feeding in the Open Abdomen: A Preliminary Study of Wound Management and Nutritional Status After Damage Control

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Purpose: Damage control laparotomies can be life saving for severe hemorrhage or infection; however the management of the open abdomen and subsequent induced catabolic state is associated with significant morbidity. Our institution has taken on a quality initiative of early enteric feeding in these critical patients, and the purpose of this study is to evaluate the impact of nutritional status on final wound management. Our study hypothesis is that early enteric feeding and superior nutrition status in the open abdomen is associated with high rates of definitive closure.
Methods: A retrospective analysis was performed on patients managed with open abdomens from January 2010 to January 2011. Thirty one patients were identified and n=15 were general surgery and n=16 were due to trauma. Patient demographics, APACHE II scores, injury severity scores (ISS), nutritional parameters, pneumonia rates, enteric fistulas, length of stay (LOS) and mortality was recorded. Wounds managed with definitive measures (primary fascia approximation or closure with biologic material), versus wounds managed with skin closure only or negative vacuum therapy were compared. The Fisher's exact test and the Student's t test were used for categorical and continuous data, respectively. A p value of < 0.05 was considered statistically significant.
Results: The mean age was 40 + 14. The ISS was 44+ 17 and APACHE II score was 15 + 5. The overall LOS was 41+31 days and mortality was 13%.
Conclusions: Damage control surgery was performed in a high risk cohort of general surgery and trauma patients. In this small series of patients; early enteric feeding and superior nutritional status were associated with high rates of definitive wound management. There was a trend towards improved mortality in the early enteric group but this did not reach statistical significance. Local wound complications and pneumonia rates were not impacted. More studies aimed at optimizing nutritional support in the critical surgical and trauma population are needed to facilitate superior outcomes.

Table 1. Comparison of Definitive Wound Management.

Open AbdomenManagement	Fascia Repair or Biological Mesh n= 21	Skin Closure or Negative Pressure Therapy n=10
Apache II	15 + 5	15 + 6
ISS	47 + 17	27 + 1
Days to enteral nutrition	4+ 2	8 + 4, p= 0.02
Prealbumin at one week	10 + 2	5 + 1, p= 0.002
Pneumonia rates	38%	50%
Enteric Fistula	28%	20%
Mortality	9%	30%

Encore: Previously presented at: Premiere Breakthroughs Conference and Exhibition. Published with permission of the authors

40 - Clinical and Economic Effects of the Use of Glycemia-Targeted Specialized Tube Feeding Formulas Among Patients with Diabetes in U.S. Hospitals

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Purpose: The purpose of the study was to compare the clinical outcomes and costs for diabetic patients tube fed glycemia targeted specialized nutrition (GTSN) versus standard nutrition (STDN) formulas during acute-care hospitalizations.

Methods: The study was designed as a retrospective analysis covering a 10-year period (2000-2009) of clinical and cost data from 54,892 adult tube-fed patients with diabetes mellitus (DM) from the Premier research database. Patients had been tube fed either GTSN or STDN formulas, as a component of comprehensive care for dysglycemia of varied causes (type 1 or 2 diabetes mellitus, secondary DM). To adjust for potential cohort imbalances, GTSN fed patients were matched with STDN fed patients with DM across many characteristics including age, gender, race, 3M™ All Patient Refined (APR™)-DRG illness severity, APR-DRG mortality risk and comorbidities using propensity scores that were computed via a logistic regression model. . Multivariable linear regression was used to estimate adjusted length of stay and costs, adjusting for propensity score, admission type, admission source, discharge status, nutrition duration, infection, and amputation. Hospital costs were adjusted to 2009 US dollars.

Results: GTSN tube fed patients with DM had nearly a 1-day shorter adjusted length of hospital stay (LOS) as compared to STDN tube fed patients (from 11.55 to 10.67 days, or a 0.88-day reduction [$p<0.0001$]). This translates to a 7.7% shorter LOS for patients who were tube fed GTSN versus STDN. Additionally, adjusted inpatient hospital episode costs were reduced significantly by $2,586 (from $26,769 to $24,383, $p<0.0001$) for GTSN tube-fed patients as compared to STDN tube-fed patients, which signifies a 9.7% reduction in episode cost.

Conclusions: Results support the use of GTSN tube feeding formulas in acute-care hospital settings as a vital component of comprehensive diabetes management.

41 - Identifying Predictors for Enteral Nutrition in Patients Undergoing Chemoradiation Therapy for Head and Neck Cancer

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Purpose: Previous research has identified improved outcomes from the use of prophylactic enteral nutrition (EN) in patients undergoing concurrent chemoradiation therapy (CRT) for head and neck cancer (HNC). Generally, decision for prophylactic tube placement is based on clinical judgment. The aim of this study was to determine tumor, treatment, patient, or nutrition factors that could be predictors for the use of enteral nutrition in patients undergoing CRT for HNC, and in turn better advise patients prior to initiation of therapy.

Methods: A retrospective study was conducted on 144 patients with Stage III or IV HNC receiving CRT at the James A. Haley Veterans' Hospital in Tampa, FL. The population was predominantly white males with a mean age of 61.8. Initial analysis examined relationships between predictor variables (tumor, treatment, patient, nutrition factors) and outcome variables (enteral nutrition required or not). Any relationships that met p value of .10 or less were further evaluated using logistic regression to determine which variables overall, significantly influenced the need for enteral nutrition.

Results: Of the 81 patients with feeding tubes (FT), 100% were dependent on FT as primary source of nutrition at the end of treatment. The initial analysis identified six predictor variables that were at least marginally significantly related to the requirement for enteral nutrition (see Table 1). These six were included in further analysis resulting in the following predictors ranked in order of highest significance: greater than 2% pre-treatment weight loss, 6 month pre-treatment BMI of <23, T4 tumor classification, and presence of tracheostomy.

Conclusions: Patients undergoing CRT for stage III and IV HNC are at high nutritional risk. Identifying predictors such as pre-treatment weight change, pre-treatment BMI, tumor classification, and tracheostomy status will allow clinicians to better advise patients on feeding tube placement, resulting in improved quality of life and prognosis.

Table 1: Correlations Between Tumor, Treatment, Patient, and Nutrition Related Factors and Requirement of Enteral Nutrition		
Category	**Factor**	**p value**
Tumor Factors	Cancer Site	0.428
	Cancer Stage	0.664
	T Stage	0.021*
	N Stage	0.845
Treatment Factors	Chemotherapeutic agent	0.361
	Radiation Dose	0.467
	Radiation Method	0.313
Patient Factors	Gender	0.698
	Race	0.347
	Age	0.859
	Presence of Social Support	0.513
	Tobacco Use	0.158
	Performance Status	0.782
	Presence of Tracheostomy	0.065*
Nutrition Factors	6 months Pre-Tx BMI <27	0.019*
	6 months Pre-Tx BMI <25	0.112
	6 months Pre-Tx BMI <23	0.016*
	6 months Pre-Tx % wt change > 3%	0.007*
	6 months Pre-Tx % wt change > 2%	0.006*

42 - Fluidity of a Slightly Viscous Enteral Formula (400mPa×s) Through Nasogastric Tubes

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Purpose: Enteral nutrition through nasogastric tubes (NG tubes) is commonly used both in hospital and nursing home settings. The flow rate of liquid formulas is managed by adjusting a clamp to the desired setting or by employing a continuous feed pump. Flow rates through NG tubes are expected to be closely related to viscosity, but there are few enteral formulas that are only slightly viscous because of difficulties in controlling a formula's properties. We hypothesized that a formula of specific viscosity could pass through conventional NG tubes without the need for clamps or enteral feeding pumps. Thus, we investigated the fluidity of a slightly viscous enteral formula (SV-EF) through NG tubes.

Methods: The viscosity of the SV-EF was 400mPa×s (catalogue specification) which is more viscous than typical liquid enteral formulas. The SV-EF was packaged in a plastic, ready-to-use container (220 ml, 400 kcal). Outflow time and outflow volume of the SV-EF were measured with a 120-cm extension tube (JMS, Japan) and NG tubes with five different external diameters (8, 10, 12, 14 and 16 Fr., 120 cm length). Two separate experiments were conducted to measure outflow time and outflow volume. Experiment 1: Outflow time through the NG tubes was measured at several height levels (100 and 120 cm for 8 Fr. tube; 80, 100 and 120 cm for 10 Fr. and 12 Fr. tubes; 60, 80 and 100 cm for 14 Fr. and 16 Fr. tubes). Experiment 2: Outflow time through a 10 Fr. NG tube was measured at heights of 60, 80, 100 and 120 cm and the outflow volume at each respective height was measured.

Results: The outflow time of the SV-EF through the NG tubes varied from about half an hour to over 180 minutes (Table 1). The larger the external diameter of the NG tube was, the shorter the outflow time of the SV-EF. The lower the height of the end of the NG tube was, the longer the outflow time of the SV-EF. The outflow time was determined by the diameter of the NG tube and the height of the end of the NG tube. The outflow time of SV-EF through the 10 Fr. NG tube was 152±15 min. at 60 cm, 96±6 min. at 80 cm, 72±8 min. at 100 cm and 62±2 min. at 120 cm. The variation of these outflow time values was within 10%, which is the same as that of enteral feeding pumps. The outflow volume of the SV-EF increased linearly with administration time (Figure 1).

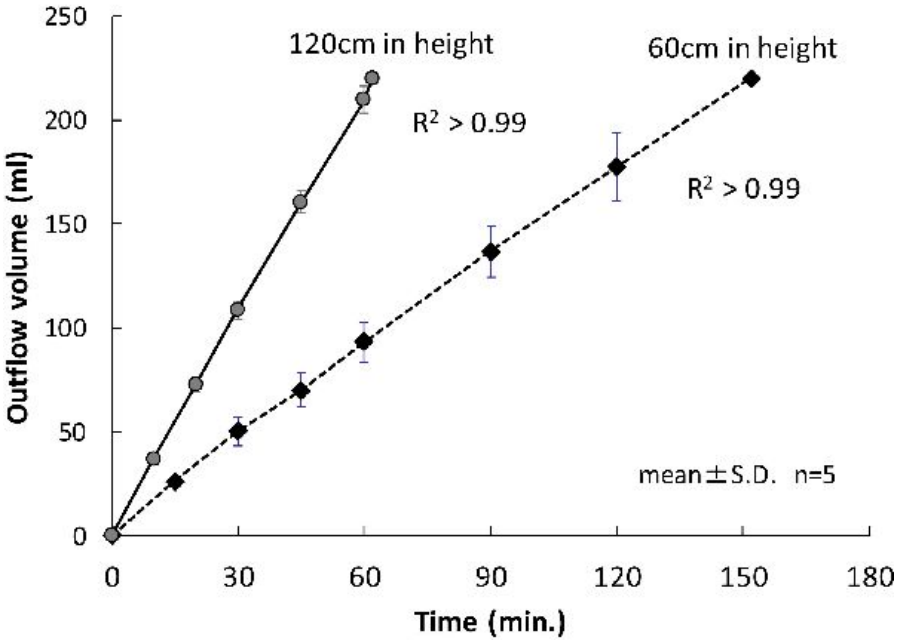
Conclusions: This slightly viscous enteral formula, with a viscosity of 400mPa×s, passes through NG tubing (8 to 16 Fr.) using the gravity drip method in 0.5 to 3 hours. By selecting the NG tube size and height of the upper end of the NG tube relative to the lower end, a simpler and safer feeding method over conventional methods is expected using this slightly viscous enteral formula.

Table 1. Outflow time (min.) of SV-EF through NG tubes

	External diameter of NG tube				
	8 Fr.	10 Fr.	12 Fr.	14 Fr.	16 Fr.
Height					
120 cm	153±27 [a]	70±15 [a]	38±3 [a]	—	—
100 cm	194±22 [a]	95±26 [a]	47±5 [a]	32±2 [b]	26±1 [c]
80 cm	—	134±30 [a]	66±7 [a]	44±1 [b]	34±1 [c]
60 cm	—	—	—	68±6 [b]	59±7 [c]

a: mean±S.D. of 5 trials b: mean±S.D. of 4 trials c: mean±S.D. of 3 trials

Figure 1. Outflow volume of SV-EF through a 10 Fr. NG tube



43 - Dietary Restriction Affects Peyer's Patch Lymphocyte Numbers and Intestinal Immunoglobulin A Levels

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Purpose: The intestine is the largest immune organ in the body. Lack of enteral nutrition is well known to cause gut associated lymphoid tissue (GALT) atrophy. However, oral intake of food may also impair gut immunity, when the amount is insufficient. In this study, we employed a murine model to examine the influences of dietary restriction on Peyer's Patch (PP), an inductive site of gut mucosal immunity, lymphocyte number, subpopulations and intestinal immunoglobulin A (IgA) levels.
Methods: Male ICR mice were randomized to ad libitum (AD, n=5), mild restriction (MR, n=8) and severe restriction (SR, n=10) groups. The AD, MR and SR groups received chow amounts of 170, 119 and 68 g/kg/day, respectively. After 7 days of feeding, whole small intestines were harvested. Lymphocytes from PP were isolated and counted. Their phenotypes were analyzed with flowcytometry (CD4+, CD8, αβTCR+, γδTCR+, B220+). IgA levels in small intestinal washings were also measured.
Results: Total lymphocyte number, B220+ lymphocyte cell numbers and IgA levels of intestinal washings were decreased, as was body weight, with the degree of dietary restriction (DR). CD4+ and αβTCR+ cell numbers were reduced only in the SR group as compared with the AD group. No marked changes were observed in the CD8+ or γδTCR+cell number.
Conclusions: DR reduces PP lymphocyte cell numbers, particularly that of B cells. The B lymphocyte number decrease and the degree of DR were closely related, leading to intestinal IgA reduction. These phenomena may be important mechanisms underlying impaired host defense due to malnutrition.

		PP lymphocyte numbers				
	Body weight change (g/body)	total ($x10^6$/body)	CD4+/CD8+ ($x10^6$/body)	αβ+TCR/γδ+TCR ($x10^6$/body)	B220+ ($x10^6$/body)	Intestinal IgA (μg/ml)
AD	7.0±1.9	34.1±2.7	4.9±0.7/0.5±0.1	5.9±1.1/0.13±0.02	22.6±2.8	28.9±3.1
MR	-4.6±1.1*	21.8±3.1*	4.6±0.7/0.5±0.1	5.2±0.8/0.18±0.04	12.2±1.8*	20.6±3.8
SR	-8.7±0.6*†	9.8±1.7*†	2.5±0.5*†/0.3±0.1	2.8±0.5* †/0.08±0.02	5.7±0.7*†	14.7±2.8†

Means±SE, * $p<0.05$ vs. AD, †$p<0.05$ vs.MR ANOVA

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44 - The Use of Objective Structured Clinical Exams as a Means to Develop Clinical Skills in Dietitians
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Purpose: Objective Structured Clinical Exam (OSCE), an educational technique using patient simulations to test medical students' competence and knowledge application of clinical skills, is common in medical schools, but rarely used in dietetics education. OSCEs have also been used as a learning activity to allow clinicians to apply core concepts and practice skills with expert feedback. Cleveland Clinic incorporated OSCEs into a comprehensive education program aimed at training the health system's registered dietitians to diagnose malnutrition using the new Academy of Nutrition and Dietetics / ASPEN guidelines. The purpose was to demonstrate dietitian acceptance of this educational format and describe OSCE efficacy as a means to introduce nutrition-focused physical exam skills and apply knowledge of new malnutrition criteria.
Methods: Ninety-four registered dietitians and dietetic interns completed the malnutrition education program at the Cleveland Clinic Multidisciplinary Simulation Center over a period of seven months (11/2012-5/2013). Each learner read selected articles, attended a lecture series, participated in hands-on sessions focusing on nutrition-related physical exam skills, then rotated through three OSCE stations representing different states of malnutrition. Learners were expected to diagnose the etiology and degree of malnutrition and determine micronutrient deficiencies for each scenario. Learners were evaluated by a trained observer who used a standardized checklist to evaluate performance and provide immediate feedback. Learners then completed a survey to rate their experience. The learners were privy to the understanding that this experience was introductory, and that as dietetics professionals, were expected to continue honing their newly learned skills through workplace practice or supervised sessions.

Results: The overall program as good or excellent by 94% (n=81) of participant surveys using a 5 point scale. Eighty-five (97%) participants rated the effectiveness of the feedback sessions as good or excellent. There was no significant difference in this data when participants were grouped by years of experience, specialty area, or the date of OSCE completion.
Before training, participants judged their ability to diagnose malnutrition and to identify micronutrient deficiencies lower compared to their perceived abilities post-education. 89% of participants felt their ability to diagnose malnutrition improved after the program; 88% of participants felt this way about identifying micronutrient deficiencies.
While 85% of learners rated their ability to diagnose malnutrition as good or excellent after the training, 61% correctly identified the etiology and degree of malnutrition for at least two of three scenarios (24% did so correctly on all three scenarios). Similarly, 82% perceived their ability to detect micronutrient deficiencies as good or excellent after the training, 65% correctly identified deficiencies in both scenarios.
Conclusions: Most learners rated OSCEs, particularly the live feedback aspect, as an effective teaching method to learn the designated key concepts. Furthermore, most learners rated their capability to identify malnutrition and micronutrient deficiencies as improved after completing the training. However, the learners self efficacy was not necessarily reflected in their OSCE performance.

45 - Perceptions and Attitudes Surrounding Pharmacy Students and Dietetic Interns Pre- and Post-Nutrition Support Lecture

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Purpose: The health care system in the United States is a dynamic and fluid environment. It demands the education and training of health care professionals keep pace with the ever changing promotion and delivery of health care. The health care professional faces many challenges, including the provision of care despite limited resources. The interdisciplinary health care team comprised of a diverse group of professionals offers efficient and effective patient-centered care. Does the concept of team work need to be addressed in the education of health care professionals? The purpose of the study was to evaluate an interdisciplinary teaching model that combined faculty and students from the USJ School of Pharmacy and Department of Nutrition and Public Health. The study focus was to determine if a nutrition support lecture to a group of pharmacy students and dietetic interns influences the perceptions and attitudes of pharmacy students to dietetic interns and vice versa.
Methods: Following informed consent, a survey was distributed to pharmacy students and dietetic interns attending a joint lecture on nutrition support in the adult population. The class consisted of a 90 minute lecture on enteral nutrition and a 60 minute activity with a randomized group of five pharmacy students and one dietetic intern per group. In the afternoon session, the pharmacy students and dietetic interns heard a 90 minute lecture on parenteral nutrition and participated in a 60 minute group activity in the assigned group. At the conclusion of the day, the same survey was distributed and completed by the students. A total of 50 surveys were completed pre and post nutrition support lecture on class day. The survey focused on the students' attitudes and perceptions toward enteral and parenteral nutrition, nutrition support teams and each others future profession.
Results: Students responded to 11 questions focused on EN, PN and health care teams (Table 1). Results of the survey were averaged pre and post lecture for each question. The post lecture data indicates an increase in the student's belief that knowledge of EN and PN and working on a health care team is important as a student and a future practitioner. Respondents identified the likelihood of consulting another health care professional in future practice pre and post lecture (Table 2). Results for enteral nutrition indicated that the likelihood of consulting a pharmacist increased, a physician or nurse decreased and a dietitian remained unchanged post lecture. Results for parenteral nutrition indicated that the likelihood of consulting a pharmacist or dietitian on parenteral nutrition remained unchanged post lecture. The likelihood of consulting a physician or nurse on parenteral nutrition decreased post lecture.
Conclusions: Historically, health care professionals have been educated and trained in courses and practicums that are limited to that particular discipline. Cooperative learning may serve as a model to promote successful teamwork by future practitioners. Results of this study, although limited, indicated that the perceptions and attitudes of pharmacy students and dietetic interns appear to be impacted by the combined teaching model. The findings of this study suggest that future pharmacists and dietitians may consult each other as practicing professionals. Further studies that include other health care students, such as nursing, are warranted to identify teaching methods that cultivate respect between different health care disciplines and successful health care teams. Such studies may reveal

a more clear connection between cooperative learning and developing positive perceptions and attitudes toward other health care professionals.

Table 1. General attitude toward health professionals working in the field of enteral and parenteral nutrition.

Question	Pre Lecture 1=Strongly Agree 5=Strongly Disagree Average Result	Post Lecture 1=Strongly Agree 5=Strongly Disagree Average Result
Knowledge about enteral nutrition is important to me as a student/future practicing health professional	2.68	1.62
Knowledge about parenteral nutrition is important to me as a student/future practicing health professional	1.535	1.534
More combined lectures of student health professionals should be included in my school's curriculum	2.1	2.0
Working with other student health professionals in a classroom will improve my interactions with health care professionals when I enter the job market	1.92	1.61
In my future practice, I will likely consult other health professionals to offer best practice to my patients	1.51	1.23
Understanding the role of different health professionals such as a nurse, dietitian or pharmacist is essential to my future practice	1.6	1.465
Working with other professionals on a nutrition support team or another type of health care team is threatening to me	3.82	3.55
Working with other nutrition support professionals will increase time spent per patient	2.58	2.6
As a future practicing health professional, working on a team will complicate my job	3.6	3.9
Working with other health professionals as a team improves the quality of patient care	1.48	1.25
In my future practice, I would like to work in the area of enteral and parenteral nutrition	3.0	3.75

Table 2. How would you approach other health care professionals in your future practice?

Question: Would you consult the following on any aspect of Enteral Nutrition?	Pre Lecture 1=Not Likely 5=Very Likely Average Result	Post Lecture 1=Not Likely 5=Very Likely Average Result
Consult a pharmacist	3.64	3.85
Consult a physician	3.75	3.58
Consult a dietitian	4.3	4.3
Consult a nurse	3.65	3.58
Question: Would you consult the following on any aspect of Parenteral Nutrition?	Pre Lecture 1=Not Likely 5=Very Likely Average Result	Post Lecture 1=Not Likely 5=Very Likely Average Result
Consult a pharmacist	4.01	4.01
Consult a physician	3.92	3.8
Consult a dietitian	4.1	4.1
Consult a nurse	3.65	3.58

46 - Cost of Delivering Parenteral Nutrition (PN) Therapy to Hospitalized Patients in a Nonprofit Community Hospital

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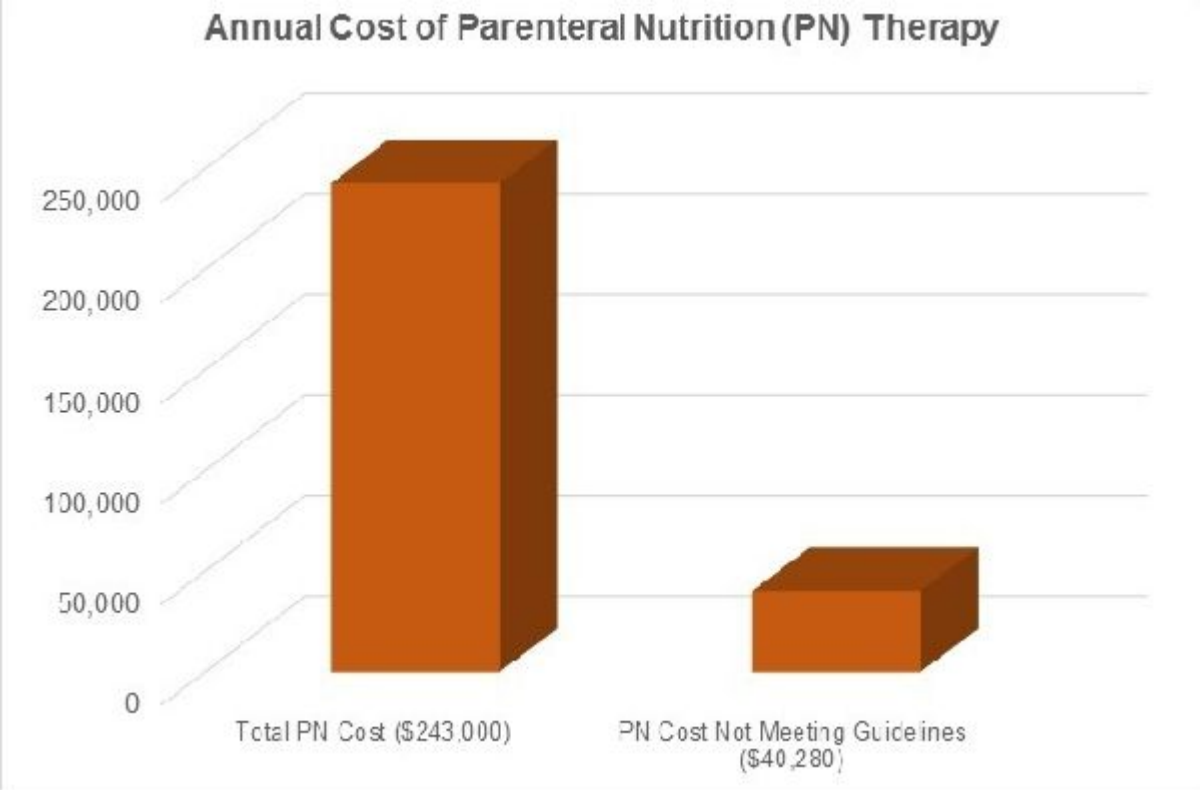
Nutrition and Food Services Department/Pearlman Comprehensive Cancer Center, South Georgia Medical Center, Valdosta, FL.

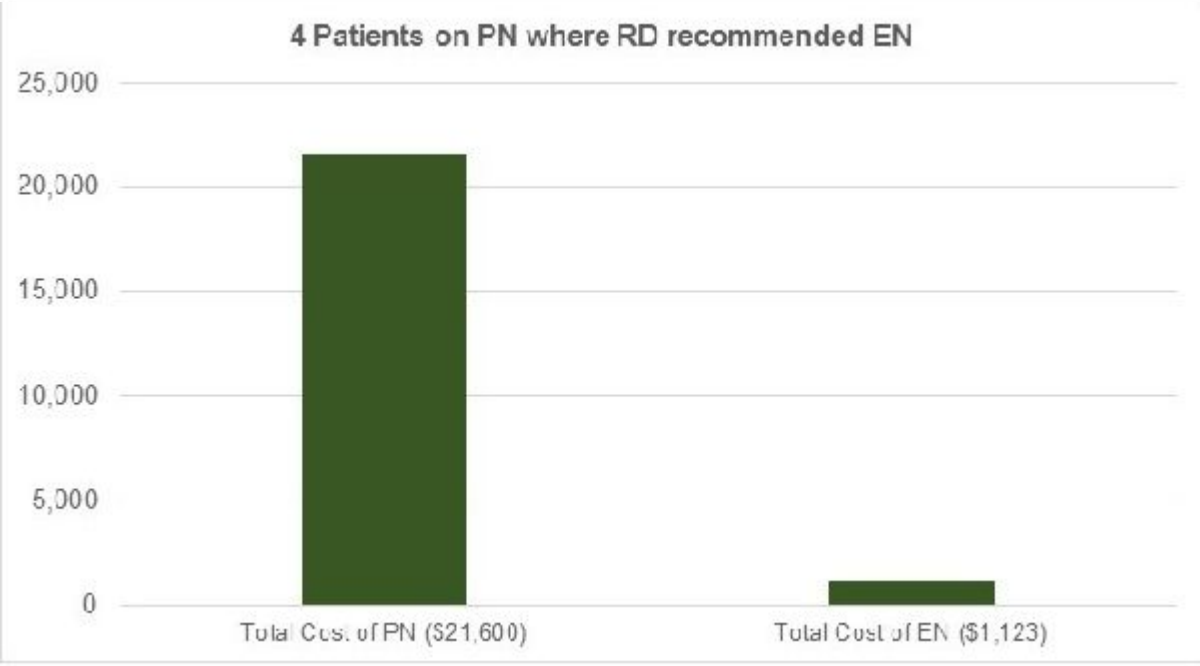
Purpose: When a patient is unable to tolerate adequate or any amounts of nutrition by mouth, they may need supplemental or full source nutrition using specialized nutrition support (SNS). There are two different routes of SNS either parenteral nutrition (PN) or enteral nutrition (EN). The American Society of Parenteral and Enteral Nutrition (ASPEN) has specific guidelines for the indication and use of PN/EN. Research has shown that with the use of PN there is not just an increase in hospital costs, but also risk in infection. With the appropriate use of PN, hospitals can decrease unnecessary costs and risk of patient complications. The objective of this quality improvement study is to determine the costs incurred of PN therapy of hospitalized patients in a community based non-profit hospital, and to look at possible processes that could help with unnecessary costs.

Methods: The registered dietitian (RD) performed a retrospective cohort study, looking at all patients who received PN while inpatient for one quarter (February 1, 2013-April 30, 2013). All patient data was analyzed looking at the type of PN received, length of time on PN, medical diagnosis, reason for PN, length of stay (LOS), enteral nutrition recommendation per RD, new infections, patient outcomes, and hospital charges for PN (materials and pharmacy labor to make) and EN (materials).

Results: There were 45 patients included in the analysis. A total of 556L of Central Parenteral Nutrition (CPN), 25L of Peripheral Parenteral Nutrition (PPN), and 581L of total PN therapy provided. 92L of CPN (16.5%) and 4L of PPN (16%) did not meet ASPEN guidelines for PN therapy. The average length of time a patient spent on PN therapy was 7.5 days, with the range of time being 1 to 25 day(s). The average hospital LOS was 17.4 days, with the range of admission being 3 to 41 days. 18 patients (40%) had EN recommendations from the RD, and 4 of those patients (9%) did not meet the guidelines to be on PN therapy. The average patient received 1.7L of PN a day, which correlates to an average of 13L of PN for the average 7.5 days of PN therapy. 4 patients (9%) developed an infection while inpatient. Patient admission diagnoses varied from abdominal/gastrointestinal (GI) to general medical conditions. Reason for a patient placed on PN therapy varied as well from different GI related surgeries to a patient being uncooperative. Out of the 45 patients included in the analysis 21 (47%) discharged home, 7 (16%) died, and 3 (7%) left the hospital with hospice. The cost for the hospital to make 1L of PN is $17 plus $150 for pharmacy to prepare; averaging about $180 a day for 1.7L of PN. This cost does not include lab monitoring, nursing administration, line placement, and RD/pharmacy management. The average cost of the same amount of caloric content of EN is $10 a day.

Conclusions: The data collected correlates to hospital PN costs of $243,000/year; $40,280 (17%) of total PN costs did not meet ASPEN Guidelines for PN therapy. These costs do not include lab monitoring, nursing administration, line placement, and dietitian/pharmacy management. 4 patients on PN did not meet ASPEN Guidelines for PN therapy, but had EN recommendations from the RD. These patients PN therapy cost $21,600/year, where EN would have cost $1,123/year; this shows a 95% reduction in cost if EN was used. With the creation of a SNS protocol this can help patients receive the right nutritional therapy regimen. Many hospitals are creating Nutrition Support Teams (NST) to help facilitate a SNS protocol, which consists of a multidisciplinary team with a physician, RD, pharmacist, and RN. This can help reduce unnecessary costs of nutrition therapy, decreased LOS, decreased infection, and improved outcomes.





47 - A Case for the Use of Beta-Hydroxy Beta-Methylbutyrate (HMB) in Addition to Medical Nutrition Therapy in the Debilitated Patient With Chronic Obstructive Pulmonary Disease

Gigi C. Farrell, Honors Applied Human Nutrition BSc Post Graduate Dietetic Internship

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Purpose: We report a case of a de-conditioned patient with chronic obstructive pulmonary disease (COPD) who successfully gained strength and independence using HMB in addition to medical nutrition therapy.
A 69-year-old male with a history of COPD/asbestosis, hypertension, coronary artery and peptic ulcer disease was admitted to the Intensive Care Unit (ICU) with a gastrointestinal bleed (Hb 50g/l), and a non-ST segment elevation myocardial infarct. The history provided by the patient and his wife confirmed his normal habits were bed to chair activity using a walker, minimal food intake and excessive alcohol consumption, with trend of weight loss over the past year. Nutritional assessment findings were consistent with severe malnutrition. Our goal was to improve strength for rehabilitation and discharge.
Within 24 hours of ICU admission due to his shortness of breath a two calorie formula tube feed was initiated at goal, with 750 mg HMB twice daily (as directed by manufacturer). By day four he was successfully weaned from tube feeds to a No Added Salt diet with a two calorie enteral formula medication pass (med pass) and HMB. On follow up he was having no difficulty eating > 50% of meals, meeting his estimated requirements with the med pass. The fifth day after admission the patient was transferred to a medical unit. By day six he was no longer short of breath and by day eight he was ambulating independently around the unit with his walker. The patient's wife reported enthusiastically that he had made surprising gains in strength and independence.
COPD is a chronic inflammatory end-stage disease responsible for frequent "all cause" readmissions to acute care, contributing to length of stay (LOS) as well as alternate level of care (ALC) days in Canada and the USA. One study reported that the nutraceutical, HMB resulted in anti- inflammatory and anticatabolic effects on ICU patients with COPD. Other studies report improvements in strength and lean muscle mass in patients with chronic inflammatory diseases. Using HMB in addition to standard medical nutrition therapy we observed our patient gain strength and increase ambulation distance independently above reported baseline, quickly and without rehabilitation therapy.
HMB may enhance the effectiveness of medical nutrition therapy, improving strength and functional ability in the debilitated patient with COPD. Additional research is needed to address this relationship given our observations and the contribution of COPD to acute readmissions, LOS and ALC days.

Encore: Previously published in Clinical Nutrition Vol 32 Supp 1 Sept 2013; previously presented at ESPEN 2013.
Unable to attend CNW.

48 - An Audit of the Dietetic Management of Refeeding Syndrome in a Dublin Teaching Hospital
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49 - Fish Oil–Based Fat Emulsion (FOFE) for Treatment of Essential Fatty Acid Deficiency
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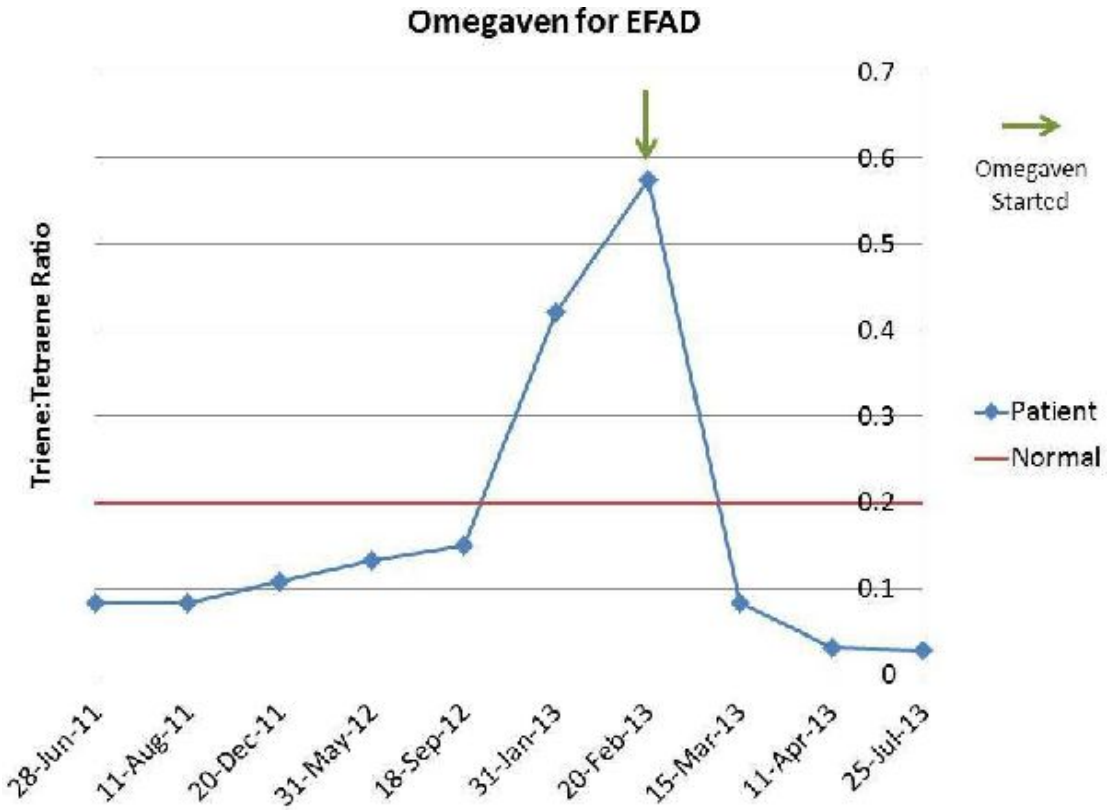
Purpose: A nine year old male presents with multiple diagnoses including mitochondrial disorder, hypothyroidism, chronic steroid dependence, osteopenia, eosinophilic gastroenteropathy, intestinal dysmotility, colectomy with right end ileostomy and parenteral nutrition (PN) dependence. He was unable to receive IV Intralipid (soy based fat emulsion) due to a reported allergy and was receiving canola oil 20-24 ml/ day via the jejunal port of his gastro-jejunal tube. His fatty acid profile reported from an outside institution showed an abnormal triene:tetraene (t:t) ratio of 0.08 (nl 0.013-0.05). Serial labs over demonstrated an increasing t:t ratio, but still below the level of true deficiency defined by a ratio >0.2. After an episode of severe pancreatitis in August 2012, he developed recurrent abdominal pain with enteral canola oil as well as signs of fat malabsorption. A stool elastase was 127.9 (normal= 200- >500) demonstrating slight to moderate exocrine pancreatic insufficiency. Pancreatic enzymes were not an option given reported pork allergy. Enteral canola oil was discontinued and reintroduction attempts failed. Five months later, he developed essential fatty acid deficiency with a t:t ratio of 0.421.
Given prior case reports in the literature1 and our own experience with Omegaven (FOFE); Fresenius) for intestinal failure associated liver disease, we obtained an emergency compassionate use IND from the FDA and Stanford IRB approval to administer FOFE to this patient. After parental consent and patient assent, we started the FOFE under a desensitization protocol in our pediatric intensive care unit given concerns for soy and fish allergy. The patient received test doses of 0.25 gm/kg then 0.5 gm/kg then 1 gm/kg which was treatment dose. No reactions were

documented. Within one week significant changes were noted in his t:t ratio (0.574 decreased to 0.083) and the t:t ratio corrected to normal (0.031) in five weeks. He continues to tolerate FOFE without any difficulties and has had a sustained resolution of his essential fatty acid deficiency.
The FOFE that is currently available in the US may be a safe alternative source of lipid for complex patients who are unable to receive enteral or standard intravenous soy based fat emulsion due to allergy. Although administration requires FDA and IRB approval, fish oil-based fat emulsion can provide essential fatty acids.
1. Gura, K., Strijbosch, R., Arnold, S., McPherson, C. & Puder, M. The role of an intravenous fat emulsion composed of fish oil in a parenteral nutrition-dependent patient with hypertriglyceridemia. Nutr. Clin. Pr. Off. Publ. Am. Soc. Parenter. Enter. Nutr. 22, 664-672 (2007).



50 - Advance Directives in Patients With Amyotrophic Lateral Sclerosis (ALS) on Home Enteral Nutrition
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Purpose: Many patients with amyotrophic lateral sclerosis (ALS) go home on long term home enteral nutrition (HEN). Because HEN may prolong the dying process, advanced directives (ADs) are essential in outlying patient medical care preferences. We are unaware of previously published studies examining the prevalence and specific details of AD in patients with ALS on HEN
Methods: Institutional review board (IRB) approval was obtained prior to conducting this retrospective study. Medical records of all patients with ALS who received HEN at Mayo Clinic (Rochester, Minnesota) were studied. Inclusion criteria were: Age > 18 years, research authorization, newly started on HEN between January 1, 2005 and December 31, 2012. We abstracted the prevalence and contents of ADs in these patients.
Results: During the study period, 161 patients (men, 47%) were newly started on HEN for ALS. Mean age (SD) of

the cohort was 69 (12.6) years. A total of 139 (86%) patients were Caucasian, 22 (14%) were of other races. Overall, 91 patients (56%) had ADs. A total of 81(58%) Caucasians had ADs and 10 (45%) of other races had ADs(p = 0.35). A living will was found in 12 (13%) patients, and power of attorney in 25 (27%) patients. A total of 36 (40%) patients had mentioned HEN in their ADs. CPR/ACLS was mentioned by 28 (31%) patients, mechanical ventilation was mentioned by 21 (23%) patients, dialysis in 7 (8%) patients, and pain management in 42 (46%) patients. Home was the preferred place of death in 21(23%) patients, hospice in 1 (1%) patient and unknown in 67 (74%) patients. A total of 80 (88%) patients completed ADs by themselves, 11 (12%) with others.
Conclusions: Our results suggest that about 60% patients with ALS have ADs. The management of nutrition specifically HEN was mentioned in less than half of these patients. Nutrition specialists must do a better job in assisting patients and their families consider ADs when starting HEN. Clear ADs in ALS patients can assist families and medical providers with written instructions regarding medical care preference when patients are unable to make decisions. Having ADs can help reduce confusion and disagreement over nutrition support at the end of life.

51 - Advance Directives in Patients on Home Parenteral Nutrition
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Purpose: Home parenteral nutrition (HPN) can be a lifesaving treatment for patients with intestinal failure. HPN is not without risk which can include sepsis, thrombosis, renal failure, and death. Advanced directives (ADs) are written instructions regarding patient medical care preferences which can guide physicians and family members when patients are unable to make healthcare decisions. We are unaware of previous studies examining the use of ADs in patients on HPN.
Methods: Following the institutional review board (IRB) approval, we conducted a retrospective review of the medical records of all patients who were newly started on HPN at Mayo Clinic (Rochester, Minnesota) between 2003 and 2012. We determined the prevalence and contents of ADs in these HPN patients.
Results: During the study period, 561 patients (men, 53%) were newly started on HPN (mean age [SD] at HPN initiation, 53.4 [15.3] years). Overall, 166 patients (30%) had ADs. Mean age (SD) of those with ADs were 57.4 (14.3), those without ADs were 51.8 (15.3), p <0.001. A total of 506 (90%) patients were Caucasian, 55 (10%) were of other races. A total of 157 (31%) Caucasians had ADs and 9 (16%) of other races had ADs, p = 0.028. Various clinical characteristics of patients with and without ADs are presented in table 1. Of those patients with ADs (n=166) a living will was found in 32 (16%) patients, power of attorney in 57 (28%) patients, combined (living will and power of attorney) in 94 (46%) patients. A total 78 (47%) patients had HPN mentioned in their AD, 88 (53%). CPR/ACLS was mentioned by 47 (28%) patients, was not mentioned in 119 (72%) patients. Mechanical ventilation was present in 45 (27%) patients, not present in 121 (73%) patients; dialysis was mentioned in 21 (13%) patients, not mentioned in 145 (87%) patients.
Conclusions: Our results suggest that only about one in three patients newly started on HPN have ADs. And among the patients who have executed ADs; only less than 50% patients mention management of HPN in their ADs. Furthermore, our results showed that older patients on HPN were more likely to complete ADs and that Caucasians were more likely to have ADs completed compared to other races. Our study suggests that nutrition support providers should do a better job at encouraging patients and families to clearly state their medical care preferences in ADs when on therapies with risk of unexpected complications such as HPN. Having clear ADs may prevent end-of-life ethical dilemmas related to HPN and its continuation.

	All Patient x	Subgroup		
Characteristic[1]	**(N = 561)**	**With AD (n=166)**	**No AD (n=395)**	**P Value**
Hypertension				<001
Yes	201 (36)	80 (40)	121 (60)	
No	360 (61)	86 (24)	274 (76)	
Dementia				.09
Yes	11 (2)	6 (55)	5 (45)	
No	550 (98)	160 (29)	390 (71)	
Diabetes mellitus				.007
Yes	124 (22)	49 (40)	75 (60)	

No	437 (78)	117 (27)	320 (73)	
COPD				.12
Yes	54 (10)	21 (39)	33 (61)	
No	507(90)	145 (29)	362 (71)	
Palliative Care				.12
Yes	25 (5)	11 (44)	14 (56)	
No	536 (95)	155 (29)	381 (71)	

Poster Abstract of Distinction

52 - Incidence of Feeding Intolerance in Adult Patients on Parenteral Nutrition Managed With a Protocol to Advance the Energy Prescription According to Refeeding Risk

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Purpose: Refeeding syndrome (RS) is defined as organ dysfunction accompanied with shifts in fluid, electrolyte, and mineral metabolism upon initiation of nutrition support in moderately to severely malnourished patients. The benefits of a protocol to identify patients at risk for RS along with guidelines for the initiation and advancement of parenteral nutrition (PN) goals are largely unknown. Our standard of care is to stratify patients according to refeeding risk along with a feeding strategy to advance the energy prescription to goal in three days in normal risk patients and four to five days in refeeding risk patients if PN is tolerated. The objective of this study is to determine the efficacy of refeeding risk screening criteria following initiation and management of PN.

Methods: This single-centered retrospective study involved adult patients who initiated PN from January 2012 through October 2012 at Vanderbilt University Medical Center. The study was IRB approved. Exclusion criteria consisted of home PN dependence, age less than 18 years, PN initiated at an outside institution, renal replacement therapies, or incomplete serum electrolytes at baseline (within 72 hours of PN initiation). Patients were stratified into three categories (severe, moderate, or normal) based on their refeeding risk adapted from the NICE Guidelines (www.rcseng.ac.uk) (Table 1). The primary endpoint was occurrence of feeding intolerance (FI) which was defined as a 25 percent decrease in two of three serum electrolytes (potassium, magnesium, and phosphate) during the first seven days of PN. Secondary endpoints were daily electrolyte changes, number of days needed to achieve goal calories, and mortality.

Results: One-hundred eighty-five adult patients were started on PN, 85 were excluded, and 100 were included in the chart review. Of those reviewed, 39 patients were determined to be at moderate (n = 17) or severe (n = 22) risk of developing RS. FI only occurred in the normal feeding tolerance group (n = 4). There was no significant difference in electrolyte changes between any risk groups from baseline to day 7. Fewer patients at refeeding risk achieved goal energy requirements over the first seven days of PN therapy compared to patients at normal feeding tolerance (69.2 vs 83.6%, p = 0.02). It took patients at refeeding risk longer to achieve goal energy requirements compared to patients with normal feeding tolerance (5.07 ± 1.59 vs 4.02 ± 1.26 days, p = 0.0019). Mortality occurred in two patients (one with normal and one with severe refeeding risk); however, these events were independent of PN.

Conclusions: This modest sized retrospective study demonstrated refeeding syndrome did not occur when patients are stratified for refeeding risk using modified published guidelines and a feeding strategy based on this risk is utilized. Interestingly, FI was only seen in normal feeding risk patients. As expected, energy goals took longer to achieve in patients at refeeding risk. While gradual energy advancement may contribute to the patient's negative energy deficit, more rapid calorie advancement would subject the patient to the adverse consequences of the refeeding syndrome. Further study is needed to see if more rapid energy advancement can be safely undertaken.

Table 1. Screening Criteria

Severe Refeeding Risk	Moderate Refeeding Risk	Normal Feeding Tolerance
Patient has 2 or more of the following:		
• BMI < 16 kg/m^2 • Unintentional weight loss ≥ 15% within the last 3 – 6 months and/or ≥ 10% within the last 1 month • Little or no nutritional intake for > 10 days • History of recent alcohol abuse	• BMI 16 – 18.5 kg/m^2 • Unintentional weight loss ≥ 10% within the last 3 – 6 months and/or ≥ 5% within the last 1 month • Little or no nutritional intake for > 7 days • History of recent alcohol abuse	• BMI > 18.5 kg/m^2 • Minimal recent unintentional weight loss (< 10% within the last 3 – 6 months and/or < 5% within the last 1 month) • 50% of normal intake within the past 7 – 10 days • No history of recent alcohol abuse

53 - Home Parenteral Nutrition Order-Writing Practices: Advancing Role of the Registered Dietitian

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Purpose: Formulation of parenteral nutrition (PN) orders, including both macro- and micronutrient dosing, is an emerging role for Registered Dietitians (RD) in home infusion. Over the past decade, there has been a progressive expansion in the scope of nutrition support practice by RDs, specifically including PN order-writing. Nutrition support teams (NST) were developed in order to provide safe and comprehensive care of the PN patient. These teams typically consist of a physician, pharmacist, nurse, and a RD. Historically, physicians were responsible for PN orders and management in home infusion, despite minimal training with PN. However, a shift is being seen with more PN orders being written by RDs and RD-led NSTs. It has been shown that RDs with order-writing privileges may decrease inappropriate PN use and costs. To review PN order-writing roles and responsibilities at a home infusion company over a 5 year period.

Methods: A retrospective review of PN patient medical records was conducted at a home infusion office. Patients 18 years of age and older and started on PN between January 1, 2009 and August 1, 2013, were evaluated. At PN initiation, communication was made with the physician associated with each patient to determine their preferred method of PN management. The physician chose from one of three options: 1) RD responsible for writing the PN order, 2) Physician responsible for writing the PN order, and 3) Collaborative PN order-writing between the RD and the Physician. Data were collected on PN management type (RD, MD, or Collaborative), physician specialty, total number of days on PN, and patient demographics.

Results: A total of 399 patients were started on PN therapy during the review period. The number of RDs writing orders for PN in home infusion increased from 66% in 2009 to 89% in 2012 (Table 1). In addition, data for the first half of 2013 indicates RDs are writing new PN orders 94% of the time. Physicians more likely to request RD-managed PN were Gastroenterology (41%) followed by Hematology/Oncology (26%) (Table 2). Collaborative management and physician management were observed primarily in the areas of Internal Medicine and Gastroenterology. Outcomes reported an average decrease of 69 PN days per patient from 2009 to 2012. Patient demographics remained stable throughout the review period.

Conclusions: Parenteral nutrition order-writing is an advancing role for RDs and RD-led NSTs. Currently, more than 90% of new home PN prescriptions are being managed by RDs. Continued research is needed to determine the effect of RD-managed PN in home infusion on patient outcomes, including days on PN and occurrence of re-hospitalizations.

Table 1: Parenteral nutrition patient characteristics according to year from 2009 to 2013					
YEAR	2009	2010	2011	2012	2013
# PN[a] Starts (n)	90	66	79	110	54[b]
Management (n,%)					
Registered Dietitian	59 (66.0)	45 (68.0)	63 (80.0)	98 (89.0)	51 (94.0)
Collaboration	14 (16.0)	11 (17.0)	8 (10.0)	7 (6.0)	2 (4.0)
Physician	12 (13.0)	6 (9.0)	0 (0.0)	3 (3.0)	0 (0.0)
Pharmacist	3 (3.0)	3 (4.5)	2 (2.5)	1 (1.0)	0 (0.0)
Never Obtained	2 (2.0)	1 (1.5)	6 (7.5)	1 (1.0)	1 (2.0)
Average PN Days (days)	142	91	98	73	36.2
Average BMI[c] (kg/m^2)	24.4	23.5	25.6	24.7	25.0
Average Age (years)	53	62	51	53	51
[a] parenteral nutrition					
[b] The year 2013 represents January 1st through August 1st 2013					
[c] body mass index					

Table 2: Physician specialty according to parenteral nutrition management type						
	Gastroenterology	Surgery	Internal Medicine/ Family Medicine	Hematology/ Oncology	Obstetrics/ Gynecology	Other (Cardiology, Nephrology, Urology)
Collaborative[a] (n=40)	9 (23)	7 (17)	16 (40)	7 (17)	1 (3)	0 (0)
Physician[a] (n=21)	9 (43)	1 (5)	8 (38)	2 (9)	0 (0)	1 (5)
Registered Dietitian[a] (n=265)	109 (41)	17 (6)	58 (22)	69 (26)	5 (2)	7 (3)
[a] Data presented as, n (%)						

Encore: Previously presented at the ASHP Mid-Year Clinical Meeting 2013. Published with permission of the authors.

54 - Unusual Cause of Oral Intolerance and Need for Parenteral Nutrition

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Background: Tonsillectomy is generally considered a benign procedure with minimal risks. As the age of the patient increases, so do the risks associated with this procedure. This case reports discusses a 41 yo patient that developed hyperactive dysfunction syndrome of the cranial nerves post compression after tonsillectomy. Patient presented with severe nausea and vomiting with significant dehydration after swelling reduced the week after surgery.

The post-operative course initially was benign and marked only by extensive swelling. As the swelling reduced, and by day 4 post op, patient had developed extensive vomiting and the inability to swallow and keep down any oral intake. By day 9, patient had lost 9 pounds and was having significant issues associated with dehydration. Patient was admitted on day 10 and hydration initiated. Due to patients rapidly dropping protein and concerns about impact on other conditions, nutrition support was needed. PICC line was placed day 18 and parenteral nutrition (PN) initiated day 19. By this point, patient had lost 19 lbs (> 10% usual body weight). A full work up by gastroenterology offered no explanation for the severe nausea and vomiting. Antiemetics offered imited benefit. After 2 weeks inpatient, the cause of the nausea and vomiting was still not determined and patient was discharged on PN with further outpatient workup.

The clinical course has been marked by continued vomiting with oral intake, sensation of swelling in throat, back of tongue not seating evenly in the mouth and taste disturbances. Swallowing difficulties are lessened but continue with gagging, nausea and ear pain upon swallowing. Testing was conducted and it was determined the pharyngeal gag

reflex was hyperactive and swallowing uncoordinated. GI testing also showed inconsistent motility and mild inflammation. Working diagnosis became cranial nerve dysfunction of cranial nerves 9 and 10. The therapeutic course included multiple trials of oral intake, antiemetics (parenteral, oral and transdermal), IV steroids and Gabapentin to reduce the inflammation and neuropathy associated with the syndrome. Improvements seen after steroids and gabapentin confirmed the diagnosis.
Upon literature review, very little information was found on cranial nerve dysfunction syndrome and no cases required PN. Some of the cases required enteral therapy. In our patient, due to the significant amount of retching with vomiting and current anticoagulation therapy for a different diagnosis, enteral feedings were not considered a safe option for the patient.
Patient is currently 3 months from surgery and still requiring PN. Current oral intake is approximately 200-300 kcal per day. Patient continues to vomit when eating more than 2-3 ounces of food or liquid at one time, moves too quickly after eating, consumes more than 1-2 ounces protein at one time or chews in the back of the mouth. Patient continues to be maintained on anti-emetics and gabapentin. Botox injection to the nerve was considered but deferred at this time. Additionally, patient uses viscous lidocaine prior to eating when hyperactivity is increased. Goal is to continue to slowly advance diet with the help of medications and discontinue PN once able to maintain oral intake. Gabapentin will be continued until nerve irritation resolves.
This case presents an unusual neurological etiology for severe nausea and vomiting. Often when a gastroenterology workout does not determine cause, patients can be told to "wait it out" or that it is due to "stress". This case demonstrates how additional workup and medication trials may be indicated. Instead of managing with anti-emetics, further pharmacologic intervention was needed with steroids and gabapentin.

55 - Suspected Refeeding Syndrome in a Noncompliant Parenteral Nutrition Patient

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Background: Refeeding Syndrome is comprised of a set of symptoms which may present at or near the initiation of nutrition support when parenteral nutrition (PN) is started aggressively in malnourished patients. The syndrome is characterized by the presence of physiologic symptoms such as neurological, cardiovascular or gastrointestinal conditions, muscle weakness, edema, hypoxia and metabolic acidosis or alkalosis and laboratory abnormalities such as decreases in phosphorous, magnesium and potassium and increases in glucose. We present a case that demonstrates the potential for refeeding syndrome to occur during therapy secondary to noncompliance resulting in malnutrition.
Patient DS is a 61 y/o female with Ischemic Bowel Disease and is status post multiple resections. DS has been receiving PN from a national home infusion provider since 2005. Upon initiation of PN, DS weighed 73 kg and was 65 inches tall. The initial PN formula provided 100 gm AA (1.36 gm/kg) and 1800 kCal in 2070 ml total volume. During her initial therapy, she had minor therapy adjustments based on oral tolerance and lab results. While on therapy her weight declined to 58 kg and she was referred to another prescriber to evaluate her ongoing nutritional decline.
In June 2012, due to an enhanced clinical focus of the home infusion company, a clinical case review was performed. During this review, patient assessments and clinical evaluations were studied. After case conference, a discussion occurred with the patient where she detailed her symptoms and concerns. It was determined that the patient may have previously been verbalizing compliance and the lack of side effects, however was actually infusing portions of bags, missing days of therapy and experiencing adverse effects. Over the latter duration of therapy her noncompliance may have led to malnutrition based on the reported decreases in weight to 42.5kg, total protein of 5.7 gm/dL, albumin 3.3 gm/dL, prealbumin 9 mg/dL, magnesium 1.2 mg/dL, phosphorus 3.2 mg/dL and potassium 3.9 mMol/L with symptoms of severe cramping in her feet and hands with possible tetany and reported parathesias, swelling in face and lower extremities, muscle weakness, diarrhea and generally "feeling weird and off" during attempted PN infusions. DS affirmed her desire to continue on PN as ordered and maintain communication with the pharmacy team. At this time, a "mild" PN formula was re-introduced which provided 40 gm AA (1 gm/kg) and 850 kCal. The formula was advanced gradually to meet overall nutritional goals and increase tolerance.
Since re-formulation, DS has gained 4.5-6 kg (up to 49.5 kg). Labs are normalizing with prealbumin and total protein (14mg/dL, 6.6gm/dL), albumin (unchanged), magnesium (1.7 mg/dL), phosphorus (3.9 mg/dL) and Potassium (5.1 mMol/L). Clinically DS is no longer experiencing the adverse effects discussed above.
This case demonstrates the importance of ongoing clinical and laboratory assessments in patients receiving long term PN as the potential for complications always exists during therapy. Close communication between the patient and clinical team coupled with detailed clinical monitoring are the keys to successful outcomes in the long term

patient population.

56 - Inaccurate Assignment of Malnutrition ICD-9 Codes to a Sample of Malnourished Patients

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Purpose: The International Classification of Diseases, Ninth Revision, or ICD-9, assigns codes to hospitalized patients in the U.S. These codes were originally created to assist in determining mortality statistics; the codes now play a role in billing services, often submitted to both private and public insurance companies for institution reimbursement. Interestingly, limited codes are available to define malnutrition. The purpose of this observational study was to determine frequency of use of ICD-9 codes in a population of malnourished hospitalized patients.
Methods: A convenience sample of 1371 patients admitted to a large, urban academic medical center was used as part of a QI project. Expedited approval was obtained from the institution's IRB. Subjective Global Assessment (SGA) was performed; patients with an SGA score of B or C were deemed malnourished. Charts were reviewed after discharge to determine assignment of ICD-9 codes. Codes relating to malnutrition are outlined in Table 1.
Results: A total of 441 (32%) patients had SGA scores of B or C, indicating mild-moderate or severe malnutrition. Of these patients, only 40 (9%) received codes relating to malnutrition; the most common coding was "loss of weight," "anorexia," "adult failure to thrive," and "unspecified protein-calorie malnutrition". As seen in Table 1, only 9 unique codes were used to identify malnutrition; the ICD-9 code for "kwashiorkor", "other severe malnutrition", and "malnutrition of a moderate degree" were not utilized.
Conclusions: A very small percentage of patients identified as malnourished were coded as such. Further education may be required to ensure facilities receive maximum reimbursement for nutrition-related diagnoses. Additionally, standardizing the definition of malnutrition would assist in continuity among health care institutions and improve overall reimbursement.

Table 1. ICD-9 Codes, information, and number of patients with each code of patients identified at risk using a novel screening tool.

ICD-9 Code	Code Information	Number of Patients with Code
260	Kwashikor	0
261	Nutritional Marasmus	3
262	Other severe malnutrition	0
263.0	Malnutrition of a moderate degree	0
263.1	Malnutrition of a mid degree	1
263.2	Arrested development following protein-calorie malnutrition	0
263.8	Other protein-calorie malnutrition	0
263.9	Unspecified protein-calorie malnutrition	5
780.94	Early Satiety	1
783.0	Anorexia	6
783.21	Loss of Weight	23
783.22	Underweight	1
783.7	Adult Failure to Thrive	5
799.4	Cachexia	1

57 - Estimating Protein Needs of the Acutely Ill Hospitalized Patient

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Purpose: Since the initial observations of Cuthbertson over 80 years ago, it has been known that critically ill patients have an increased need for protein. The catabolic rate of muscle and nitrogen loss are loosely associated

with the degree of hypermetabolism. Improvements in the balance between protein catabolism and synthesis appear to be driven by protein intake. Current clinical guidelines recommend protein intakes of 1.2 - 2.0 g protein/kg of actual body weight. These ranges of protein intake, when calculated for an individual patient, are so wide and non-specific that the guidelines become meaningless. We sought to compare the existing guidelines for protein intake to the actual needs as determined from the measured urinary urea nitrogen (UUN) and to examine the relationship between clinical characteristics and the UUN.
Methods: A retrospective medical record review of 75 patients followed by the Nutrition Support Service who received parenteral or enteral nutrition and had a 24 hour UUN analysis was conducted. Exclusion criteria were: patients with hepatic failure, renal failure, small bowel fistula, stage III or IV pressure ulcers, hyperthyroidism or patients taking an oral diet in addition to parenteral or enteral nutrition. Descriptive statistics were calculated for continuous variables of age, height, weight, body mass index (BMI), ideal body weight (IBW), UUN, urine creatinine, creatinine height index (CHI), C reactive protein, fibrinogen, and protein needs. Protein needs were estimated by adding 6 gms of nitrogen to the measured UUN and multiplying by 6.25. Frequency distribution was used to describe the categorical variables of gender, race, medical diagnosis, ventilator status, SOFA score and APACHE II score. The relationship between variables was assessed using a correlation matrix. Predictor variables were identified. Multivariate ANOVA was performed to develop a predictive model commencing with variables which were significant at the 0.10 level. Data analysis was performed using Minitab.
Results: The mean patient age was 66.7 years, 97% were male and 84% were Caucasian. The most common primary medical diagnoses were: gastrointestinal surgery 48%, small bowel obstruction or ileus 19%, cardiovascular surgery 9% and sepsis 9%. The mean(SEM) weight at time of UUN analysis was 88.9 kg (2.59), admission weight was 88.3 kg (2.58), BMI 28.1 (0.74), UUN 10.8g (0.43), urine creatinine 1001.4 mg (44.9), CHI 0.59 (0.02) and APACHE II score 9.2(0.47). The mean estimated protein need was 105.3g protein/d (1.24 g protein/kg actual weight). The variables which most significantly contributed to the prediction of UUN excretion were location, CHI and APACHE II score. A predictive model of UUN excretion was developed where UUN g = 7.46 - 3.03 (location) + 6.36 (CHI) + 0.15 (APACHE II) which has an R2 of 29.7 and a correlation coefficient of 0.6. While the model is highly significant ($p<0.001$), it is not predictive of actual nitrogen requirements.
Conclusions: UUN excretion appears to be a stochastic process with a wide distribution and is difficult to predict. Use of existing guidelines to estimate protein needs will just as likely underestimate as well as overestimate needs. To accurately predict the protein needs of an individual patient, actual measurement of UUN is preferred.

58 - Hospital Bed Scale Weight Accuracy
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Purpose: Weight trends are important for nutrition assessment and medical monitoring of fluid status. Weight changes are an easily identifiable criteria for identifying malnutrition. Severe malnutrition criteria includes weight losses of >2% in 1 week, >5% in 1 month, >7.5% in 3 months, and >10% in 6 months. Hospitalized patients are weighed on various scales throughout their in-patient stay and recorded weight changes are at times not explainable by either hydration or nutrition. This has led to a lack of trust of weights, in particular bed scale weights. The goal of this study was to assess the accuracy of patient weights on properly zeroed bed scales as compared to standing scale.
Methods: Clinical Partners (nurse assistants) were asked to measure planned patient weights twice, on the zeroed bed scale (Stryker Go Bed II - Model FL28EX, accuracy +2% up to 227 Kg) immediately before or after weight on digital standing scale with arm support (Scaletronix, model 5002). Patients were not to eat or go to the bathroom between the two weight measures. Bed items were to be the same as for a new admit per usual practice. The beds are 4 to 6 years old and receive recommended maintenance.
Results: Thirty nine measurements were obtained on 10 days from 18 beds, up to 4 measures on different days per bed. Maximum patient weight was 120 Kg.
Zeroed bed scale weights compared to standing scale weight ranged -14.9 to +2.2 Kg. Absolute discrepancies or errors (all data made positive) ranged 0 to 14.9 Kg (0 to 16.2%), mean 2.3 Kg (3.2%), median 1.0 Kg (1.3%). Using significant weight changes as per criteria for malnutrition:
Errors of >10% occurred in 2 measures (5%) from 1 bed (5%).
Errors of >7.5% occurred in 7 measures (18%) from 4 beds (22%).
Errors of >5% occurred in 10 measures (26%) from 7 beds (39%).
Errors of >2% occurred in 15 measures (38%) from 9 beds (50%).
For medical monitoring of hydration status in vulnerable patients (e.g., CHF) a weight change of 1 Kg represents 1

L fluid change. In this survey, measurement errors of over 2 Kg were common (33%) and errors of over 5 Kg were not uncommon (15%).
Conclusions: Hospital bed scale weights may not be sufficiently accurate for nutrition and medical monitoring. In our experience bed scales should be used only in cases where weight cannot be obtained from a standing or other more accurate scale. Suspected weight changes based on bed scale measures should be validated by an alternate method if possible.

59 - Patients With Decubitus Ulcers Have Scurvy; Starting Vitamin C at First Signs of Chronic Scurvy Prevents Pressure Ulcers

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Purpose: Collagen is one third of all formed protein in the body. Unlike other mammals that convert glucose into vitamin C, humans and guinea pigs cannot. Pre-collagen requires vitamin C to hydroxylate proline and lysine. Hydroxylation then allows three collagen threads to cross link and twist forming a strand stronger than a strand of steel of the same diameter. The purpose of this study is to observe the relationship between Scurvy and pressure ulcers
Methods: A total of 229 nursing home patients with pressure wounds from two different facilities (facility A= 139; facility B= 90) were referred to the wound care service. The wound consult consisted of a physical exam to document the location and stage of pressure wounds as well as inspection for the oral and cutaneous signs of micronutrient deficiencies. Chronic scurvy was diagnosed as a thinning of the dermis, particularly on the dorsum of the hand, purpura and skin tears. A plasma vitamin C was determined at consult and monthly thereafter. Micronutrient supplements, including 1gm vitamin C were started.
Results: All patients from facility A had signs of scurvy, with a plasma vit C level below normal. (Normal=0.4 to 2.0mg/dl) By stage: II=0.10; III=0.30; IV=0.27; III/IV=0.11mg/dl (Figure 1). Vitamin C by decade of life: 50's=0.18; 60's=0.39;70's=0.80;80's=0.36; 90's=0.34mg/dl. Plasma vit C over time: Initial=0.34; 30d=0.44; 60d=0.42; 90d=0.43 mg/dl (Figure 2). To have a plasma C result of zero (0mg/dl) was not unusual. Facility B: Since it was established that all patients with pressure wounds had a vitamin C deficiency in facility A, micronutrient supplements were started if the admission skin assessment documented signs of scurvy. In 9 months, the incidence of institution acquired pressure wounds in facility B decreased from 8 to10 to 0 to 2.
Conclusions: It takes time to accrue a total body collagen deficit. It happens as the daily intake of vitamin C fails to meet requirements for collagen turnover. Severe deficits are obvious on physical exam and should start aggressive supplements to treat/ prevent pressure ulcers. Scurvy is a consistent finding in patients with pressure wounds. therefore, starting vit C supplements at 500mg BID appears to play a significant role in healing and prevention.

Figure 1

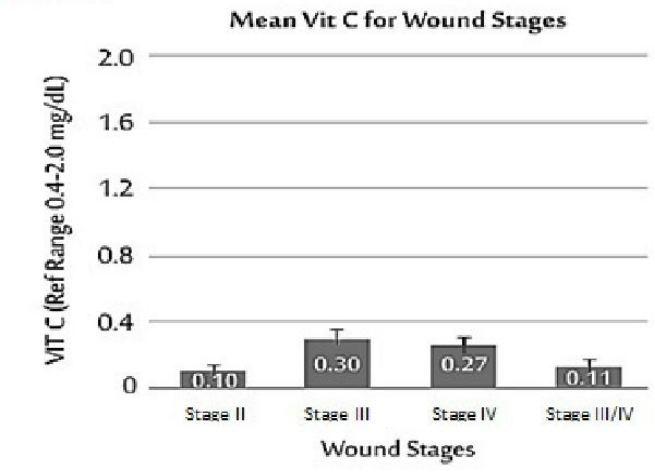
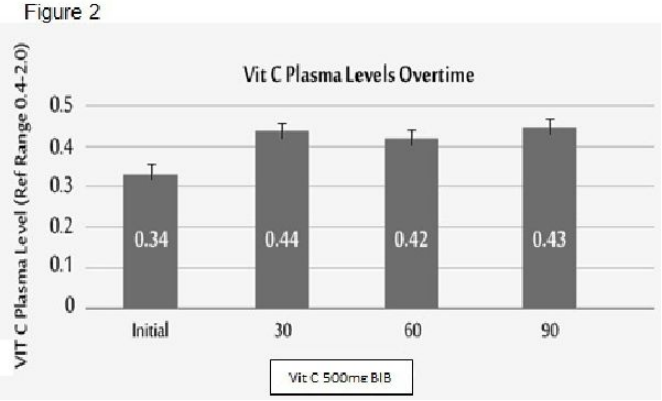


Figure 2



60 - An Interdisciplinary Collaboration to Develop an Etiology-Based Malnutrition Coding Tool for Hospitalized Adults Integrating National Recommendations and Commonly Used International Classification of Diseases Malnutrition Codes

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Background: Malnutrition is a prevalent but often underreported condition in hospitalized adults. While malnutrition prevalence varies from 13-88%, only an estimated 3% of adult patients admitted for acute care in the U.S. receive a malnutrition diagnosis. Data collected at our facility indicated a similar trend of 3.7% and 6.9% in 2010 and 2011. The Academy of Nutrition and Dietetics (AND) and the American Society for Parenteral and Enteral Nutrition (ASPEN) reached a consensus about the classification of and proposed markers for describing malnutrition. Clinicians at the study hospital asked for guidance on criteria, language and codes.

Objective: The goal of this quality improvement project was to develop a user-friendly, etiology-based coding tool to define malnutrition in adult hospitalized patients based on the AND/ASPEN recommendations and commonly used International Classification of Diseases (ICD) 9 malnutrition codes.

Methods: In 2011, the Nutrition Support Team, dietitian staff, clinical documentation specialists and health information coordinators formed an interdisciplinary committee to review the literature and create an action plan. The group and subcommittees met monthly to discuss tool development. Physicians requested concise language to differentiate between mild, moderate and severe malnutrition and an easy process for documentation. Clinical staff requested that dietitians and providers be educated on using the tool to ensure consistency. Clinical documentation specialists provided guidance on compliant descriptive language and malnutrition codes. Health Information staff compiled historical data and Information Specialists developed the electronic health record documentation process.

Results: The Etiology-Based Coding for Malnutrition Tool (adult) (Table 1) provides a standardized format for describing malnourished patients. Definitions include Kwashiorkor and Marasmus for use in a future project to define pediatric malnutrition. Acute disease or injury-related and chronic disease-related malnutrition definitions acknowledge the relationship between marked, moderate and mild inflammation and malnutrition severity. The chronic disease-related malnutrition with acute illness or injury definition suggests criteria for ICD code 263.8. ICD codes 799.4, 263.0 and 263.1 identify cachexia, malnutrition of moderate and mild degree and reflect the absence of inflammation in malnourished states with varying degrees of unintentional weight change, compromised intake and changes in physical findings. ICD codes V85.4 and V85.0 define specific BMI extremes, although malnutrition may occur at any BMI. Measures of physical function were not included and will be examined in future revisions. A list of examples for definitions and practical markers of inflammation reflect those suggested in the literature and other patient conditions which may result in moderate or mild protein-calorie malnutrition. Both ICD 9 and, subsequently, ICD 10 code information were included to keep the tool user-friendly as prescribing providers transition to using ICD 10 codes. A key point in tool development was to include commonly used ICD malnutrition codes and not to guide prescribing provider decision-making by omitting codes.

Conclusion: The interdisciplinary collaborative development of the Etiology-Based Coding Tool for Malnutrition (adults) incorporates nationally recognized definitions, adapted clinical characteristics and common ICD malnutrition codes. This format can be used by registered dietitians, prescribing providers and clinical documentation specialists to standardize the process for defining, diagnosing, documenting, and coding for malnutrition in adult hospitalized patients.

Table 1.

Etiology-Based Coding for Malnutrition Tool (adults)
May 2013

Use any 2 or more markers to identify malnutrition

Etiology	Dx Code ICD 9/ ICD 10	BMI	Inflammation (y/n) (*)	Unintentional Weight Change	Compromised Intake **	Physical Findings
+Kwashiorkor	260.0/ E40					
+Marasmus	261.0/ E41					
Acute disease or injury-related malnutrition	262.0/ E43 Other severe protein- calorie Malnutrition/ Unspecified Severe protein-calorie malnutrition	Any BMI	Marked inflammatory response	>2% in 1 wk >5% in 1 mo >7.5 in 3 mo >10% in 6 mo >20% in 12 mo	≥5days intake ≤50%	Lean muscle loss @ temples, clavicles, shoulders, interosseous, scapula, thigh and/or calf. Subcutaneous fat loss: orbital, triceps, fat overlying ribs. Fluid accumulation
Chronic disease- related malnutrition with acute illness or injury	263.8/ NONE Other protein-calorie malnutrition	Any BMI	Moderate/ ICD 9	1-2% in 1 wk 5% in 1 mo 7.5 in 3 mo 10% in 6 mo 20% in 12 mo	≥7days intake ≤75%	Lean muscle loss @ temples, clavicles, shoulders, interosseous, scapula, thigh and /or calf. Subcutaneous fat loss: orbital, triceps, fat overlying ribs. Fluid accumulation
Chronic disease- related malnutrition	263.9/ E46 Unspecified protein- calorie malnutrition	Any BMI	Mild/ ICD 9 Moderate/Mild for ICD 10.	1-2% in 1 wk 5% in 1 mo 7.5 in 3 mo 10% in 6 mo 20% in 12 mo	≥30days intake ≤75% ≥7days intake ≤75% for ICD 10.	Lean muscle loss @ temples, clavicles, shoulders, interosseous, scapula, thigh and/or calf. Subcutaneous fat loss: orbital, triceps, fat overlying ribs. Fluid accumulation
Starvation related malnutrition	799.4/ E64 Cachexia	Any BMI	No	1-2% in 1 wk 5% in 1 mo 7.5 in 3 mo	≥30days intake ≤75%	Variable-include if appropriate

				10% in 6 mo 20% in 12 mo		
	263.0/ E44.0 Malnutrition of moderate degree/ Moderate protein-calorie malnutrition	Any BMI	No	<1-2% in 1 week <5% in 1 mo	≥ 7 days intake ≤ 50%	None
	263.1/ E44.1 Malnutrition of mild degree/Mild protein-calorie malnutrition	Any BMI	No	Without weight change	≥ 7 days intake ≤ 75%	None
	V85.4/ Z68.41	BMI ≥40				
	V85.0/ Z68.1	BMI <19 (>20 yo)				

(*) Practical markers of inflammation include decreased albumin, decreased pre-albumin, elevated CRP and clinical signs of fever, leukocytosis, hyperglycemia and altered temperature regulation (as a symptom of nutrient deficiency). NCHS defines "chronic" as a disease/condition lasting 3 months or longer. (+) Kwashiorkor and Marasmus for use in pediatric patient populations typically from poorly resourced countries. **(**)** Intake includes oral, ENT and PN intake

Encore: Previously presented at the National Home Infusion Association Annual Conference 2013. Published with permission of the authors.

61 - Retrospective Review of Home Total Parenteral Nutrition: Clinical Outcomes in Home-Start Versus Hospital Discharged Patients

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Purpose: There is minimal documentation in the literature to support the practice of initiating total parenteral nutrition (TPN) in the home. ASPEN recommends that TPN should only be started in the home when assessment confirms that benefits outweigh risks. This retrospective review compared the clinical outcomes of adult patients serviced by a national home infusion provider who were home-started on TPN with adult patients who were transitioned to the home setting after hospital initiated TPN.

Methods: This HPN provider established standards of practice for home-start TPN in 2001 and implemented electronic nutritional assessment tools in 2011 that categorized home start vs. hospital initiated TPN patients. Adult patients started on TPN between 9/1/2011 and 8/31/2012 with documented electronic TPN assessments completed between 9/1/2011 and 9/30/2012 were included totaling 164 patients. Patients with previous HPN experience were excluded. A retrospective analysis of the electronic medical record compared home-start TPN (HSTPN) to patients with hospital-initiated TPN (HITPN) with outcome parameters of 30 day and aggregate hospital admission rates and rates of documented clinical interventions. Eighty one percent of patients were HITPN, with 19% HSTPN.

Results: The majority of patients in both groups were between 60-69 years of age. In the homestart group, the top 4 diagnosis categories were neoplasm (60%), GI disorders (15%), malnutrition unspecified (18%), and hyperemesis gravidarum (9%). In the hospital initiated group, neoplasm (40%), GI disorders (33%), malnutrition (9%), fistula (8%), hyperemesis gravidarum (7%) were the top 4 categories. Rates of hospitalization were similar for both groups in the first 30 days, but HITPN patients had a higher rate of hospitalizations overall with clinical deterioration as the most commonly documented reason. The HSTPN group had more clinical interventions, both in the 30 day and overall category with the most common reason being lab value monitoring with correction of abnormalities.

Conclusions: The results support this provider's standard of practice for initiating PN in the home setting when appropriate and when benefits outweigh risk. The higher rate of clinical interventions in the first 30 days for HSTPN was anticipated, reflecting greater service intensity. The lower rate of overall hospitalizations for HSTPN vs. HITPN was encouraging. Ongoing collection of outcome data on a national level is indicated to further establish sound practice patterns for initiation of TPN in the alternate site.

62 - A systematic Review on the Timing of Parenteral Nutrition in Critical Illness

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Purpose: Parenteral Nutrition (PN) is an important component in the management of the critically ill patient with gut dysfunction precluding enteral nutrition. Early enteral nutrition remains first line in critical illness; however there is a cohort in whom this will not be possible. In these patients PN may be an appropriate choice; however the timing of initiation of PN remains controversial and divisive as evidenced by consensus guidelines that differ in opinion between Europe and North America. Recent prospective randomized trials have attempted to address this issue. The aim of this systematic review was to determine which of these strategies (i.e. early vs. late) is supported by the currently available evidence.

Methods: A systematic literature search was performed (Medline, and Cochrane Library) to identify relevant articles. We identified all prospective, randomized trials where timing of PN initiation was the intervention, and subsequent clinical outcomes were the primary end-points. Our primary endpoints were mortality and infectious complications. Pooled outcomes were calculated.

Results: We identified seven trials in which early PN was the active intervention. Five of these trials were retrospective and were excluded. In the two remaining trials, 3,684 patients were randomized to receive early PN (less than 48 hours) or late PN (between 5 and 7 days after admission to ICU). Aggregation of the data revealed no difference with respect to mortality OR 0.97 (0.84-1.13). However, a significant increase in infectious complications was seen in the early PN group (OR 1.16 (1.02-1.31)).

Conclusions: Early PN would appear to confer no benefit with respect to mortality, and in fact was associated with an increase in overall infectious complications. Although the numbers of trials that have prospectively addressed this issue are small, the large numbers of patients recruited in two recent publications support these conclusions. Late PN was variably defined between the two included trials and so conclusions regarding late initiation must be interpreted with caution. Despite limitations in the current literature, the available data would support the avoidance of PN in the first 48 hours (at least) of critical illness. Consensus guidelines should be amended to recognize the recent publications.

63 - A Pilot Study on the Acceptance of Nasogastric Feeding Tubes in Nursing Homes in New York City

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Purpose: Percutaneous Endoscopic Gastrostomy (PEG) tubes are recommended by consensus guidelines for patients in whom a requirement for enteral nutrition of more than 30 days is anticipated. However, PEG tube insertion is not a frivolous procedure, with 30 day mortality variably reported between 10 and 26%. There is a cohort of patients for whom naso-gastric (NG) feeding tubes are an appropriate and viable option for the safe delivery of longer-term enteral nutrition. Our anecdotal experience would suggest that more PEG tubes are being placed earlier in the course of a patient's illness so as to facilitate discharge of patients to nursing homes that refuse to accept nasal feeding tubes. As part of a larger policy intervention, we have endeavored to quantify the pervasiveness of this policy in New York City.

Methods: We performed a survey of all New York City nursing homes that accept patients for medium- to long-term care from the Milstein adult hospital at New York Presbyterian Hospital - Columbia University Medical Center. Nursing homes were contacted during June and July 2013. A total of 127 nursing homes were identified within the bounds of New York City. The Nurse Directors of the nursing homes were contacted directly by telephone and queried on the nursing homes policy with respect to acceptance of NG tubes, and when appropriate, the reasons for non-acceptance.

Results: Overall response rate in our study was 88%. The majority of nursing homes (88, 81.5% of responders) surveyed do not accept patients with NG tubes. Four (4%) nursing homes declined participate in the study. Reasons included for not accepting NG tubes include: Department of Health policies (despite no such policy existing),

concerns re: perceptions of safety (i.e. related to aspiration), and a lack of trained staff. Only 20 of the nursing homes contacted (18.5%) accepted NG tubes. In the nursing homes that do accept NG tubes most had qualifying requirements for acceptance. These included: only if the patient was receiving end of life care, the requirement for the tube to be removed within 2 weeks. Many of the nursing homes that do accept NG tubes had not accepted a patient with an NG tube in the last year.
Conclusions: The majority of nursing homes in the New York City area do not accept NG tubes. Most cite risk of aspiration as a reason for this policy (despite a lack of published evidence to support this). These findings are of concern as this policy may be leading to a significant number of PEG insertions (and all of its attendant risks) without appropriate medical indications. Further work to determine whether this policy is specific to New York City or a wider issue within the region and indeed nationally is lacking. Efforts to address this are ongoing at present.

64 - Characteristics of Hospitalized Adults With a Diagnosis of Malnutrition: United States, 2010
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Purpose: Malnutrition is common in hospitalized patients in the United States. In the United States in 2010, approximately 1.2 million hospitalized patients over the age of 18 had a diagnosis of malnutrition. This report summarizes nationally representative, person-level characteristics of hospitalized adults with a diagnosis of malnutrition.
Methods: Data are from the Healthcare Cost and Utilization Project (HCUP), which contains patient-level data on hospital inpatient stays. When weighted appropriately, estimates from HCUP represent all U.S. hospitalizations. The data set contains up to twenty-five ICD-9 diagnosis codes for each patient. Using these codes, adult patients with a diagnosis of malnutrition during their hospital stay were identified.
Results: Demographics
-In 2010, 95.7% of hospitalized patients with a diagnosis of malnutrition were age 18 years or older. Of adults with this diagnosis, approximately 61% were age 65 or older.
-The average age of an adult with a malnutrition diagnosis was 67.6 years, while the average for an adult patient without this diagnosis was 56.7 years.
-Medicare was the primary expected payer for 65.6% of adults with a diagnosis of malnutrition and 43.7% of adult patients without this diagnosis.
-Although the vast majority of all adult patients were treated at non-profit hospitals, those with a malnutrition diagnosis were more likely to be treated at private, for-profit facilities compared to adults without this diagnosis (17.4% vs. 13.1%). They were also more likely to be treated at facilities that are part of multi-hospital systems (72.0% vs. 67.2%).
Outcomes
-Length of stay among adults with a diagnosis of malnutrition was almost 3 times longer than those without this diagnosis (12.4 days vs 4.5 days).
-Hospital costs for adults with a malnutrition diagnosis were 2.5 times higher than those without the diagnosis ($26,883 vs. $10,287).
-61.8% of hospitalized adults with a malnutrition diagnosis were admitted emergently compared to 51.5% among adults without this diagnosis.
-Adults with a diagnosis of malnutrition were 4.8 times more likely to be discharged dead than their counterparts without this diagnosis (9.1% vs. 1.9%).
-12.8% of adults with a diagnosis of malnutrition received either enteral or parenteral nutrition during their hospital visit.
Conclusions: Hospitalized adults coded with a malnutrition diagnosis had more comorbidities, longer length of stay, and higher costs compared to those without this diagnosis.

65 - Smart Cup: Development of a Device to Monitor Liquid Intake
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Purpose: Malnutrition (i.e., undernutrition) is a common geriatric syndrome across the care continuum. Older adults accounted for 34% of the 39 million discharges from US hospitals in 2010, and 58% of the 1.2 million patients discharged with an ICD-9 code of malnutrition were older adults. While a small but consistent weight gain is observed in malnourished older adults who receive oral liquid nutrition supplements (ONS), there is a gap in measuring compliance with ONS which contributes to the limited evidence of improvement in clinical outcomes in those treated with ONS. Researchers inconsistently report how the amount of ONS consumed was quantified, and in clinical practice, nurses often fail to document oral intake consistently. Continuous real-time unobtrusive monitoring of liquid intake with sensors (smart cup) has the potential to impact outcomes for malnourished older adults by documenting if the prescribed amount of ONS was consumed. If the amount was not consumed then alerts can be sent to clinicians so they can suggest alternative treatments. The purpose of this proof-of-concept study was to develop a smart cup prototype to quantify the amount liquid consumed and the time liquid was consumed.
Methods: We designed a two-piece Smart Cup prototype that provides information on the volume and time of liquid consumed during a monitoring session, comprising a series of consumption events. When a new disposable vessel is placed into the cup holder, the device is turned on. When a known liquid is first poured into the newly-placed cup, an accelerometer wakes up all the sensors and initiates a monitoring session. A microcontroller in the cup holder base performs limited data analysis calculations while most of the data analysis is done in a central server, or cloud computing environment. We have validated our volume measuring sensory system (VMSS) in a laboratory setting by detecting a change in liquid volume in variety of blinded tests.
Results: We tested and validated the performance of the cup by measuring changes in the volume of known liquids. We also developed the algorithm to translate the data generated by our cup into meaningful information about each drinking event. We tested the ability of the cup to measure preselected volumes of liquid with an accuracy of better than 5cc.
Conclusions: We validated the design of our Smart Cup in the laboratory setting. Further human-factor design and usability testing is needed prior to using the cup as a measurement device in a randomized clinical trial.

66 - Characteristics of Hospitalized Children With a Diagnosis of Malnutrition: United States, 2010
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[1]Mercy Childrens Hospital, Kansas City, MO; [2]LeBonheur Childrens, Memphis, TN; [3]Nationwide Children's Hospital, Columbus, OH; [4]ASPEN, Silver Spring, MD; [5]ASPEN, Silver Spring, MD.
Purpose: Malnutrition is common in hospitalized patients in the United States. In the United States in 2010, approximately 53,700 of 6,246,300 hospitalized patients under the age of 18 had a diagnosis of malnutrition. This report summarizes nationally representative, person-level characteristics of hospitalized pediatric patients with a coded diagnosis of malnutrition.
Methods: Data are from the 2010 Healthcare Cost and Utilization Project (HCUP), which contains patient-level data on hospital inpatient stays. When weighted appropriately, estimates from HCUP represent all U.S. hospitalizations. The data set contains up to twenty-five ICD-9 diagnosis codes for each patient. Using these codes, pediatric patients with a diagnosis of malnutrition listed during their hospital stay were identified. Since the data only includes those with malnutrition diagnostic codes, the data may under-represent the true incidence.
Results: 1. In 2010, 4.3% of hospitalized patients with a diagnosis of malnutrition were under the age of 18 years. Of these children, approximately two-thirds were less than 1 year of age.
- 21.3% of children with a diagnosis of malnutrition are black, compared to 16.4% of children without this diagnosis.
- Among children with a diagnosis of malnutrition, 56.2% had Medicaid as the expected primary payer, while Medicaid was the expected payer for 48.7% of children without this diagnosis.
- Children with a diagnosis of malnutrition were about half as likely to be treated at a rural hospital (5.2%) compared to children without this diagnosis (10.3%).
- Children with a malnutrition diagnosis were more likely to be treated at teaching hospitals than their counterparts without this diagnosis (75.8% vs. 55.7%)
2. Length of stay among children with a diagnosis of malnutrition was almost 4.4 times longer than those without this diagnosis (16.7 days vs 3.8 days).
3. Hospital costs for children with a malnutrition diagnosis were more than 5 times higher than those without the diagnosis ($28,292 vs. $5,485).
4. Hospitalized children with a malnutrition diagnosis were less likely to have a routine discharge and almost 4.7 times more likely to be discharged to home care.
5. 26.6% of hospitalized children with a diagnosis of malnutrition received either parenteral or enteral nutrition

during their hospital stay. 2.5% of children without this diagnosis also received one of these therapies.
6. Children with diagnosed malnutrition were more likely to have a number of other diagnoses including weight loss, fluid/electrolyte disorders, anemia, coagulopathy, paralysis, and other neurological disorders.
Conclusions: Hospitalized children coded with a malnutrition diagnosis are associated with more comorbidities, longer length of stay, and higher costs as compared to those without this diagnosis. These malnourished children may utilize more health care resources both in the hospital and outside it. Clinicians and policy makers should factor this in to healthcare resource utilization planning

67 - Comparison Between Handgrip Dynamometry and manual muscle testing performed by Registered Dietitians in Measuring Muscle Strength and Function of Hospitalized Patients

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Introduction: The Academy of Nutrition and Dietetics (Academy) and the American Society for Parenteral and Enteral Nutrition (ASPEN) recently proposed characteristics to identify and standardize clinical malnutrition. Diminished functional status is a diagnostic characteristic, but due to its vague definition it is difficult to objectively measure. Hand grip strength (HGS) is a validated measurement of muscle function, but with limited application due to the patients' inability to perform. Manual muscle testing (MMT) is a validated method used to assess impairment and asymmetry of muscle. Typically performed by Physical Therapists, Registered Dietitian (RD) can be trained to perform MMT.
Purpose: The primary aim was to test the hypothesis that MMT performed by a RD can be used as a surrogate for HGS as measured by hand grip dynamometry in assessing muscle strength and function in hospitalized patients. A secondary aim was to determine if abnormal HGS or MMT was associated with malnutrition.
Methods: Patients admitted to the cardiac stepdown units at Cleveland Clinic Main Campus (n=50) prospectively had HGS measurements obtained three times by a RD, alternating between each hand with the highest of the three readings recorded. MMT was performed the same day by a trained RD blinded to the HGS results. Additionally, each patient was assessed for malnutrition using the ASPEN/Academy adult malnutrition criteria. Spearman's correlation coefficient was used to estimate the correlation between HGS and MMT. Spearman's correlation coefficients were used to assess associations between HGS and nutritional status. MMT and malnutrition were compared using Pearson's chi-square test. A p value of <0.05 was considered statistically significant.
Results: Of the fifty subjects, 84% had an abnormal HGS and 76% had an abnormal MMT. Considering HGS as the gold standard for muscle function, overall MMT had a sensitivity of 98% and specificity of 13%. Seventy two percent of patients had moderate or severe protein-calorie malnutrition. Abnormal MMT score was found in 100% of patients with moderate and 94% of patients with severe protein-calorie malnutrition while abnormal HGS score was found in 80% of patients with moderate and 84% of patients with severe protein-calorie malnutrition.
Discussion: The primary aim of the study, to determine whether MMT performed by an RD can be used as a surrogate measure for HGS, remains to be established. MMT was highly sensitive, meaning subjects with a normal MMT would likely have a normal HGS. On the other hand, MMT had a low specificity, meaning an abnormal MMT is not a good predictor of an abnormal HGS. Based on these results, MMT could potentially be used to screen patients being evaluated for malnutrition, reserving HGS testing only for patients with an abnormal MMT. The Academy and ASPEN suggest using HGS to determine functional status in the diagnosis of malnutrition. However, we found functional assessment via MMT was more sensitive to malnutrition than HGS. These results warrant further study for validation of HGS or MMT with new ASPEN/Academy malnutrition guidelines in cardiac stepdown patients

68 - Appetitive Response of a Glycemia-Targeted Specialized-Nutrition Breakfast in People with Type 2 Diabetes

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Purpose: Controlling body weight is a key goal and a part of the globally recognized guidelines for people with diabetes. However, achieving and maintaining clinically significant weight loss via diet and lifestyle intervention is a major hurdle for this population. Convenient, prepackaged low-glycemic, glycemia-targeted specialized-nutrition (GTSN) formulas used as meal replacements have been demonstrated to increase adherence to dietary modification when consumed at either the breakfast or lunch eating occasion by obese, type 2 diabetes patients. Additionally, GTSN meal replacements are likely to modulate subjective appetitive response. Modulations in subjective appetitive

responses that would aid adherence to diet modification would include prolonged hunger suppression and fullness elevation aligned with or beyond reported typical inter-meal intervals reported to be approximately 3 hours (Popkin and Duffey, 2009). These modulations are hypothesized to minimize overconsumption at the subsequent meal or snack. To investigate how GTSN meal replacements might impact adherence to diet modification, this study was designed to measure the appetitive response of GTSN meal replacements consumed at breakfast by people with diabetes.
Methods: Men and women (N=20) with T2DM participated in this acute, single-arm study evaluating the postprandial appetitive responses from a GTSN product consumed at breakfast. Subjects were between the age of 18 and 75 years old, had a HbA1c >6.0 but ≤ 8.5 and a body mass index > 18.5 and < 40.0 kg/m2. On a single visit, fasting subjects consumed the product at their usual breakfast time and utilized a 100 mm visual analogue scale to rate hunger, fullness, prospective consumption and desire to eat at baseline, 15, 30, 60, 90, 120, 150, 180, 210, 240, 270, and 300 minutes following product consumption. Responses were analyzed as the time to return to baseline from 0 to 300 minutes. ClinicalTrials.gov Identifier: NCT01850810
Results: Median time for the subjective hunger rating to return to baseline was 3 hours 34 minutes with an inter-quartile range of 27 -300 minutes. The mean time for the subjective hunger rating to return to baseline was 2 hours 54 minutes with a 95% confidence interval of 1 hour 54 minutes to 3 hours 53 minutes. Median time to return to baseline for fullness, prospective consumption, and desire to eat was 4 hours, 2 hours 23 minutes, and 4 hours 6 minutes, respectively.
Conclusions: These data demonstrate that in people with diabetes, this glycemia-targeted specialized-nutritional formula can suppress subjective hunger and elevate fullness responses. These data suggest that subjective appetitive responses may play a significant role in successful adherence to dietary modification.

Poster Abstract of Distinction
69 - Effect of 50% Enterectomy on Nutritional Parameters in Lean and Obese Rats
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Purpose: The presence of obesity prior to the development of short bowel syndrome (SBS) may be protective for the patient against the weight loss and wasting associated with SBS. The purpose of this study was to determine whether obese vs. non-obese rats would respond differently after 50% enterectomy. We hypothesized that nutritional parameters would be less adversely affected by massive resection in the obese rat relative to the non-obese rat.
Methods: Rats (CD®IGS; male; age 5 months at study initiation; starting N = 75) were fed ad libitum with either a high fat diet or normal rat chow during a four month induction period, and then were randomized into one of three surgical procedures: (1) resection of the proximal half of the small bowel; (2) resection of the distal half of the small bowel; (3) small bowel transection with re-anastomosis (control/sham resection). Food intake, weight, and body composition (measured by quantitative magnetic resonance) were monitored before and for 4 weeks after surgery. Blood was collected at sacrifice after an overnight fast for measurement of plasma peptide levels using a Millipore multiplex assay. Numerical data were analyzed with two-way ANOVA; planned comparisons of treatment means were evaluated by t-tests; differences were considered significant if $p < 0.05$.
Results: Refer to Table 1. During the induction period, subjects on high fat diet (referred to as obese rats) had a 30-40% weight gain and ~150 gram gain in fat with respect to normal chow controls (referred to as lean rats); lean mass was not different between obese and lean subjects. Obese rats generally lost more grams of total weight after surgery compared to lean rats, but percent weight loss was not different between obese and lean. Obese rats had a greater postoperative decrease in both grams of body fat and percent body fat with respect to lean rats; however, the obese rats lost less lean mass (grams and percent) in the postoperative period compared to lean rats. In lean but not obese rats, 50% distal resection appeared to produce a greater decrease in body weight, percent body weight, and percent body fat when compared to control surgery. In obese but not lean rats, 50% proximal resection produced a greater decrease in relative caloric intake when compared to control surgery. Fasting levels of leptin, insulin, and GIP were higher in obese compared to lean rats at time of sacrifice. Ghrelin appeared to increase in subjects having a 50% distal resection, while GIP decreased and PYY increased after either resection type.
Conclusions: The high fat diet induced obesity without a change in lean mass during the four month induction period. All subjects appeared to lose weight after surgery, with distal resection appearing to produce greater weight and fat loss in lean rats. The presence of obesity seemed to be protective of lean body mass after any surgery, and also appeared to be protective of fat mass after a 50% distal resection. Whether the increased levels of leptin, insulin, and GIP in obese subjects contributed to these protective effects is speculative.

Table 1. Effect of diet type and resection type on body weight, body composition, caloric intake, and plasma peptide levels in rats.

Variable	group 1 NL, cont (N = 9)	group 2 NL, prox (N = 9)	group 3 NL, dist (N = 8)	group 4 HF, cont (N = 12)	group 5 HF, prox (N = 11)	group 6 HF, dist (N = 13)	p value (2-factor ANOVA) Diet	Resection	Interaction
iBW (g)	692 ± 23	722 ± 32	665 ± 23	908 ± 35	926 ± 40	946 ± 42	<0.001	0.80	0.53
ΔBW (g)	-59 ± 6	-72 ± 12	-90 ± 12[a]	-96 ± 14	-120 ± 17	-107 ± 22	0.02	0.38	0.65
ΔBW (%)	-8.5 ± 0.8	-9.6 ± 1.5	-13.5 ± 1.7[a]	-10.3 ±1.3	-12.6 ± 1.4	-10.9 ±1.8	0.55	0.21	0.17
iFat (g)	129 ± 14	130 ± 14	113 ± 14	296 ± 13	295 ± 23	278 ± 21	<0.001	0.55	0.99
iFat (%)	18.4 ± 1.6	17.6 ± 1.3	16.8 ± 1.6	33.6 ± 1.2	32.3 ± 1.5	30.3 ± 1.6	<0.001	0.25	0.84
ΔFat (g)	-18.7 ± 4.6	-27.2 ±5.0	-33.8 ± 8.0	-50.8 ±7.6	-56.8 ± 9.1	-41.8 ±9.6	0.001	0.65	0.26
ΔFat (%)	-14.4 ± 3.4	-20.4 ±3.1	-29.3 ±6.1[a]	-17.1 ±2.5	-19.0 ± 2.3	-14.9 ±3.3	0.12	0.19	0.04
iLean (g)	473 ± 12	500 ± 15	465 ± 13	488 ± 11	499 ± 12	520 ± 19	0.06	0.42	0.14
ΔLean (g)	-25.8 ± 4.3	-33.0 ±6.3	-41.8 ± 8.5	-19.1 ±4.4	-21.7 ± 6.0	-16.8 ± 7	0.007	0.52	0.31
ΔLean (%)	-5.4 ± 0.8	-6.34 ±1.2	-8.9 ± 1.7	-4.0 ± .9	-4.4 ± 1.2	-3.1 ± 1.3	0.003	0.53	0.15
ΔIntake (kcal)	20 ± 100	70 ± 65	-161 ± 108	180 ± 103	-308 ±118[b]	-11 ± 115	0.80	0.10	0.02
Leptin (ng/mL)	6.2 ± 0.9	3.9 ± 0.8	3.2 ± 1.1[a]	25.9 ±4.3	19.9 ± 2.4	20.2 ±2.5	<0.001	0.21	0.78
Insulin (ng/mL)	2.30 ± 0.3	1.9 ±0.4	2.3 ± 0.5	2.7 ±0.3	3.1 ± 0.6	2.8 ±0.4	0.04	0.99	0.66
Ghrelin (pg/mL)	272 ± 41	244 ± 30	429 ± 79	248 ± 26	189 ± 40	302 ± 39	0.06	0.003	0.48
GIP (pg/mL)	63 ± 12	28 ± 4	30 ± 2[a]	83 ± 9	37 ± 3[b]	51 ± 7[b]	0.008	<0.001	0.68
PYY (pg/mL)	96 ± 9	168 ± 44	169 ± 31[a]	69 ± 7	114 ± 15[b]	152 ± 27[b]	0.12	0.008	0.75
Amylin (pg/mL)	40 ± 4	58 ± 26	31 ± 6	45 ± 5	48 ± 7	47 ± 5	0.63	0.34	0.41

[a]$p < 0.05$, compared to normal control (unpaired t-test); [b]$p < 0.05$, compared to high fat control (unpaired t-test); cont, control (transection and re-anastomosis only); dist, 50% distal small bowel resection; HF, high fat diet; iBW, initial body weight (at time of bowel resection); iFat, initial fat mass; iLean, initial lean mass; NL, normal rat chow diet; prox, 50% proximal small bowel resection; ΔBW, change in body weight (during postoperative period); ΔFat, change in fat mass; ΔIntake, cumulative change in caloric intake during postoperative period relative to intake during preoperative period; ΔLean, change in lean mass; Basal plasma peptide levels prior to sacrifice determined with Millipore Milliplex assay; GLP-1 = too low to determine.

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70 - Comparison of Measured and Estimated Energy Expenditure in Patients With Nontraumatic Head Injury

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Purpose: Non-traumatic head injury can induce an increase in energy expenditure, hypermetabolism and hypercatabolism through an increase in cytokine levels and counterregulatory hormones. Metabolic consequences include: tachycardia, increased cardiac output, and increased oxygen consumption. Resting energy expenditure in

head-injury patients has been estimated to increase 40- 200% above that of a non-injured person. Sedatives, paralyzing agents, and barbiturates may decrease energy expenditure by 12-32%. Indirect calorimetry has been the long-standing gold standard to measure energy expenditure. When cost or lack of trained personnel constrain the use of indirect calorimetry, clinicians rely on predictive equations to determine energy requirements. The aim of this study was to compare measured results of indirect calorimetry to estimated energy requirements calculated by the commonly used equations: Penn State (PSU) 2003b and 2010, Harris Benedict Equation (HBE) actual weight, HBE actual body weight x 1.2, 20 kcals/kg, and 25 kcals/kg in patients with non-traumatic brain injury.
Methods: Seventeen critically ill, mechanically ventilated patients (mean age 53.5 years, mean BMI 29.9) with diagnosis of Ischemic stroke or Hemorrhagic stroke were retrospectively included in this study. Indirect calorimetry (Medical Graphics, Ultima CPX System) was conducted while intubated and the results were compared with resting metabolic rate calculated with PSU 2003b, PSU 2010, HBE actual weight, HBE actual body weight x 1.2, 20 kcals/kg, and 25 kcals/kg.
Results: Thirteen patients were diagnosed with hemorrhagic stroke and four with ischemic stroke. Six patients were receiving propofol and two patients were receiving versed at the time of indirect calorimetry. Enteral regimens were decreased to account for propofol calories. One patient was undergoing therapeutic hypothermia protocol when indirect calorimetry was conducted. Regression analysis showed minimal correlation between results of indirect calorimetry and any of the predictive equations, table 1. The PSU 2003b had the highest R2 value at 0.036, but a p-value of 0.482 essentially invalidating the relationship.
Conclusions: Indirect calorimetry remains the gold standard to measure energy expenditure in critically ill, mechanically ventilated head-injury patients. Energy expenditure should be measured by IC and not calculated in view of poor correlation to all predictive formulas. Measurements with IC should be conducted more than once in view that patient conditions change frequently. Further research specific to predictive energy equations and head-injury patients is recommended, should indirect calorimetry be unavailable.

Table 1. Predictive equations compared to IC.

Predictive Equations	R^2	t-stat	p-value
HBE (actual wt)	0.010	0.372	0.715
HBE (actual wt) x 1.2	0.010	0.373	0.715
PSU 2003b	0.036	-0.723	0.482
20 kcals/kg	0.000	0.070	0.945
25 kcals/kg	0.000	0.070	0.945

71 - Cross-Talk Between Insulin and Angiotensin in Burn Injury
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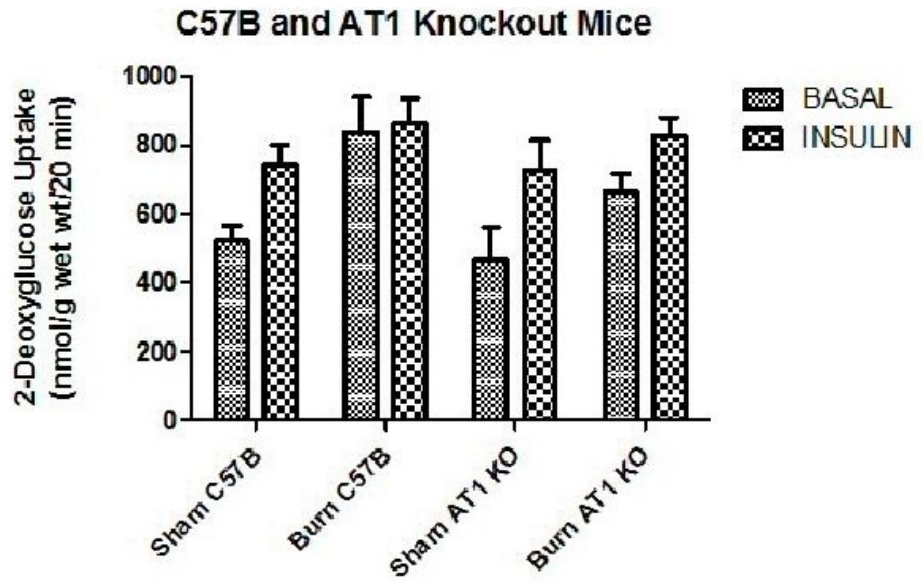
Purpose: Burn trauma results in insulin resistance and impaired glucose metabolism. We have shown that upregulation of the renin-angiotensin system (RAS) plays a critical role in altering insulin receptor signaling transduction pathways through negative cross talk between the AT1 and insulin receptors in skeletal muscle after burn injury in rats. We reported that blockade of the RAS with an AT1 receptor blocker (losartan) attenuated a decrease in serine473 AKT phosphorylation and increased insulin-stimulated IRS-1-associated PI3-kinase activity as well as GLUT4 translocation in skeletal muscle after burn injury. Insulin-stimulated glucose uptake in skeletal muscle was also shown to be decreased with burn injury and that AT1 receptor blockade normalized insulin-stimulated glucose uptake to the level of sham-burned animals, abolishing the insulin resistance. This study aims to further elucidate this mechanism by using an angiotensin II type 1a receptor knockout mouse (AT1 KO) to determine the role of the AT1 receptor in burn injury induced insulin resistance by specifically examining insulin-stimulated glucose transport and serine473 phosphorylated levels of AKT in skeletal muscle. We hypothesize that AT1 KO animals should have improved insulin-stimulated skeletal muscle glucose uptake and insulin receptor signaling in burn injury.
Methods: An angiotensin II type 1a receptor knockout mouse (Agtr1atm1Unc/J) and the control mouse strain (C57BL/6J) were purchased from Jackson Laboratories. Four groups of mice were used; C57BL/6J and AT1 KO

mice were deeply anesthetized and given a full-skin-thickness scalding burn on the dorsum using 80°C water for 8 s to produce a 30% total body surface area burn injury (sham mice were immersed in 23°C water). After euthanasia (day 4), soleus muscles were removed and basal and insulin-stimulated (2 mU/mL) glucose transport was assessed in vitro by measurement of radiolabeled 2-deoxyglucose uptake. Western blot analysis of serine473 AKT and total AKT were determined in rectus abdominus muscle.
Results: The figure shows basal and insulin-stimulated 2-deoxyglucose transport in soleus muscles of the four groups. In the basal state, 2-deoxyglucose transport was similar between the sham C57B and sham ATI KO mice. Insulin (2 mU/mL) stimulated the transport of 2-deoxyglucose in soleus muscles of sham C57B and sham ATI KO mice. The basal rate of 2-deoxyglucose transport was elevated in the burn C57B mice and in the burn AT1 KO mice. Insulin did not significantly increase 2-deoxyglucose transport in the burn C57B mice indicating insulin resistance, whereas, insulin significantly increased 2-deoxyglucose transport in the burn ATI KO mice. Importantly, insulin sensitivity was maintained in the burn AT1 KO mice suggesting an important role of the AT1 receptor in the development of skeletal muscle insulin resistance in burn injury. In burned C57B rectus muscle, serine473 phosphorylation of AKT was significantly decreased by 62% ($P > 0.05$) as compared with the C57B sham animals. In the AT1 KO mice, this decrease in serine473 phosphorylated AKT was abolished and there was a 31% increase in serine473 phosphorylation of AKT in the burned AT1 KO mice as compared with the AT1 KO shams. The total levels of AKT were relatively unchanged across all groups.
Conclusions: The lack of an AT1 receptor in AT1 KO mice resulted in improved insulin receptor signaling as shown by elevated serine473 phosphorylation of AKT in skeletal muscle and an increase in basal and insulin-stimulated skeletal muscle glucose transport after burn injury. These results support our previous studies and demonstrate that the RAS plays a major role in the regulation of insulin signaling in burn injury.



72 - Vitamin E Reverses Age-Associated Susceptibility to Streptococcus Pneumoniae Lung Infection by Modulating the Neutrophil Response
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Purpose: The elderly are at an increased risk of invasive life-threatening infections by Streptococcus pneumoniae (pneumococcus) such as pneumonia, meningitis and bacteremia. Despite the presence of vaccines and antibiotic therapies, pneumococcus remains the leading cause of community-acquired pneumonia in the elderly and results in a direct cost of approximately $2.5 billion annually due to hospitalizations in the USA. This creates a considerable health and economic burden and raises the need for novel preventative therapies to combat this infection.

Uncontrolled pulmonary inflammation mediated by neutrophils upon Streptococcus pneumoniae infection is associated with poor control of the disease. Although neutrophils are required to clear the bacteria, their excessive influx into the lungs causes significant tissue damage and paradoxically increases systemic spread of the bacteria. Since aging is often associated with an overall chronic inflammation, termed "inflamm-aging", this could account for the heightened susceptibility of the elderly to invasive pneumococcal disease. The objective of this study was to test whether vitamin E, a potent regulator of immunity, can be used to target neutrophil responses as a preventive strategy to mitigate the age-associated decline in resistance to pneumococcal infections.
Methods: Young (4-mo) and old (22-mo) C57BL/6 male mice were fed a diet containing 30 parts per million (PPM) (control) or 500 PPM (supplemented) vitamin E for 4 weeks and then intra-tracheally challenged with the pneumococcal strain TIGR4. Body weights were then monitored over time and lung inflammation was assessed by histological analysis of lung sections and measurement of cytokine levels and cellular influx into the lungs. Bacterial burdens in the lungs and blood were also quantified two days post-infection. Further, the effect of vitamin E on the ability of neutrophils to migrate across pnemococcal-infected lung epithelial cells in vitro was assessed.
Results: On the control diet, old mice were significantly more susceptible to pneumococcal infection than young mice, as expected. Remarkably, this age-related difference was completely reversed by vitamin E supplementation: supplemented old mice did not loose weight, had drastically lower bacterial burdens in their lungs and did not suffer systemic spread of pneumococci. Strikingly, pulmonary inflammation was abolished in aged mice given the supplemented diet. The protective effect of vitamin E correlated with a decrease in neutrophil influx into the lungs of aged mice. This effect was reproduced using an in vitro model in which vitamin E inhibited neutrophil egress across polarized lung epithelial cells in response to pneumococcal infection. Since neutrophil trans-epithelial migration in response to S. pneumoniae infection is dependent on the production of the eicosanoid hepoxilin A3 (HXA3) by the enzyme 12-lipoxygenase, we tested the effect of Vitamin E on this pathway. Interestingly, although vitamin E had no effect on 12-lipoxygenase level or function, it decreased the responsiveness of neutrophils to HXA3-mediated migration. The effect of vitamin E was specific to this pathway, since migration in response to the positive control chemotactic peptide f-Met-Leu-Phe was not altered.
Conclusions: Our findings indicate that vitamin E mitigates immunosenescence by modulating an important innate cell type that is involved in host defense against multiple infections. Since neutrophils in excess can be potent mediators of tissue destruction in pneumonia, our findings suggest that vitamin E reverses age-associated susceptibility to pneumococcus by reducing the influx of these inflammatory cells into the lungs.

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73 - The Impact of Nutrition on the Clinical Outcome of Ventricular Assist Device Patients
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Purpose: Potential ventricular assist device (VAD) recipients are generally malnourished due to the severity of their underlying cardiac disease. Compounding this baseline nutritional depletion, emergency cardiac surgery for VAD implantation and subsequent complicated post-operative courses further stress this pre-existing malnutrition. The nutritional management of this vulnerable patient population has yet to be defined. We hypothesize that early nutrition support improves VAD patient clinical outcome.
Methods: A retrospective study was conducted in a 720-bed tertiary-care academic urban hospital over a seven year course from 2005 through 2011. Of the total 170 VAD patients 150 were eligible for the study. Nutritional status at the time of admission, pre-op and post-op was classified as at-risk for malnutrition, marasmus, nonspecific protein-calorie malnutrition (NSPCM) or unclassified. The impact of early (post-op $\leq$ 5 day) versus later (post-op $\geq$5 day) nutrition intervention on the clinical outcome was evaluated and Kaplan-Meier survival analysis was performed.
Results: The average age is 51.4±14.5 years. Nutrition status significantly deteriorated throughout the hospital course with the incidence of NSPCM and marasmus increasing from 20%-22% at the time of admission or pre-op to 77% post-op ($P<0.0001$) (Table1). Hospital and ICU length of stay was not different among these four groups. The overall mortality was highest in marasmus (100%) vs. 52% in malnutrition vs. 69% in at risk group and 42% in unclassified group ($P<0.034$). Among malnutrition and marasmus groups, 82 patients received early nutrition support, 31 received later nutrition support. Kaplan-Meier survival analysis shows a trend of better survival rate in early nutrition support (highest on the second year, 65% vs 42%) but does no reach significant level (log-rank $P=0.08$).
Conclusions: Malnutrition among VAD patients significantly increases post-operatively and is associated with increased mortality. Early nutrition support is likely better than the later for the long-term survival rate. Prospective studies are needed to minimize patient and treatment selection bias.

Table 1. Nutrition assessment at the time of admission, pre-op, post-op.

Patient classification by nutrition status	On admission	Pre-op	Post-op	p-value
				<0.0001
at-risk, N(%)	19(13)	20(13)	16(11)	
NSPCM, N(%)	26(17)	33(22)	108(72)	
marasmus, N(%)	3(2)	6(4)	7(5)	
unclassified, N(%)	102(68)	91(61)	19(13)	

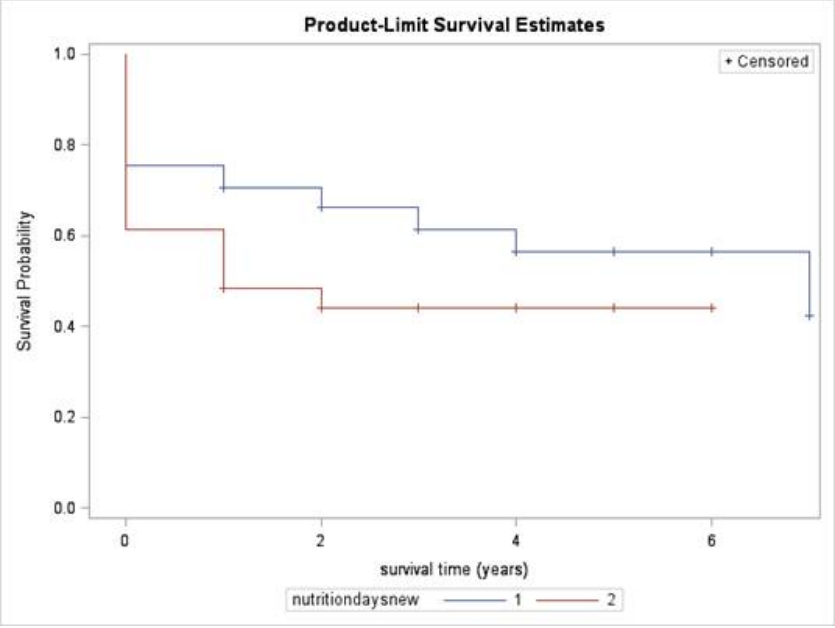
NSPCM: nonspecific protein calorie malnutrition

Table 2. Baseline characteristics and clinical outcome comparison among the four groups.

Variable	Unclassified (N-91)	At-risk (N=20)	NSPCM (N=33)	Marasmus (N=6)	p-value
age (yrs)	51.6 ± 15.4	51.1 ± 12.2	49.4 ± 12.6	60.3 ± 17.7	0.41
BMI (kg/m2)	28.8 ± 7.0	29.2 ± 5.2	27.2 ± 5.6	22.8 ± 3.3	0.1
hospital LOS (days)	55.4 ± 47.8	50.6 ± 32.2	52.8 ± 30.4	53.3 ± 25.0	0.97
ICU LOS (days)	24.9 ± 35.2	17.8 ± 11.2	16.4 ± 14.2	11.2 ± 5.2	0.34
EN, N(%)	44(48)	10(50)	19(58)	4(67)	0.8

NSPCM: nonspecific protein calorie malnutrition BMI: body mass index LOS: length of stay ICU: intensive care unit EN: enteral nutrition initiated

Figure 1. Kaplan-Meier survival analysis of early vs later nutrition intervention in NSPCM + marasmus group. 1=early intervention (blue line); 2=later intervention (red line). log-rank P= 0.86.



74 - Higher Body Mass Index Is Protective Early but Not Later in Ventricular Assist Device Patient Survival

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Purpose: The paradoxical impact of body mass index (BMI) on the clinical outcome of ventricular assist device (VAD) recipients has attracted considerable interest. BMI of patients suffering from congestive heart failure (CHF) may be confounded by fluctuations in their water weight. There is a paucity of investigations characterizing VAD patients by BMI. In this investigation we examine the association between BMI, nutrition status (as determined by a dietitian specializes in the management of CHF patients), and VAD outcomes. We hypothesize that malnutrition is common in overweight CHF patients and early nutrition intervention will improve their clinical outcomes after VAD.
Methods: This is a retrospective review in which 150 patients who received VAD from 2005 to 2011 were divided into two groups with BMI ≤ 24.9 (N=49, lean group) vs >24.9 (N=89, overweight group). Baseline characteristics, nutrition status and clinical outcome were compared. Subsequent analysis was conducted in overweight group comapre early (post-op ≤ 5 day) and later (post-op ≥5 day) nutrition support. We also applied the Kaplan-Meier methods to asses overall survival.
Results: Lean group has more cardiomyopathy ($p<0.009$) but the nutrition status is worse in overweight group ($p<0.05$). Hospital length of stay and ICU length of stay is longer in lean group than overweight group with $P<0.017$ and $P<0.05$ respectively. No difference in mortality rate at the time of discharge and overall mortality (Table 1). Kaplan-Meier survival analysis shows trend of higher survival rate in lean than overweight group (Log-Rank $P=0.06$) (Figure 1). Subgroup analysis in overweight group shows mortality is higher (39%) in later nutrition (21%) than early nutrition support with Kaplan Meier survival analysis shows significant difference with early nutrition high survival rate (Log-Rank $P<0.04$) (Figure 2).
Conclusions: Malnutrition status is worse in overweight group than lean group. Overweight patient has short hospital stay and ICU stay. However, the long time survival rate is likely worse in overweight patient. Early nutrition support improves the patient survival in overweight patient.

Table 1. Nutrition status in two groups at the time of admission.

Variable	Overweight (BMI>=24.9), N=89	Lean (BMI<24.9), N=49	p-value
			0.05
unclassified, N(%)	56(63)	34(69)	
at-risk, N(%)	15(17)	4(8)	
NSPCM, N(%)	18(20)	8(16)	
marasmus, N(%)	0(0)	3(6)	
hospital LOS (days)	48.8 ± 34.8	66.8 ± 51.4	0.017
ICU LOS (days)	17.6 ± 16.6	26.5 ± 36.7	0.05

BMI (kg/m2): body mass index NSPCM: nonspecific protein calorie malnutrition LOS: length of stay ICU: intensive care unit

Figure 1. Kaplan Meier survival analysis of overweight vs lean group. Blue line:lean group support, red line: overweight group. Log-rank P=0.06

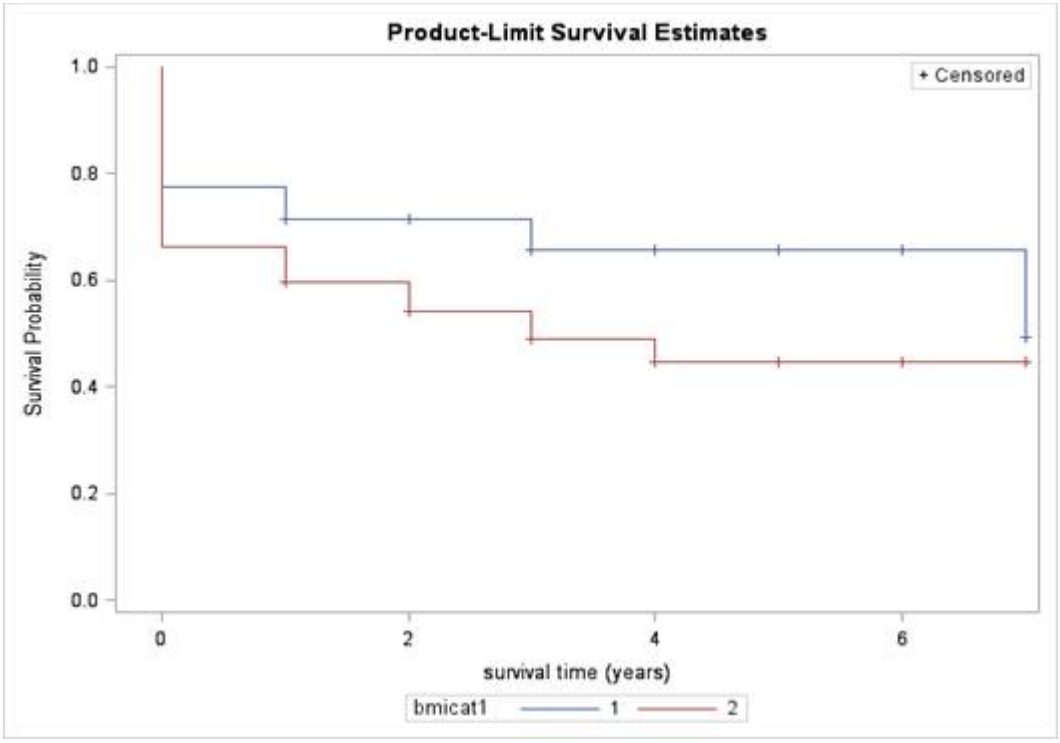
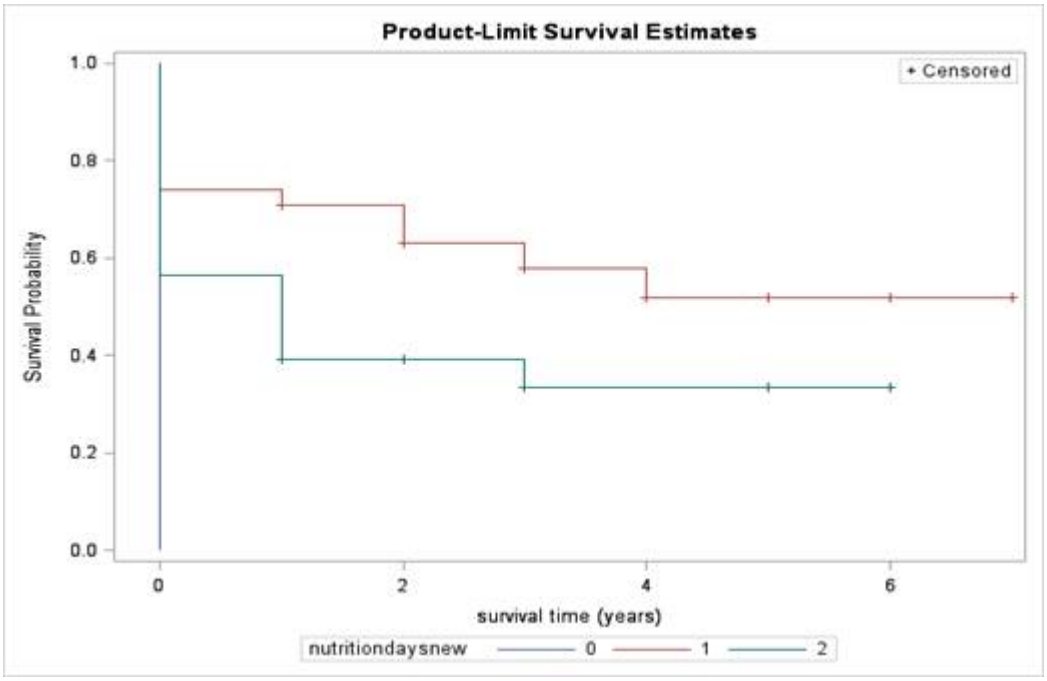


Figure 2. Kaplan Meier survival analysis of early nutrition support vs later nutrition support in overweight group. Blue line: early nutrition support, red line later nutrition support. Log-rank P<0.04.



75 - Administration of the Ketogenic Diet for a Patient With Medically Refractory Epilepsy and Frequent Admissions for Status Epilepticus: Overcoming Challenges With Diet Administration and Maintenance of Ketosis Upon Hospital Admission

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Introduction: Refractory status epilepticus (RSE) generally leads to poor outcomes, including high risk of morbidity and mortality. Ketogenic diet (KD) therapy is a high-fat, low-carbohydrate, adequate protein diet that may be administered via oral, enteral or parenteral routes. It has been found to be an effective treatment for epilepsy, particularly among children; however, little clinical data is available regarding the implementation of this therapy for adults with RSE.

Case Study: We describe the case of a 52-year-old female with history of hypothyroidism, hypertension, dyslipidemia and seizure disorder (complex-partial seizures, diagnosed at age 35), with frequent hospital admissions for status epilepticus (SE) who was successfully started on ketogenic enteral nutrition and transitioned to a modified Atkins diet (MAD) prior to hospital discharge. Hospital admissions for SE begun at age 49, increasing in frequency over the next two years, due to seizures refractory to at least seven anti-epileptic medications. Hospital courses were complicated by frequent and prolonged intubation, difficulty weaning from mechanical ventilation, ultimately leading to tracheostomy.

The decision was made to initiate the KD as a "last resort", with the overall goal to reduce frequency of seizure onset and subsequent hospitalization for SE. The KD was initially administered as enteral nutrition via feeding tube, and maintained until ketonemia and resolution of SE were achieved. Once cleared for an oral diet, the enteral KD feedings were weaned, transitioning to the 15-gram net carbohydrate MAD. To improve ketosis, 3-5 tablespoons (45-75 mL) of medium chain triglyceride (MCT) oil was added daily. Subsequent admissions have followed the same KD administration pathway.

Since initiation of the KD, the patient has experienced an overall 38% reduction in admissions for SE (13 during the 10 months prior to KD initiation versus 8 in the 10 months following KD initiation), with a 60% longer average length of time between admissions (2.96 weeks versus 4.75 weeks), a 27.4% weight reduction (27.5 kg), and improvements in dyslipidemia (total cholesterol 410 versus 265 mg/dL, triglycerides 385 versus 157 mg/dL, LDL 284 versus 166 mg/dL, and HDL 49 versus 68mg/dL).

Discussion: Challenges in administration of the KD with frequent hospitalizations primarily include prevention of carbohydrate-containing medications, as well as ensuring adequate delivery of fat. These challenges may be overcome with a multidisciplinary approach, involving KD-educated physicians, registered dietitians, pharmacists, nursing and kitchen staff, assessment of blood and urine ketones within 12-24 hours of admission, use of a dextrose allergy on the patient chart to prevent administration of carbohydrate-containing medications, a nutrition consult, readily-available ketogenic enteral and oral diets to ensure the KD is appropriately administered and maintained upon admission.

Table 1. Changes in outcomes pre- and post-initiation of the ketogenic diet (KD).

	Pre-KD Initiation	10 Months Post-KD Initiation	Change
Number of Admissions for Status Epilepticus	13	8	-5 (-38%)
Average Time Between Admissions (weeks)	2.96 (range 1-8)	4.75 (range 2-9)	-1.79 (-60%)
Weight (kg)	100.5	73.1	-27.5 (-27.4%)
Lipid Profile* (mg/dL) Total Cholesterol Triglycerides LDL HDL	410 385 284 49	265 157 166 68	-145 (-35%) -228 (-59%) -127 (-15%) +19 (+39%)

*Lipid profile reflects changes at 6 months following initiation of the KD

Table 2. Key steps for overcoming challenges associated with administration of the ketogenic diet (kd) among hospitalized patients.

1. Assess blood (beta-hydroxybutyrate) and/or urine (acetoacetate) ketones within 12-24 hours of hospital admission to assess compliance of the KD at home.

2. Place a \"dextrose\" allergy on the patient's chart to prevent administration of carbohydrate-containing medications, including special instructions to make all intravenous (IV) medications with normal saline and to maintain all oral medications in tablet, capsule or sugar-free solution forms.
3. Place a nutrition consult to alert the registered dietitians and kitchen of patient admission and the need for enteral or oral KD, as well as to assess diet composition and KD compliance prior to admission.
4. Maintain a stock of ketogenic enteral nutrition formula and medium chain triglyceride (MCT) oil to ensure ability to initiate and/or continue the KD upon admission to the hospital.
5. Create a specialized menu with no more than four grams net carbohydrate per meal, one gram carbohydrate or less per snack, with approximately 70% of total calories from fat.
6. Provide basic KD education to all staff involved in the care of a patient receiving the KD, including physicians, registered dietitians, pharmacists, nursing and kitchen staff. Discuss the basics of the KD, importance of ensuring adequate fat intake and preventing administration of carbohydrates (both from medication and diet), appropriate food choices, substitutions and portion sizes, and what to do if the patient inadvertently receives excessive carbohydrate, inadequate fat, or does not produce ketones.

76 - Mammary Gland Organ Culture Assesses Pomegranate Juice as a Chemopreventive Agent for Human Breast Cancer

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Purpose: The 2012 American Cancer Society statistics rank breast cancer as a leading cause of cancer related deaths in American women with currently available treatment options showing varied success. Chemoprevention involves using a synthetic or natural agent to prevent cancer before is has begun. Several drugs are currently approved for breast cancer prevention in high risk women, however identifying foodstuffs as chemopreventives can be a less expensive, non-invasive form of protection for the patients. Pomegranate (Punica granatum) fruit juice (PJ) has been shown to hinder cancer cell proliferation, as well as promote apoptosis in human breast cancer (HBC) and other cell lines. Feline mammary carcinomas have been identified as a suitable model for human breast cancer research because they are estrogen and progesterone receptor negative; over express the HER2 gene; and have metastatic tendencies. Although established human and feline cell lines are available, organ culture allows for in vitro study of treatment effects on heterogeneous cell populations, which is more indicative of the natural disease dynamics. Therefore, the objectives of this study were to 1) develop a sustainable feline mammary gland organ culture model; 2) evaluate PJ as a chemopreventive agent using the organ culture model.
Methods: Mammary glands were obtained from adult intact female cats identified at a local animal shelter immediately following euthanasia. Gland tissue was placed in a micro temperature-, humidity-, and perfusion-controlled culture system and exposed to various hormone supplementation (estrogen, progesterone, prolactin) for 48 hrs, then 7,12-dimethylbenz(a)anthracene (DMBA, 0-24 µg/ml) for 24 hrs. Tissue samples were obtained daily for 9 days for histological evaluation of preneoplastic lesions. Following establishment of our DMBA-induced lesion protocol, PJ was supplemented to the culture system (0-20%) with histological evaluation daily for 14 days.
Results: Glandular tissue from cats examined at time of harvest showed normal cellular architecture. The circulating perfusion system optimized cell-within-organ viability. Dysplastic lesions developed in gland tissue based on DMBA dose by culture day 9. The dose of 12 µg/ml DMBA resulted in dysplastic lesions in gland tissue as early as culture day 5. Pomegranate juice was protective against DMBA-induced cell dysplasia in a dose dependent manner with 5% resulting in maximum protection.
Conclusions: Based on histological evaluation of the culture gland tissue it was determined dysplastic lesions, identified as preneoplastic changes, were clearly identified in lactating and non-lactating gland tissue following treatment with DMBA in a dose dependent manner. Pomegranate juice, as a functional food, exhibited protection against DMBA-induced cell dysplasia. This model shows great potential as a physiologically-appropriate and short-response screening system for potential non-drug chemotherapeutics. Pomegranate shows value as a natural chemoprotective agent as well as a previously reported anti-tumorigenic agent for breast cancer, and has the potential to be incorporated into both human and feline diets at physiologic levels.

77 - Support in ICU Trauma Patients: A Systematic Review
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Purpose: National guidelines have been developed to guide nutrition support administration in ICU patients however trauma patients have been categorically excluded from all of these guidelines no meta-analyses of prospective randomized clinical trials (PRCT) in this population has been reported. Trauma patients are a unique ICU population because they tend to be young, healthy and in good nutritional status prior to injury. These characteristics limit the relevancy of feeding guidelines developed for other ICU patients for trauma populations. Therefore, we conducted a systematic review of PRCTs in trauma patients receiving nutrition support with the intention for meta-analysis of data abstracted.
Methods: PRCT's of enteral nutrition (EN) and/or parenteral nutrition (PN) in ICU trauma patients that reported relevant clinical outcomes (mortality rates, length of hospital/ICU stay, number of days on mechanical ventilation, and infection rates) were included. Trauma studies involving burn patients, spinal injury or closed head injury were excluded. A MEDLINE search was performed using Medical Subject Heading (MeSH) terminology. This was augmented with a PubMed search limited to non-MEDLINE articles. These articles (n=423) were scanned for relevance; 7 articles met the inclusion criteria and were entered into Web of Knowledge and articles citing them (n=1030) were scanned; no additional trials were found. Risk of bias was assessed using the Cochrane Collaboration's "Criteria for judging ‘Risk of Bias' assessment tool". Eight qualities (1 pt/quality, potential range 0-8) were assessed to compare the robustness of the data between studies.
Results: Overall significant findings for outcomes were sparse. The most recent trial was reported in 1999.4 Three compared EN to PN support,1,5,7 one compared EN to no nutrition support,2 one compared early to late EN,3 one compared early EN to 24 hrs of PN followed by EN,4 and one compared early EN to no nutrition for five days followed by PN.6 Significantly greater infections in participants randomized to PN were found in two studies comparing PN to EN. One trial found significantly higher infection rates in patients receiving early EN versus late EN.3 One found patients who received early EN (within 12-18 hours post-op) had fewer infections than patients who had no EN/PN for 5 days prior to PN.6 The mean score for "robust data" was 2.6 +1.1(range 1-4). Four studies lacked a clear hypothesis.1-3,6 Intention-to-treat analysis was used in only one trial.2 None described assessment of nutritional status at enrollment. Only one study included a non-fed control group2 and two studies specified the administration of insulin.1,7 After assessing trial design for vulnerability to bias, only one of the seven trials was at low risk of bias4 and five trials carried a high risk.1-3,6,7 Therefore, completion of a meaningful meta-analysis was not possible.
Conclusions: In the past two years five large well designed PRCT's of nutrition support in ICU populations have been reported, but blunt and penetrative trauma were not included in most of these studies and represented <10% of overall participants in the trials that did include them. Six of the 7 PRCT's in trauma patients were reported over 20 years ago1-3,5-7 and the most recent trial is 14 years old.6 Advances in trial design, glycemic control, and abdominal surgery have rendered the findings for these trials obsolete. High quality PRCT's with comparable methods and relevant outcome measures are urgently needed to inform the use of nutrition support in these patients.

Table 1 Study Design and Relevant Outcomes

Reference	Total/# per group	Patient Eligibility Criteria	Intervention	Number of Infections	Number of Patients with infection(s)	Days on Mechanical Ventilation	Length of Stay (days)	Mortality
Adams et al, *J Trauma,* 1986 (1)	46/ 23 exp 23 ctrl	Trauma patients, 18-60 years old, 80 – 130% of desirable body weight receiving laparotomy.	Experimental: TPN 14 d or until 70 oral intake Control: EN jejunal feeding Isocal HTN or Traumacal	Experimental: 15 Control: 15	Experimental: N/R Control: N/R	Experimental: 10 ± 10 Control: 12 ± 11	Experimental ICU:10±10 Hosp: 31±29 Control ICU:13±21 Hosp:30±2.1	Experimental: 3 Control: 1
Chuntrasakul, *J.Med.Assoc. Thai.*,1996 (2)	38/ 21 exp 17 ctrl	Trauma pts 26-33 years old w/ ISS 20-40.	Experimental: EN immediate feeding sup/PN if necessary Control: IV D5W	Experimental: N/R Control: N/R	Experimental: N/R Control: N/R	Experimental: 5.29±1.37 Control: 6.12±1.29	Experimental: ICU:8.14±1.37 Hosp:N/R Control: ICU:8.35±1.16 Hosp:N/R	Experimental: 1 Control: 3
Eyer, *J Trauma,* 1993 (3)	38/ 19 exp 19 ctrl	Blunt trauma pts w/ ISS> 13 expected to be ≥ 7 day post pyloric nutrition support .	Experimental: Early EN within 24 hours of admission. Control: Late EN ≥72 hours post-admit.	Experimental: 29 Control: 14 *	Experimental: N/R Control: N/R	Experimental: 10.2±8.1 Control: 8.1±6.8	Experimental: ICU:11.8±7.9 Hosp:N/R Control: ICU:9.6±6.7 Hosp:N/R	Experimental: 2 Control: 2
Kompan et al, *Intensive Care Med.*,1999 (4)	28/ 14 exp 14 ctrl	Mult. injured pts w/ ISS > 25 and a GCS >= 12, who recovered from shock < 6 days post-admission.	Experimental: Immediate EN Control: 24 hrs PN, then EN	Experimental: N/R Control: N/R	Experimental: N/R Control: N/R	Experimental: 8.0 (9.3-17.5) Control: 11.9 (6-17.7)	Experimental: ICU:11 (10.5-24.7) Hosp:N/R Control: ICU:14.0 (7.2-20) Hosp:N/R	Experimental: 0 Control: 1
Kudsk et al, *Ann.Surg.*, 1992 (5)	96/ 51 exp 45 ctrl	Pts with an acute trauma index of 15, inclusive of pts w/ excessive blood loss, re-op in first 72 hrs, ATI ≥ 40.	Experimental: EN Control: PN nutritionally equivalent to EN soln.	Experimental: 12 Control: 34*	Experimental: 12 Control: 20*	N/R	Experimental: ICU:N/R Hosp:36.6±9.4 Control: ICU:N/R Hosp:28.7±9.3	N/R
Moore, E.E. & Jones, T.N., *J Trauma,* 1986 (6)	63/ 32 exp 31ctrl	Pts with ATI > 15 receiving emergency celiotomy.	Experimental: Elemental EN 12-18 hrs post-op Control: IV D5W for 5 days, then TPN	Experimental: 3 Control: 9*	Experimental: 3 Control: 9*	N/R	Experimental: ICU:N/R Hosp:25.3±5.8 Control: ICU:N/R Hosp:28.6±6.1	Experimental: 1 Control: 2
Moore, F.A. et al, *J Trauma,* 1989 (7)	59/ 29 exp 30 ctrl	Pts with ATI >15 and <40	Experimental: Elemental EN Control:PN nutritionally equiv. to EN soln.	Experimental: 5 Control: 14*	Experimental: 5 Control: 11	N/R	N/R	N/R

*= Statistically Significant Finding N/R=not reported

Table 2 Issues Effecting Data Quality

Reference	Clear Hypothesis	Intention to Treat	Identified & Included Malnourished Patients	True Control Group	Specify Insulin	Methods Reproducible	Avoid Double Counting Infected Patients	Low Risk of Bias	Study Quality Comparison Score
Adams et al, *J Trauma,* 1986 (1)	No	No	No	No	Yes	Yes	Unclear	No	2/8
Chuntrasakul, *J.Med.Assoc. Thai.*,1996 (2)	No	Yes	No	Yes	No	Yes	N/A	No	4/8
Eyer, *J Trauma,* 1993 (3)	No	No	No	No	No	Yes	No	No	1/8
Kompan et al, *Intensive Care Med.*,1999 (4)	Yes	No	No	No*	No	Yes	Yes	Yes	4/8
Kudsk et al, *Ann.Surg.*, 1992 (5)	Yes	No	No	No	No	Yes	Yes	No	2/8
Moore, E.E. & Jones,T.N., *J Trauma,* 1986 (6)	No	No	No	No	No	Yes	Yes	No	2/8
Moore, F.A. et al, *J Trauma,* 1989 (7)	Yes	No	No	No	Yes	Yes	Yes	No	3/8

* Kompan had a control group of five healthy volunteers who received the treatment, but a true control would have been to provide neither early nor late EN to an unhealthy control group.

78 - A Case Report of Intravenously Infused Protein and Glutamine Powder Induced Septic Shock in a Burn Patient

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Purpose: Our intent is to report a case of a burn patient who intravenously self-administered enteral protein and glutamine powder following 1st and 2nd degree burns to both feet who subsequently developed signs and symptoms of septic shock and acute respiratory distress syndrome (ARDS).

Despite optimal nutrition support, patients sustaining major burn injury lose significant amounts of protein via wound exudate and urine during the first ten days following injury.1 Current recommendations suggest that 20-25% (1.5 - 2.0 g/kg/d) of total nutrient intake be provided as protein.2 Protein administration in excess of these amounts has not been shown to be beneficial and may cause azotemia.3

A variety of nutrients, including glutamine, have been studied in critical illness, trauma, and surgery for potential anti-inflammatory, immune-modulating, and cell protective effects. Glutamine serves as a fuel source for rapidly dividing cells, a precursor for the synthesis of nucleic acid, and plays a role in renal acid buffering.4 Glutamine induces heat shock proteins providing stress tolerance and protection from continued injury that could normally lead to apoptosis.4,5 SCCM/A.S.P.E.N. guidelines recommend enteral glutamine supplementation of 0.3 to 0.5 g/kg/d in trauma and critically ill surgery patients.6 Parenteral glutamine can be considered in the critical care setting at doses ranging from 0.35 to 0.5 g/kg/d.4

Description:

- 48 year-old male with obstructive sleep apnea, hyperlipidemia, depression, and anxiety was admitted for 1st and 2nd degree burns to both feet from a grease spill while cooking.
- Patient was discharged home that day with silver sulfadiazine 1% cream, oxycodone/acetaminophen 5/325 mg and his home medications pravastatin, olanzapine, and alprazolam XL.
- At his follow-up burn clinic visit 4 days after discharge, he was instructed to increase his protein intake; therefore, he purchased Triple Whey Protein Powder® and Glutamine Powder®.
- Per report from a family member, the patient intravenously infused a bag of normal saline mixed with protein and glutamine powder at home. Subsequently he felt cold, complained of pain, shivering, and diarrhea. He then infused an additional bag of normal saline without any powder and after thirty minutes started vomiting. Approximately one hour later, emergency medical services were called and the patient was taken to an outside hospital.
- He presented with hypotension, tachypnea, tachycardia, and hypoxia. He was intubated for respiratory distress and transferred to The Ohio State Wexner Medical Center (OSUWMC) Medical Intensive Care Unit (MICU) for further care.
- Refer to Figure 1 for a timeline of events during his OSUWMC MICU admission.

Figure 1. Timeline of events from OSUWMC MICU admission to discharge

Results: Figures 2 - 4 illustrate laboratory trends significant to hospital course.

Figure 2. White Blood Cell Count

Figure 3. Urine Output

Figure 4. Liver Function Tests

Conclusions: Intravenous self-administration of protein and glutamine powder can result in septic shock, ARDS, and multi-system organ failure. Other complications including seizures, arrhythmias, and acute systolic heart dysfunction can occur; however, these are likely secondary to shock. Intravenous self-administration of protein and glutamine powder should be avoided.

Day 1
- Patient arrived in septic shock and ARDS (PaO_2/FiO_2 = 105) for protein and glutamine overdose
- Fluids, broad-spectrum antibiotics, and vasopressors initiated for septic shock
- Poison Control Center contacted; recommended supportive care for protein and glutamine overdose; recommended N-acetylcysteine (NAC) if acetaminophen overdose suspected given recent history of oxycodone/acetaminophen

Day 2
- Liver function tests continued to increase; renal function continued to decline
- Three doses of NAC infused

Day 3
- Continuous renal replacement therapy (CRRT) started due to worsening metabolic acidosis and renal failure
- Four doses of methylprednisolone given for possible anaphylaxis
- Inhaled epoprostenol initiated for refractory hypoxemia on high ventilation settings

Day 5
- Vasopressors and inhaled epoprostenol weaned
- CRRT continued

Day 7
- Amiodarone bolus given for sustained supraventricular tachycardia; diltiazem continuous infusion initiated
- Found to be in atrial fibrillation with rapid ventricular response; amiodarone continuous infusion started since diltiazem infusion at 20mg/hr
- Maximum ventilation settings; inhaled epoprostenol increased; inhaled nitric oxide initiated; tried on bi-level mode of ventilation
- Still hypoxic with saturations of 70%; chest x-ray revealed complete atelectasis of left lung; changed from bi-level to assist-controlled mode; bronchoscopy performed; abundant bloody mucus plugs present in all airways and left mainstem bronchus completely impacted.
- After bronchoalveolar lavage (BAL) and suctioning, saturations were near 100% and peak airway pressures fell from 76 mmHg to 41 mmHg

Day 15
- Completed 14-day course of vancomycin and cefepime for empiric coverage
- Tracheostomy and percutaneous endoscopic gastrostomy tube placed

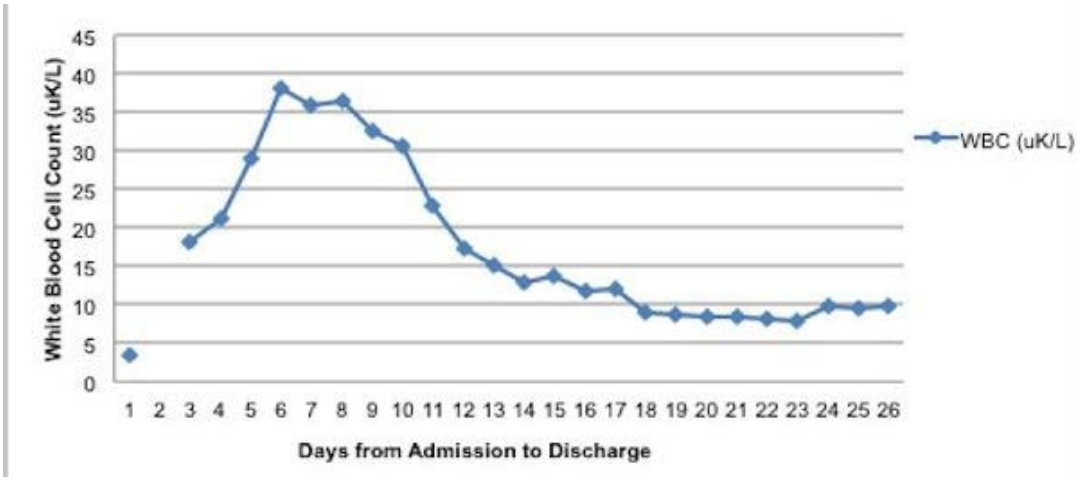
Day 16
- Seizure-like activity witnessed and resolved with 1mg IV lorazepam
- Mini BAL performed; cefepime and vancomycin restarted for lung and central nervous system coverage

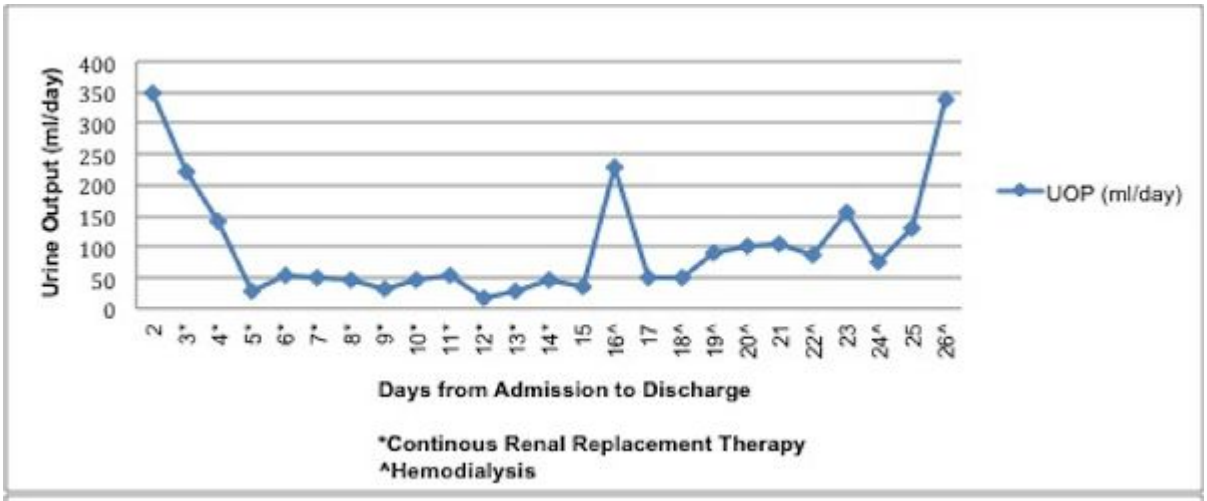
Day 17
- Neurology consulted and lumbar puncture performed due to concern for Herpes Simplex Virus encephalitis or meningitis; valacyclovir started
- A computed tomography head, magnetic resonance imaging brain, and a 24-hr electroenceohalography ordered
- All scans and tests negative; Neurology attributed seizures to metabolic abnormalities
- Antibiotics deescalated to a 14-day course of trimethoprim-sulfamethoxazole for stenotrophomonas maltophilia and MRSA pneumonia

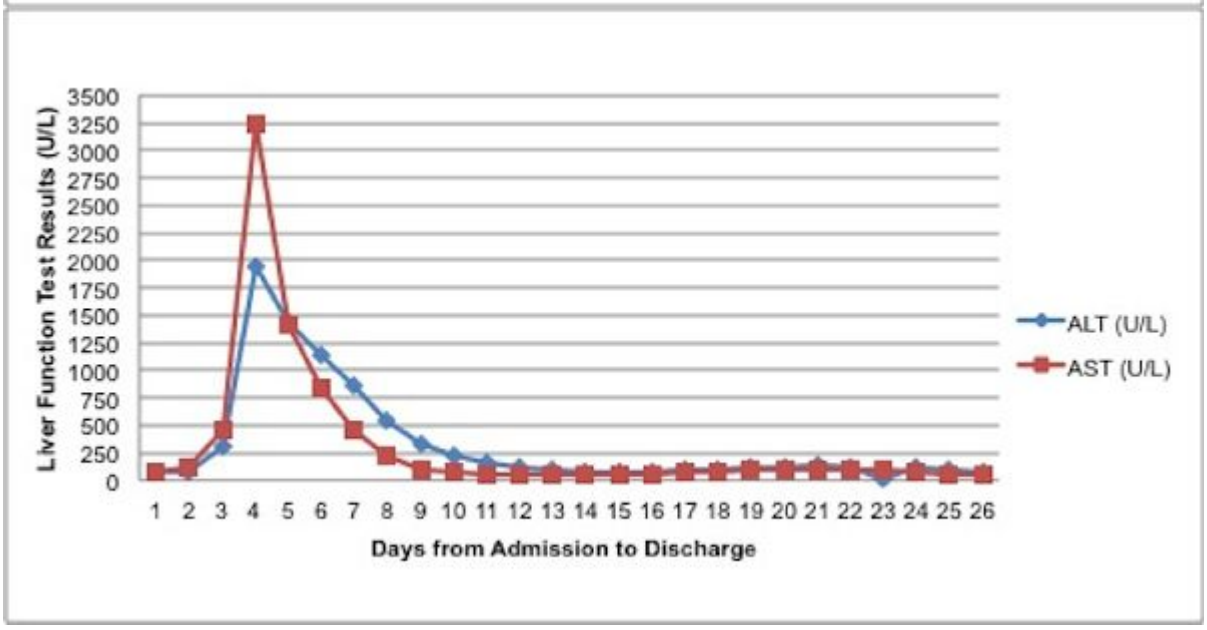
Day 21
- Permacath placed for intermittent hemodialysis

Day 23
- Above metatarsal amputation performed on left foot secondary to hypotension and hypoperfusion from septic shock

Day 26
- Weaned from ventilator to tracheostomy mask
- Transferred to a Long-Term Acute Care Hospital for further care and rehabilitation







79 - Gastrointestinal Side Effects and Adequacy of Enteral Intake in Hematopoietic Stem Cell Transplant Patients

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Purpose: Patients undergoing hematopoietic stem cell transplantation (HSCT) can experience gastrointestinal (GI) side effects as a complication of the treatment. There is limited research describing how the duration and severity of GI side effects influence the consumption of adequate calorie intake in this population. The purpose of this study was to assess differences in GI side effects in HSCT patients who consume adequate calories compared to those who consume inadequate calories during the course of their treatment.

Methods: A convenience sample of patients undergoing HSCT at a tertiary care urban academic medical center was identified to participate in the observational study. The MD Anderson Symptom Inventory- Gastrointestinal (MDASI-GI) tool was used to record GI side effects. Both a MDASI-GI component score, calculated from 13 core items and five GI items, and a MDASI-GI symptom score, calculated from four select core items and four select GI items, was recorded daily from day of transplant to engraftment. Daily calorie intake was determined via calorie counts. Adequacy of oral intake was defined as consuming greater than 60% of daily requirements. Additional data

were collected to describe the study sample, including age, race, gender, body mass index (BMI, defined as kg/meters2), HSCT type and conditioning regimen. Due to the small sample size data were presented as counts/percentages or median (25th percentile, 75th percentile); Mann Whitney U were utilized to determine differences in patients characteristics based on adequacy of oral intake. Spearman rank correlation determined the association between caloric intake and MDASI-GI component score/GI symptom score.
Results: Seventy-two patients were included in the analysis; the study population was 65% Caucasian and 64% male with a median age of 56.0 (50.0,63.0) years and median BMI of 28.0 (24.4,32.3). A majority of patients received an autologous (72%) compared to allogeneic (20%) and matched unrelated donor (8%) transplants. Median percentage calorie intake for all subjects was 49.2% (35.1,66.6) or 10.5 calories per kg per day (7.0,14.8). As seen in the figure, calorie intake decreased from baseline to transplant day 8 as severity of GI symptoms increased. Average calorie intake fell to below 60% of requirements by transplant day three. An inverse relationship between percentage of caloric needs met by total subjects and MDASI-GI component score (r_s=-0.28, p=0.019), MDASI-GI symptom score (r_s=-0.26, p=0.029), and lack of appetite score (r_s=-0.35, p<0.003) was observed. Allogeneic patients consumed a higher percentage of calories than autologous patients (60.3% [49.6, 76.2] versus 44.5% [30.8, 56.6], p=0.003). There were no significant differences in median MDASI-GI component scores or MDASI-GI symptom scores between those who consumed adequate calories compared to those who consumed inadequate calories. However, for those participants who consumed greater than 60% of caloric needs, significantly lower median diarrhea scores were observed (p<0.05). When stratified by type of HSCT, this was no longer significant. There was no significant difference in conditioning regimen between those who consumed adequate calories compared to those who did not.
Conclusions: Calorie intake was low from time of transplant to engraftment. Allogeneic subjects consumed a higher percentage of their caloric needs than autologous subjects. There were no significant differences in MDASI-GI scores between those who consumed adequate calories compared to those who did not. More research is needed to provide insight into strategies to increase intake and implications of prolonged inadequate intake.

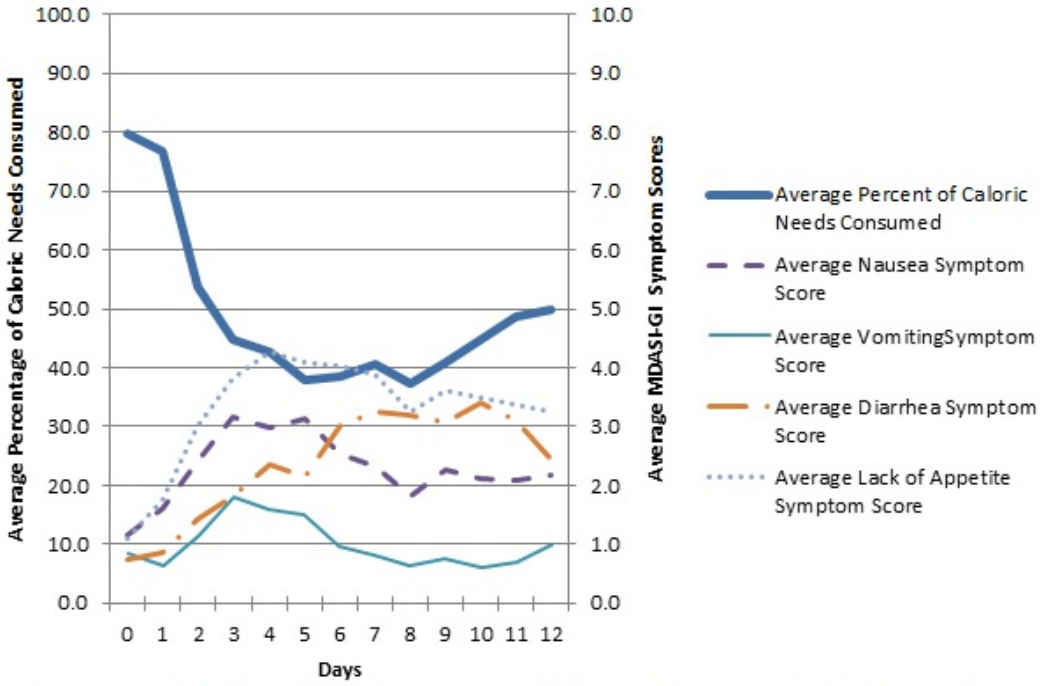

Figure 1. Average MDASI-GI Scores and percentage of caloric needs consumed in HSCT patients (n=72). Day 0= day of engraftment.

80 - Bacteriophage for Staphylococcus Aureus Central Venous Catheter-Related Infection: An In-Vitro and In-Vivo Model Evaluation

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Purpose: Bacteriophages are viruses that selectively infect and kill bacteria. The purpose of this project was to determine whether a bacteriophage antimicrobial lock technique can reduce bacterial colonization and biofilm formation on indwelling central venous catheters in a rabbit model.

Methods: In vitro: Twenty silicone discs were inoculated for 24h with broth culture of Methicillin sensitive staphylococcus aureus (0.5 McFarland standard). The inoculate was aspirated and discs placed into two equal groups for 24h: (i) untreated controls (ii) Bacteriophage treatment (Staphylococcal Bacteriophage K, propagated titer > 10^8). At the completion of the experiment discs were processed for quantitative culture. In-vivo: Cuffed central venous catheters were inserted into the jugular vein of 10 New Zealand White Rabbits under image guidance and tunneled in an intrascapular position. Catheters were then inoculated for 24h with broth culture of methicillin-sensitive Staphylococcus aureus. The inoculum was aspirated and rabbits were randomized into two equal groups for 24h: (i) untreated controls (heparinized saline lock), (ii) Bacteriophage antimicrobial-lock (staphylococcal Bacteriophage K, propagated titer > 108/ml). At the completion of the experiment, blood cultures were obtained via peripheral veins and the catheters were removed for quantitative culture and scanning electron microscopy. Statistical testing was carried out using the rank sum test.

Results: In vitro: Mean colony forming units (CFU) were significantly decreased in experimental compared to controls (control 6.3x 10^5, experimental 6.7x10^1, P = <0.0001). In vivo: Catheter CFU per cm2, as a measure of biofilm, were significantly decreased in experimental animals compared to controls (control 1.2x105, experimental 7.6x103, P = 0.016). Scanning electron microscopy demonstrated that biofilms were present on the surface of 5/5 control catheters but only 1/5 treated catheters (p=0.048). Blood culture results were not significantly different between the groups.

Conclusions: Application of bacteriophage to biofilm infected central venous catheter models significantly reduced bacterial colonization and biofilm presence. Our data suggests that bacteriophage treatment may be a feasible strategy for addressing central venous catheter staph aureus biofilm infections.

81 - Cost-Effectiveness Analysis of Oral Nutritional Supplements Among Patients With Lung Cancer

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Purpose: Deterioration of the nutritional status and appearance of malnutrition have been widely observed among patients with lung cancer under radiotherapy and chemotherapy (RT-CT). A prospective, randomized study focusing on effects of nutritional supplements on quality of life and toxicity of radiotherapy and chemotherapy in patient with lung cancer had been completed and published elsewhere and long-term survival follow-up results were recently collected.

This pharmacoeconomic analysis aimed to evaluate the cost-effectiveness of 3 different nutritional supplement strategies on time to death and metastasis in 4 years follow-up time.

Methods: Forty-five patients with lung cancer to whom similar thoracic radiotherapy applied alone or concurrent with similar chemotherapy and who had lost more than 10% of their body weight during the last 6 months had been included to the study. A comprehensive training on nutrition and nutritional support programs were provided for all patients during 5 weeks of RT-CT.

Patients had been randomized to one of the three nutritional supplement strategies; no oral nutritional supplement (ONS), standard ONS and immunomodulatory ONS, and were received these supplements during 5 weeks.

All patients were evaluated 4 years after RT-CT start in terms of metastasis and mortality.

The patients' demographics, characteristics of lung cancer and treatment modalities were previously reported as similar. Therefore only costs of oral nutritional supplements were included to this analysis, other costs were omitted. Incremental cost effectiveness ratios were calculated by using time to death and time to metastasis duration and average 5 week ONS usage costs.

Results: Long-term follow-up created 1187 patient-months data, based on these data; results of Kaplan Meier estimator revealed that means (95% confidence interval-CI) time to death of no ONS, standard ONS and

immunomodulatory ONS groups were 22.9 (16.5-29.4), 31.6 (24-39.3), 33.4 (26.3-40.5) months, respectively. Whereas means (95% CI) time to first metastasis of groups were 22.8 (17.6-28.1), 27.6 (18.9-36.4), 35.9 (27.5-44.2) months, respectively.
Incremental cost effectiveness ratios for ONS were given in Table 1.
Conclusions: Treatment of lung cancer is complicated and expensive for health care providers and social security systems. Malnutrition is widely observed in lung cancer patients. Some authors reported that annual treatment of a patient with lung cancer costs about 6000 Euro in Turkey.
Result of this analysis revealed that oral nutritional supplements (immune-enhancing or standard) seem to prolong time to death and metastasis for very affordable additional costs. The results of long-term projection models will be presented separately.

Table 1. Incremental cost effectiveness ratios of oral nutritional supplements.

	No ONS	Standard ONS
Time to death		
Standard ONS	29.9 Euro per LWG	-
Immunomodulatory ONS	26.4 Euro per LWG	9.8 Euro per LWG
Time to metastasis		
Standard ONS	54.1 Euro per MFW	-
Immunomodulatory ONS	21.2 Euro per MFW	2.2 Euro per MFW

LWG, life-week gained; MFW, metastasis free week; ONS, oral nutritional supplement.

82 - Determination of Usefulness in Early Recovery Perioperative Protocol for Patients Receiving Laparoscopic Colon Surgery

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[1]Department of Surgery, Kurume University Medical Center, Kurume, Japan; [2]Department of Surgery, Kurume University School of Medicine, Kurume, Japan.
Purpose: It had been consensus that enhanced recovery after surgery program (ERAS) was useful for the open colonic surgery however it was still not elucidated whether enhanced recovery protocol could be effective for the laparoscopic surgery. The aims of this study were to determine whether our perioperative early recovery protocol could reduce surgical stress as well as days of hospitalization in patients received laparoscopic colonic surgery.
Methods: Total number of 80 patients who received laparoscopic colonic surgery in our hospital was retrospectively analyzed. 33 patients were treated with conventional perioperative program (CO group), meanwhile 47 patients were treated with recovery enhancing perioperative program (ER group). Characteristics of patients, time until taking oral nutrition after surgery, days of hospitalization and serum CRP levels were obtained from medical record. Mann-Whitney U test, t-test and chi square test were employed for statistical analysis. A value of p less than 0.05 was considered statistically significant. Values were expressed by mean ± SEM.
Results: Characteristics of patients was almost same among the groups. Days until taking oral nutrition after surgery was 2.0 ± 0.6 in CO and 1.7± 0.3 in ER (ns). Days of hospitalization were 15.7 ± 3.5 in CO and 14.1 ± 2.3 in ER (ns). Serum CRP levels on 1 day after operation was not significantly different between groups.
Conclusions: There is no advantage in terms of surgical stress response and days of hospitalization in patients, who received laparoscopic colonic surgery, treated with perioperative early recovery protocol compared with conventional perioperative protocol.

83 - Current Nutrition Support Strategies Do Not Adequately Ameliorate Low Vitamin D Levels in the Critically Ill Patient

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Purpose: Vitamin D (Vit D) deficiency has been associated with increased length of stay, infection and mortality in the adult ICU population. While Vit D deficiency at the time of admission to the ICU has been associated with poor outcomes, it is unclear if repletion of Vit D ameliorates these complications. The purpose of this study is to evaluate if the current methods of nutritional support are adequate for correcting Vit D insufficiency/deficiency in the critically ill patient.

Methods: A retrospective chart review was performed on all patients admitted to the surgical/trauma ICU of a Level I trauma center. Vit D levels were drawn upon admission, at 72 hours and every 7 days until hospital discharge. All patients received nutritional support using a standard protocol. Vit D supplements were not administered. Insufficiency was defined as 25, hydroxyvitamin D <30 ng/ml and deficiency ≤ 20 ng/ml. The hospital lab was unable to quantify levels <13 ng/ml. Patients were divided into groups based on their nutrition support prescription during the first two weeks of hospitalization: enteral nutrition (EN) vs. regular oral diet. Data were analyzed using Mann-Whitney U-test and reported as median with IQR and percentages.

Results: During a 4 month period, 165 consecutive adult patients had serial Vit D levels drawn during their hospitalization. One hundred fourteen patients (69%) had Vit D insufficiency with 48 (42%) of these patients deficient. Seventy-one patients received EN and 94 patients received regular oral diet (Table 1). Prealbumin levels were drawn as needed. While no difference was found between the 2 groups, the EN group did show a significant increase between the 72 hr and week 3 prealbumin level [9 (7-11) vs. 18 (13-25); p=0.001]. Despite this group receiving 71% of their estimated daily enteral goals, only 52% of the RDI for Vit D was achieved. The regular oral diet group was not able to maintain prealbumin levels. It was outside the scope of this study to be able to quantify the intake of Vit D from the regular diet.

Conclusions: Critically ill ICU patients have a high incidence of low Vit D levels. In addition, these insufficient/deficient levels are not corrected with current nutrition support strategies. Whether correction of these abnormalities is feasible and clinically important is an area for future research.

Table 1. The effects of en vs. regular oral diet in restoring Vitamin D.

	All Patients	EN	Regular Diet	p-value
Number	165	71	94	
Age (years)	48 (30-68)	48 (29-69)	49 (30-67)	0.79
APACHE II	16 (12-22)	21 (18-26)	13 (9-17)	0.0001
ISS	13 (9-20)	17 (10-26)	10 (9-17)	0.003
Initial NPO hours	39 (15-26)	37 (26-60)	44 (26-81)	0.20
Initial Vit D (ng/ml)	25 (19-31)	24 (17-28)	25 (19-32)	0.05
72 hour Vit D	20 (15-26)	19 (14-25)	21 (16-28)	0.04
Week 1 Vit D (Day 4-7)	19 (14-26)	18 (13-25)	22 (16-27)	0.17
Week 2 Vit D (Day 8-14)	21 (14-28)	21 (14-28)	16 (13-30)	0.68
Week 3 Vit D (Day 15-21)	17 (13-27)	19 (14-27)	14 (13-32)	....
Week 4 Vit D (Day 22-28)	18 (13-26)	20 (15-27)	14 (13-15)	....

84 - Accurate Assessment of Caloric Requirements in a Critically Ill, Non-Obese Cancer Patient Population

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Purpose: The caloric requirements of critically ill, non-obese cancer patients are currently unknown and frequently extrapolated in the literature from data published for those without a cancer diagnosis. A previously published abstract at our institution illustrated higher caloric requirements in critically ill, obese cancer patients compared to current A.S.P.E.N./SCCM guidelines. The purpose of the current study was to assess the caloric needs of a critically ill, non-obese cancer patient population using indirect calorimetry and compare this to a frequently used estimation strategy. We hypothesized that critically ill, non-obese cancer patients have higher caloric requirements. The primary study objective was to determine if the estimation strategy of 25-30 kcal/kg/day accurately predicted caloric requirements in critically ill, non-obese cancer patients, as measured through indirect calorimetry. Secondary objectives included comparing measured energy expenditures (MEE) in critically ill, non-obese cancer patients with normal weight to those overweight, MEE in medical intensive care unit (MICU) patients to surgical intensive care (SICU) patients, and MEE in those with solid tumors to those with hematologic malignancies.
Methods: This was a retrospective review of critically ill, non-obese cancer patients in the intensive care unit (ICU) at the University of Texas MD Anderson Cancer Center from January 1, 2004 to February 28, 2013. IC was used to routinely assess MEE in ICU patients meeting IC protocol criteria. Screening of patients was performed per standing orders on mechanical ventilation order sets, post-op order sets and as needed per the Nutrition Support Team. All oncology patients ≥ 18 years of age with a body mass index (BMI) ≥ 18.5 kg/m^2 and < 30 kg/m^2 and who had at least one IC study performed during their ICU stay were included. Patients were considered having normal weight if body mass index was 18.5-24.9 kg/m^2 and overweight if BMI was 25-29.9 kg/m^2. Demographic data, patient comorbidities, recent surgical history, medications, and IC measurements were collected. All results are reported as the mean ± standard deviation in kcal/kg actual body weight.
Results: Fifty-three critically ill, non-obese cancer patients met the inclusion criteria and were included in final analysis. The mean BMI was 25 kg/m^2 (range 19.3-28.9 kg/m^2). MEE per IC was identified as 22.5 ± 6.6 with 74% of study patients exhibiting MEE below 25 kcal/kg/day. A statistically significant difference was found when comparing the MEE of normal weight cancer patients to those overweight per BMI (23.9 + 3.2 vs. 21.4 + 4.6, p = 0.04). We found no difference in the MEE between MICU and SICU patients (22.4 ± 3.6 vs. 22.5 ± 5.0, p = 0.93) and when MEE was compared between patients with solid and hematologic malignancies (21.9 ± 4.6 vs. 23.5 ± 3.4, p = 0.19).
Conclusions: Critically ill, non-obese cancer patients appear to have lower caloric requirements as determined from IC when compared to a commonly used estimation strategy of 25-30 kcal/kg/day. Clinicians without access to IC should aim for a caloric estimation of no more than 25 kcal/kg/day to prevent nutrition-related complications of overfeeding. Further studies are needed to ascertain if other predictive equations are more appropriate for use in this patient population.

85 - The Prevalence of Malnutrition and Thiamin Deficiency in Critically Ill Patients
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Purpose: Critically ill patients admitted to hospital with malnutrition are at risk for thiamin deficiency. Thiamin deficiency associated complications (Wernicke's encephalopathy, Korsakoff's syndrome and impaired cardiac performance) could adversely affect the outcome of patients in an already compromised state. The prevalence of thiamin deficiency in malnourished intensive care unit (ICU) patients is not known. Objective: To determine the prevalence of thiamin deficiency among critically ill patients whose nutritional status has been assessed using the Subjective Global Assessment (SGA).
Methods: Adult patients admitted to the medical ICU at a single tertiary care hospital were approached to participate and consent was obtained. Patients with a history of alcohol abuse were excluded. Medical charts were reviewed to confirm admitting diagnosis, medical/surgical history and use of medications and nutritional supplements. A trained Registered Dietitian completed nutritional assessments using the SGA to determine risk for malnutrition. Non fasting serum samples were obtained for the analysis of thiamin pyrophosphate (TPP), potassium, magnesium, phosphate and albumin on admission. Thiamin deficiency was defined as less than 10 nmol/L. Results expressed as mean ± SD.

Results: A total of 25 patients participated (mean age 60.5 ± 15.9 years; 15 male, 10 female; Body Mass Index 27.6 ± 10.2). 16 (64%) patients were assessed as malnourished. The prevalence of thiamin deficiency was 24% (6 patients) among the entire group. All of the thiamin deficient patients were malnourished and therefore, the prevalence of thiamin deficiency in malnourished patients was 38%.
Conclusions: There have been no studies examining thiamin levels in critically ill hospitalized patients. This study demonstrates that malnutrition, as determined by the SGA, is a risk factor for thiamin deficiency which is present in 38% of malnourished patients. Measurements of thiamin levels are not routinely available in most hospital ICU's. Therefore, empiric thiamin supplementation could be considered in malnourished ICU patients given that there are no major risks associated with this supplementation. A limitation of this study is that it was a single centre study conducted only within the medical ICU and hence a small sample size. A larger multicenter study to include all critically ill patients would be worth pursuing.

86 - Does the Subjective Global Assessment Predict Outcome in Critically Ill Patients?
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Purpose: The subjective global assessment (SGA) is a validated nutrition assessment tool that predicts outcome in different medical and surgical populations. Performing the SGA in critically ill patients may be more challenging as many patients are unable to provide their nutrition history and fluid overload may make physical assessment difficult. Therefore, its use in critically ill patients has not been well studied. Objective: To determine whether SGA predicts outcome in critically ill patients hospitalized in a tertiary care medical intensive care unit (ICU).
Methods: All patients admitted to a tertiary care medical ICU routinely undergo nutrition assessment with the SGA by a trained dietitian. This was a retrospective study that collected the following information from a chart review: Demographics, biochemical markers including serum albumin, anthropometrics, length of mechanical ventilation, length of ICU stay and mortality, and APACHE II score. Results are expressed as mean ± SD.
Results: Over a 6 month period, the charts of 57 admissions to the ICU were reviewed. The mean age was 60.1 ± 17.3, 51% male, weight 86.1 ± 25.6 kg, and BMI 29.7 ± 8.4. Nutrition status was as follows: SGA A (well nourished) - 65%, SGA B (moderately malnourished) - 19%, SGA C (severely malnourished) - 16%. Apache II Scores were not different between groups: SGA A - 20.5 ± 6.2, SGA B - 23.6 ± 7.6, SGA C - 22.2 ± 8.6. Serum albumin (g/L) was lower in malnourished patients compared with well nourished patients: SGA A - 26.3 ± 6.0, SGA B - 21.1 ± 5.1 (p=.01), SGA C - 22.2 ± 5.0 (p=.08). Mortality rates were associated with increased malnutrition (p = .004 Chi -squared testing: SGA A 10.8%, SGA B 45.5%, SGA C 55.6%. In survivors, there was no association between SGA and length of stay in the ICU or SGA and length of time on mechanical ventilation.
Conclusions: In this retrospective study, the prevalence of malnutrition in a tertiary care medical ICU was 35%. Malnutrition, as determined by SGA is associated with an increased mortality and therefore the SGA serves as a valuable prognostic tool that should be performed in all critically ill patients. Further studies are needed to determine whether critically ill patients classified as SGA B and SGA C benefit from aggressive nutrition support.

87 - Treatment with ω3 Fatty Acid Allevietes Mucositis in BALB/C Mice
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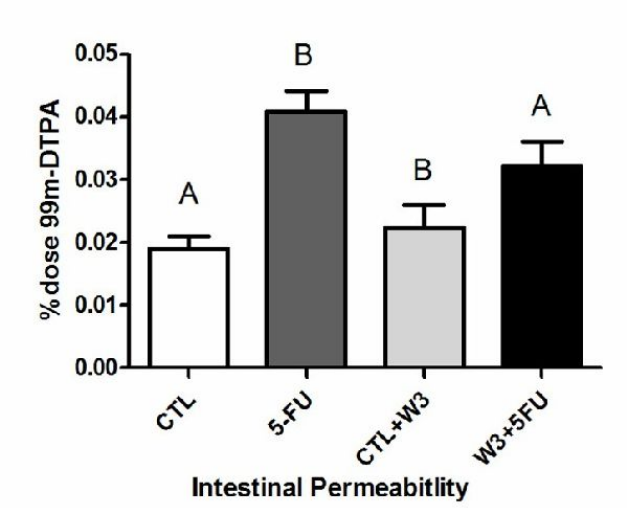
Purpose: Mucositis is a common side effect to cancer treatment and may predispose to intestinal mucosa damage. The administration of immunomodulators such as ω3 fatty acid should be an effective treatment to minimize those effects. The aim of this study was to evaluate the effects of ω3 fatty acids in an experimental model of mucositis
Methods: The experiments were procedure with BALB/c divided into four groups: Control (CTL), Mucositis (5-FU), Control+ω3 (CTL+ω3) and Mucositis+ω3 (ω3+5-FU). The animals of ω3 groups received a diet prepared with ω3 fatty acid (50% of total lipid content in the diet) during ten days before mucositis induction. Others mice received conventional AIN93G. On the tenth day the animals of group M and M+ ω3 received an intraperitoneal

injection of 200mg/kg of 5-FU for mucositis induction. After three days all mice received 0.1 mL of DTPA solution labeled with 18.5MBq of 99mTc by gavage. After four hours, all animals were anesthetized, and their blood was collected and placed in appropriate tubes for radioactivity determinations. Intestines were collected for histology analysis and cytokine measurement. Results from groups were compared using ANOVA with the Dunn test. The differences were considered statistically significant for $p<0.05$. All analyses were performed using the program GraphPadPrism.

Results: Intestinal permeability was higher in 5-FU group compared with CTL group ($p<0.05$). Treatment with ω3 was able to reduce intestinal permeability when compared with 5-FU group ($p<0.05$) (Figure 1). Reinforce these dates, histological data showed in the 5-FU group an increased amount of lamina propria cells, altered villus/crypt ratio, necrosis, hypersecretion of Paneth cells and inflammatory infiltration. However, ω3 treatment was able to reduce the intensity of those effects and maintenance of villous height. The ω3+5-FU group showed decreased of IL-6 production in ileum ($p<0.05$) but there was no significant difference in the in others cytokines levels (IFN, IL-4 and IL-10) ($p>0.05$).

Conclusions: Mucositis changes the intestinal mucosa and increase permeability. The pre-treatment with ω3 appears to alleviate this intestine damage.



88 - 30 Minute Protocols are Superior to 5 Minute Protocols for Resting Energy Expenditure Measurement in Chronically Ventilated Children

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Purpose: Traditional protocols of indirect calorimetry (IC) usually measure steady state (SS) resting energy expenditure (REE) in children over a period > 30 minutes. Owing to the challenges of IC in ventilated children, shorter duration protocols of < 5 minutes have been proposed as reliable alternatives to the longer measurement period for REE in this population.

Hypothesis: A 30 minute SS REE protocol is feasible in chronically ventilated children and such a protocol is superior to a 5 minute SS REE protocol.

Methods: IRB approved, prospective study with informed consent enrolled children (3mo-18yrs) that were chronically mechanically ventilated via cuffed tracheostomy with baseline FiO2 <0.60 and baseline oxygen saturation >92% cared for in the technology dependent Progressive Care Unit. Children with critical airway, inability to tolerate increase in FiO2, and inability to achieve resting state were excluded. IC was performed using Encore Vmax connected to a compatible Dräger ventilator with tracheostomy cuff inflated to minimal leak technique for 60 to 90 minutes to obtain at least 30 minute SS REE data (after excluding the first 10 minutes of measurement to allow for equilibration and excluding minutes with documented significant physical activity). Safety

was defined as ability to tolerate IC with no change in clinical status during IC. Feasibility was defined as ability to obtain steady state REE data (kcal/day) with a coefficient of variation (CV) <15%. The optimal 5 minute plateau within collected REE data was chosen to represent the abbreviated 5 minute SS REE protocol and compared to the 30 minute SS REE protocol.
Results: A total of 6 subjects (median age 8mo, range 4mo-6yrs) were enrolled and all completed IC. No subject experienced a change in clinical status during IC. 4/6 (66%) subjects required transition from baseline LTV ventilator to Dräger ventilator for IC and did not experience any complications. 5/6 (83%) subjects had baseline FiO2 < 30%. Total IC duration ranged from 54 - 84 minutes (mean 62 ± 11 minutes) and 6/6 (100%) subjects had at least 30 minutes of steady state REE data. 3/6 (50%) subjects were awake during IC and 3/6 (50%) had little or no movement during IC. Mean 30 minute SS REE was 225 ± 112 kcal/day. Mean CV was 11% ± 4%. Though CV of the 5 minute SS REE protocol was smaller than the CV of the 30 minute SS REE protocol (3% vs. 11%, p=0.003), the 5 minute SS REE protocol underestimated REE compared to the traditional 30 minute SS REE protocol in 4/6 (66%) subjects. Differences in REE (kcal/d) between 30 minute SS REE protocol and 5 minute SS REE protocol were as high as 14% (mean difference 6%) (Table 1).
Conclusions: A 30 minute SS REE protocol was feasible in chronically ventilated children. The 30 minute SS REE protocol appears superior to the 5 minute SS REE protocol for more reliable estimates of REE.
This work was funded in part by NIH/NCATS (National Center for Advancing Translational Sciences), Grant UL1TR000003.

Comparison of 30 minute SS REE protocol with 5 minute SS REE protocol in ventilated children.

Subject	1	2	3	4	5	6
Age	9mo	6yrs	8mo	8mo	4mo	6mo
Baseline FiO2, %	21	21	25	21	40	30
Ongoing weaning sedation	No	Yes	Yes	No	Yes	No
State during IC	Sleeping	Awake	Sleeping	Awake	Sleeping	Awake
Movement during IC	None	Rare	Yes	Yes	Yes	None
CV, kcal/d	0.09	0.11	0.09	0.08	0.19	0.11
REE with minimum of 30 minutes, kcal/d	142	218	220	434	115	220
REE with 5 minute SS, kcal/d	136	218	192	388	131	207
Difference, %	4	0	13	11	14	6

FiO2 : Fraction of inspired oxygen; IC: indirect calorimetry; CV: coefficient of variation; REE: resting energy expenditure; SS = steady state.

89 - A Comparison Between Measured and Estimated Caloric Needs for Mechanically Ventilated Patients in the Critical Care Unit
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Purpose: The key objective of the study was to compare measured metabolic assessments versus calculated metabolic assessments of mechanically ventilated patients to determine the impact on patient outcomes and possible associated cost reductions around patient care. The study included observations of 19 patients in the critical care unit (CCU).
Methods: Data was collected on patient cohort after 24 hours of post intubation using the metabolic gas analysis module (E-COVX-00) included as part of the Engstrom* Carestation* critical care ventilator. The metabolic assessment studies were initiated at, or after midnight when patients were most likely to be at steady state. All patients received Glucerna 1.20 via nasal gastric tube. The patient's resting energy expenditure was calculated using the Hamwi predictive equation. The same assessment was also conducted on each patient using indirect calorimetry technology which. Indirect calorimetry (IC) measures oxygen consumption and carbon dioxide production as a way of assessing energy expenditure and thus determining nutritional needs of the patient. The results of each assessment method were used for comparison.

Results: The results are taken from a sample of 19 patients that had an indirect metabolic calorimetry assessment performed in our critical care unit while intubated. The mean average number of ventilated days for all patients was 9.90 (SD 6.57).The observed mean average for calories measured was 1796.69 (SD 74.24). The observed mean average for calories calculated was 1817.20 (SD 358.16). A difference of only 1% (20.51 calories) was observed. However, when these results are examined on an individual patient basis, the differences are as high as 63.18% (overfed) or as low as 29.00 %(underfed) with a median of 8.14% (See Table 1). The difference in calories observed varied by as much as 1408.50, or as little as 1 calorie due to the fact that more metabolic variables are accounted for during measured assessments than during calculated assessments.
The cost savings associated with the 19 patients studied using the Glucerna 1.2 formulary was $34.85. Expansion of this study may lead to additional cost savings through decreased length of stay in CCU, reduced ventilator days, decreased TPN usage, and a decrease in infection rates.
Conclusions: In conclusion, 75% of the patients observed were being overfed, or underfed while intubated. These findings do not clearly represent the overall cost reduction potential due to unbalanced or inadequate feeding patterns with high distribution of under/overfed patients.
Predicted calculations, may be the current standard of care, however we must transition patient care toward tailoring clinical nutrition plans to specifically address individual patient needs and drive the most positive outcomes possible for mechanically ventilated patients.

Patient ID	Calories measured	Calories Calculated	Difference in calories measured vs calculated (%)	Over 10% difference (Yes/No)
1	1650	1800	9.09	No
2	1689.9	1885	11.55	Yes
3	1367.4	1705	24.69	Yes
4	1675.1	1796	7.22	No
5	1514.7	2062.5	36.17	Yes
6	1528.1	1363	-10.8	Yes
7	1738	1980	13.92	Yes
8	1364	1540	12.9	Yes
9	1818	2106	15.84	Yes
10	1432	1440	0.56	No
11	2627	1997.5	-23.96	Yes
12	1838	2407.5	30.98	Yes
13	2019	2451	21.4	Yes
14	1457	1504	3.23	No
15	2712	2328	-14.16	Yes
16	3141	1732.5	-44.84	Yes
17	2225	1980	-11.01	Yes
18	1374	1375	0.07	No
19	1755	1246	-29	Yes

90 - Outcomes of Systematic Nutritional Assessment and Medical Nutrition Therapy in Pancreatic Cancer

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Purpose: There is strong evidence in the literature demonstrating a positive correlation between well-nourished status and better clinical outcomes in oncology. However, very few studies have documented longitudinal outcomes of systematic nutritional assessment and Medical Nutrition Therapy (MNT) by a dedicated nutrition and metabolic support team (NMST) during cancer treatment. This study investigated whether or not MNT by NMST can improve nutritional status in patients being treated for pancreatic cancer.

Methods: A retrospective analysis was conducted of patients with pancreatic adenocarcinoma undergoing treatment at a national network of cancer centers between March 2008 and April 2011. The Subjective Global Assessment (SGA) was used to assess nutritional status at baseline and follow-ups. Patients were classified as: well nourished (SGA-A), moderately malnourished (SGA-B), and severely malnourished (SGA-C). Patients received Medical Nutrition Therapy (MNT) according to an algorithm based on SGA. All patients had a minimum of 3 SGA assessments done within 6 months from the date of baseline SGA assessment. Three hundred eight patients met that criterion during the specified time period. Using the baseline and last SGA, patients were categorized into 3 groups: Improved SGA, deteriorated SGA and unchanged SGA. Kaplan-Meier and Cox regression were used to calculate survival as a function of change in SGA status after controlling for relevant confounders.

Results: Of 304 patients, 183 were males and 121 females. Two hundred eighty patients had expired at the time of this analysis. One hundred ninety nine were analytic while 105 were non-analytic. The majority (192) had stage 4 disease at diagnosis. The mean age at diagnosis was 56.3 years. Median time between the baseline and the last SGA visit was 126 days. Median number of total visits was 4. At baseline, number of patients with SGA-A, SGA-B and SGA-C were 89, 155 and 60 respectively. Fourteen patients received tube feeding (2 SGA-A, 11 SGA-B and 1 SGA-C) and 42 received TPN (3 SGA-A, 25 SGA-B and 14 SGA-C). At the last follow-up, number of patients with SGA-A, SGA-B and SGA-C were 98, 145 and 61 respectively. Between the baseline and last SGA, 141 (46.4%) patients had their SGA unchanged (46 remained SGA-A, 79 remained SGA-B and 16 remained SGA-C), 87 (28.6%) had an "improved SGA", while 76 (25%) had a "deteriorated SGA". Overall median survival was 10.2 months (95% CI: 9.2 to 11.3 months). On univariate survival analysis, class of case, gender, evidence of biological anti-cancer activity, and change in SGA were significantly predictive of survival (Table 1). The median survival was 7.9, 10.5 and 12.6 months for deteriorated SGA, unchanged SGA, improved SGA groups respectively (Figure 1). On multivariate Cox analysis (Table 2), class of case, gender, evidence of biological anti-cancer activity, and change in SGA were independently predictive of survival. Patients with deteriorated SGA had a hazard ratio of 1.5 (95%CI: 1.04-2.0) compared to those with improved SGA.

Conclusions: The majority of this group of pancreatic cancer patients (75%) undergoing MNT by NMST either maintained or improved their nutritional status during cancer treatment. However, some patients still deteriorated, despite MNT. Improvement in SGA correlated with a significantly decreased risk of mortality independent of gender, class of case, and evidence of biological anti-cancer activity. Maintaining or improving nutritional status during treatment for pancreatic cancer may help patients have better outcomes.

Table 1. Univariate survival analysis (n=304).

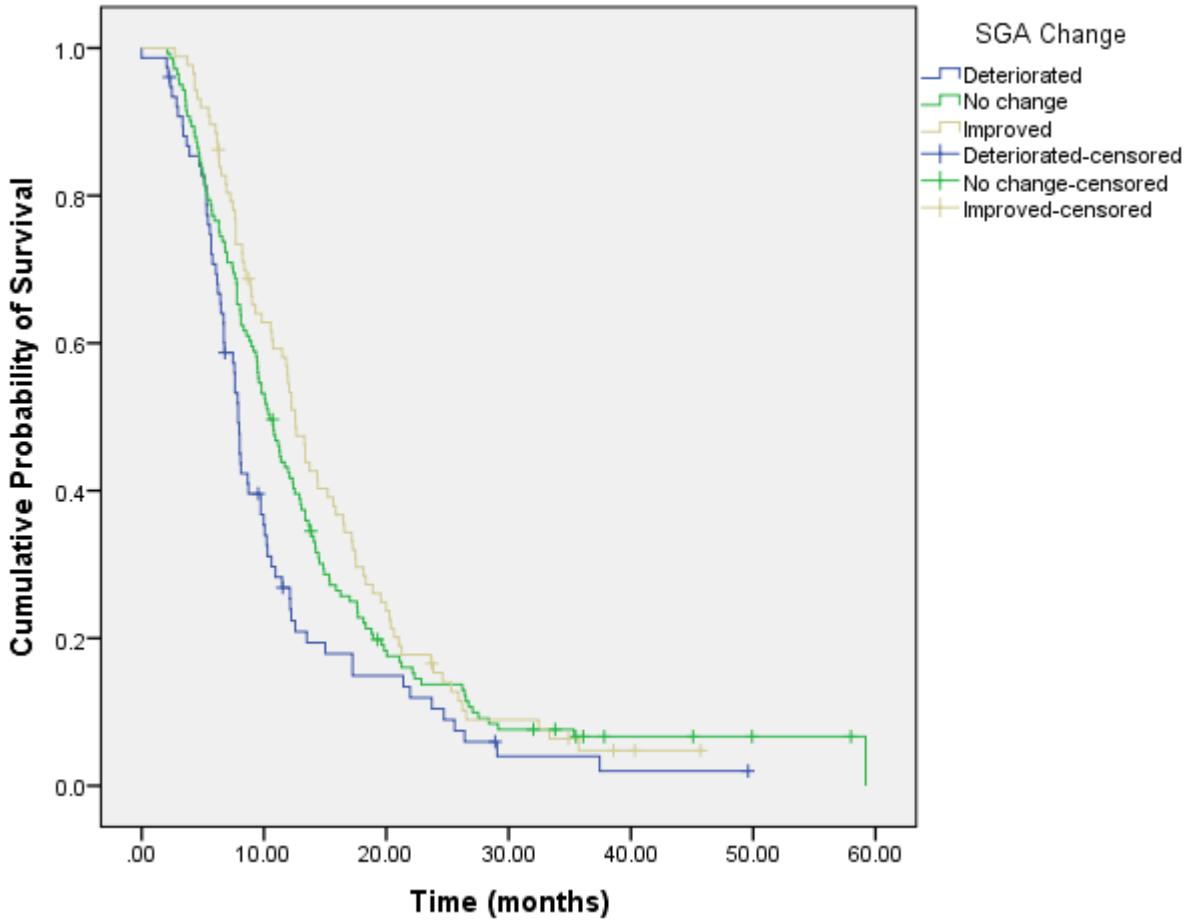
Characteristic	**Median Survival in months (95% CI)**	**P-value**
Class of Case	8.1 (6.6-9.6)	
• Non-analytic	12 (10.8-13.2)	**<0.001***
• Analytic		
Gender		
• Male	9.4 (8.1-10.6)	**0.02***
• Female	12 (10.5-13.4)	

Tumor Stage • 1 • 2 • 3 • 4	16.2 (7.3-25.2) 10 (6.6-13.4) 11.5 (9.4-13.6) 9.8 (8.7-11)	0.08
Tube Feeding • No • Yes	10.1 (9-11.2) 8 (2.9-13.1)	0.32
TPN • No • Yes	10.3 (9-11.7) 9.7 (7-12.4)	0.43
Radiotherapy • No • Yes	9.8 (8.6-11) 12.1 (10-14.2)	0.09
Chemotherapy • No • Yes	13.4 (1.9-24.9) 10.2 (9.3-11.2)	0.41
First SGA • Well-nourished • Moderately malnourished • Severely malnourished	12.1 (10.3-13.9) 9.4 (7.7-11.1) 8.2 (6.2-10.3)	**0.04***
SGA Change • Deteriorated • No change • Improved	7.9 (7.4-8.3) 10.5 (9.1-11.8) 12.6 (11.3-13.8)	**0.01***
Evidence of biological anti-cancer activity • Progression • Stable • Regression	7.5 (6.3-8.6) 11.4 (8.2-14.5) 12.5 (11-14)	**<0.001***

Dose Reduction in Chemotherapy • No • Yes	 10.3 (9.2-11.4) 8.9 (5.6-12.2)	 0.32

Table 2: Multivariate Cox regression analysis (n=304).

Characteristic	**Hazard Ratio (95% CI)**	**P-value**
Class of Case • Non-analytic • Analytic (reference)	 1.4 (1.1-1.8)	 **0.02***
Gender • Male • Female (reference)	 1.3 (1.01-1.7)	 **0.04***
SGA Change • Deteriorated • No change • Improved (reference)	 1.5 (1.04-2.0) 1.1 (0.80-1.4)	 **0.03*** 0.64
Evidence of biological anti-cancer activity • Progression • Stable • Regression (reference)	 2.0 (1.5-2.8) 0.99 (0.74-1.3)	 **<0.001*** 0.97



91 - Incidence of Micronutrient Deficiencies in Critically Ill Patients Requiring Continuous Renal Replacement Therapy: A Pilot Study

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Purpose: Continuous renal replacement therapy (CRRT) is better tolerated hemodynamically, more efficient in removing solutes, and offers relatively less hypotension risk compared to conventional hemodialysis. However, critically-ill patients who are on CRRT may be at increased risk of vitamin and trace element deficiencies. Trace elements and vitamins are vital micronutrients that have regulatory, immunologic, and antioxidant functions resulting from their actions as essential components or cofactors of enzymes throughout metabolism. Standard supplementation of trace elements and vitamins may not be adequate to meet nutritional needs during critical illness. The goal of this study is to identify the incidence of trace element and vitamin deficiencies in critically-ill patients who were referred to nutrition support service and required CRRT therapy.

Methods: This is a retrospective, chart review of adult patients who were referred to Emory University Hospital's (EUH) nutrition support services, required CRRT, and had vitamin B1, vitamin B6, vitamin C, vitamin B9, Zinc, Copper or Selenium levels during April 1st 2009 through June 1st of 2012. Patients without levels drawn were

excluded.
Documented micronutrient levels were recorded as well as demographic data and relevant treatments received. In addition, date when the levels were drawn, date of CRRT initiation, and discontinuation as well as CRRT mode and setting were recorded. Data were predominantly collected by reading clinical notes and reviewing historical laboratory data and medication records. Micronutrient levels were reported as a percentage of deficient patients and the duration of CRRT was reported as days on CRRT.
Results: Seventy five patients were included in our study (figure 1). The main ICU diagnoses were sepsis (32%), post-op (30.7%), and respiratory failure (22.7%). Table 1 shows study patient demographics. Vitamin B1 deficiency (16%) was lower than anticipated. As shown in table 2, significant deficiencies were observed in vitamin B6, zinc and copper, (66.7%, 40%, and 60.3% respectively). None of our patients had a deficient selenium level.
Study Limitations/Discussion
This is a retrospective study of which baseline micronutrient levels and consistency of lab draw time were lacking. Deficiencies can also be attributed to past GI surgeries, inflammation or baseline malnutrition.
Conclusions: Incidence of micronutrient deficiencies in critically ill patients who require CRRT may be higher than previously reported. Standard micronutrient supplementation may not be adequate to substitute losses during CRRT. The need for prospective study is warranted to delineate the optimal supplementation regimen.

Table 1. Patient demographics.

	N = 75
Age (year)	57 (17- 92)
Sex (male)	41 (54.7%)
Weight (Kg)	81.3
Body-mass index (kg/m2)	28.17 (± 5.93)
ICU diagnosis	Sepsis (32%) Post-op (30.7%) Respiratory failure (22.7%) Bleeding (5.3%) Others* (9.3%)
Past Medical History	ESLD (38.7%) GERD (26.7%) ESRD (25.3%) Malabsorption (16%) Malnutrition (16%)
Past Surgical history	GI surgery (25.3%)
Hospital Mortality	45.3%

*Others; Altered Mental Status, Hyperammonemia, Cardiac Arrest, Tylenol Overdose

Table 2. Micronutrient deficiencies.

Micronutrient	B1 (N = 56)	B6 (N = 57)		Vitamin C (N = 15)	B9 (N = 9)	Zinc (N = 25)	Copper (N = 68)		Selenium (N = 8)
Normal Range	70-180 nmol/L	5-30 ng/mL	20-125 nmol/L	≥ 0.4 mg/dL	5.9-24.8 ng/mL	≥ 60 mcg/dL	70-140 mcg/dL Male	80-155 mcg/dL Female	≥ 23 mcg/L
# of levels were deficient	9	38		13	3	10	41		0
Percentage	16%	66.7%		86.7%	33.3%	40%	60.3%		0%

GI & METABOLIC ISSUES. Abstracts #92- 108

92 - Successful Endoscopic Closure of Gastrostomy Site Using the Over-the-Scope-Clip (OTSC) in Case of Massive Gastrointestinal Bleeding After Early Inadverent G-tube Removal: A Case Report

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Purpose: We present a complex case of massive GI bleeding after inadvertent G-tube removal two weeks after its placement in patient who was anticoagulated. Control of both, GI bleeding and an excessive G-site serosanguineous drainage, were needed.
86 year old male with HTN, systolic heart failure (EF 40%), atrial fibrilation on Worfarin, dementia and G-tube was readmitted to hospital with sepsis. On hospital day 3, the patient became agitated and pulled out G-tube and his IV lines. He became suddenly hypotensive and tachycardic. He was transferred to ICU where he was intubated and vasopressors had to be initiated. Melanotic and later maroon stools were noted. His Hgb dropped to 5.5 g/dL from baseline Hgb 8.5 g/dL. His INR was 5.8. Patient was on Warfarin before admission. However, Warfarin was on hold since admission because of his INR was supra-therapeutic (5.0). ICU team ordered FFP and Vitamin K and Pentaprazole IV was started on. A large amount of serosanguinous fluid was draining from the site where G tube was previously located. 20-French PEG tube was placed 2 weeks before admission for failed swallowing study and underlying dementia. At that time, the endoscopic exam was normal. Patient received a total of 8 units of FFP, 6 units of PRBCs, and 5 mg of Vitamin K in the 24 hrs.
Emergent EGD was performed after INR was less than 1.8. Active bleeding was found at the prior G-tube site. The bleeding site was injected with 4 mL of epinephrine (1:10,000 solution) and hemostatic clip x 1 was placed successfully over the bleeding vessel. Bleeding had stopped after the hemoclip placement. The prior G-tube opening was closed with over-the- scope-clip with a single deployment to prevent further bleeding and control of external fluid drainage. Overnight patient had only one melanotic stool. His Hgb remained stable around 8 g/dL next 24 hr. Significant reduction of serosanguineous fluid drainage was noted from prior G-tube site. Chest x-ray showed no air under the diaphragm on the following day after EGD. Patient was off vasopressors within 36 hr. after procedure. No GI rebleeding was documented. Repeat endoscopy was performed 6 days later for anemia. The OTSC clip was seen in the position without evidence of bleeding. The patient was discharged home after 14 days of hospitalization.

93 - Uncommon Complications (Gastro-Colic Fistula and Gastric Stricture) After Laparoscopic Sleeve Gastrectomy: Report of Two Cases
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Background: Laparoscopic sleeve gastrectomy (LSG) is widely adopted as a low complication procedure for morbid obesity but may lead to serious complications. Over the years, unique complications have been demonstrated by the increasing number of surgical interventions. We present 2 cases of rare complications of LSG.
Case 1.
21 year old male with morbid obesity (BMI 44), s/p sleeve gastrectomy (LSG) 6 months ago (done outside US) was admitted after syncopal episode at the local airport. He had left shoulder pain x 5 months and daily nausea/vomiting x 2 months. He sustained weight loss of 80 lbs over 6 months. Sepsis and possible gastric leak were suspected due to identified complex LUQ fluid collection/ left pleural effusion. Work up lead to diagnosis of gastro-colic fistula and gastro-pleural fistula based on UGI study/CT scan. Drainage of pleural collection and left paracolic gutter fluid collection was performeed by radiology. Patient underwent complex surgery including exploratory laparotomy, extensive lysis of adhesions, proximal gastrectomy with Roux-en-Y esophagojejunostomy (70 cm alimentary/40 cm biliopancreatic limb), and subtotal colectomy with ileo-sigmoid anastomosis. He required 2 weeks of PN. His hospital course was complicated by acute renal failure, deep venous thrombosis of upper extremity, and peripheral neuropathy. He was discharged after 33 days of hospitalization in stable condition.
Case 2.
40 year old female with history of obesity (BMI 35), s/p sleeve gastrectomy LSG (done outside US) presented with inability to eat solid food x 9 months since LSG. She lost 85 lbs. since LSG. Postsurgical course was complicated by inability to advance diet to solids. She was diagnosed with a gastric stricture within 1 week post LSG. She had endoscopic dilations (up to 20 mm) x 3 of gastric stricture over 6 months without improvement. She was able to tolerate liquids only and still loosing weight on liquid caloric supplements. Her recent weight was 119 lbs. Upper GI study revealed moderate mid-stomach stricture 1-2 cm in length without proximal gastric dilation. EGD showed mid stomach stricture allowing passage of the scope. She is awaiting surgical intervention (myotomy vs. R-Y gastric bypass) to correct the gastric stricture.
Conclusions: High index of suspicion is critical for early recognition of serious and potentially life-threatening complications in patients after LSG typically associated with a relatively low complication rate. Selection of imaging studies and timing interventions are important and may prevent severe protein-calorie malnutrition in obese

patients. The number of LSG complications may be on the rise because of significant increase in number of performed surgeries.

94 - A Retrospective Analysis of Thiamine Deficiency in Oncology Patients

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Purpose: Thiamine plays an active role in energy metabolism. Deficiency has been observed in certain populations such as those with gastrointestinal (GI) surgery, chronic malnutrition, and certain cancers including hematological and sarcoma. The purpose of this study was to determine if thiamine deficiency is prevalent in oncology patients treating at Cancer Treatment Centers of America at Southwestern Regional Medical Center (CTCA-SRMC), regardless of primary oncology diagnosis or nutritional status.

Methods: A retrospective chart review was conducted for all patients who had a thiamine lab ordered by a physician at CTCA-SRMC from June 9, 2011 to February 15, 2013. Lab was primarily ordered due to symptoms such as chronic nausea, fatigue or diarrhea. Citrix Sunrise Clinical Manager version 6.0 was the electronic medical record used. Subjective data analyzed included history of gastrointestinal (GI) tract surgery excluding cholecystectomy, chronic diarrhea, fatigue, nausea, diuretic use, probiotic use, and thiamine supplementation. Objective data included primary oncology diagnosis, TPN use, metastatic disease, and living status. SAS Business Analytics software was used for statistical analysis.

Results: Of the 130 patients tested for thiamine, 39% were deficient. A thiamine level less than 10 nmol/L was considered to be low based on thiamine reference range. Chronic diarrhea within one week of lab draw revealed a positive relationship with thiamine deficiency ($p=0.002$). There was no correlation between nausea, fatigue, metastatic disease, history of GI tract surgery, thiamine supplementation, or diuretic use and thiamine deficiency ($p>0.05$). Patients who were on TPN within one week of lab draw were more likely to have adequate levels of thiamine ($p=0.0012$). There was no relationship between primary oncology diagnosis and thiamine deficiency ($p>0.05$).

Conclusions: Based on the RDA set by the IOM in 1998, it would be expected that less than 3% of the general adult population should be deficient in thiamine if the RDA was consumed daily. Deficiency was observed in 39% of tested oncology patients, albeit an at-risk group. This study highlights the possibility that oncology patients, regardless of primary diagnosis or malnutrition risk, are more likely to be deficient in thiamine.

Poster Abstract of Distinction

95 - Development of a Coculture Model of the Intestinal Epithelium to Study Barrier Function and Immune Exclusion by Bovine IgG

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Purpose: An intact intestinal epithelial barrier prevents bacterial translocation, whereas a damaged barrier loses its functionality and can result in unregulated bacterial and luminal antigen exposure to immunoreactive cells in the lamina propria. Left unchecked, the flood of luminal antigens can lead to inflammation and other serious health complications. *In vitro* models of intestinal barrier function provide insight into immune exclusion and prevention of antigen translocation. We have developed a model system where THP-1 monocytes are co-cultured with C2BBe1 (Caco-2 clone) cell monolayers to better approximate the interplay of immune cells and the epithelial lining of the gut. We used this model to investigate the effect of serum bovine-derived immunoglobulin/protein isolate (SBI) on tight junction integrity and bacterial component translocation by monitoring monocyte response.

Methods: C2BBe1 cells were seeded onto permeable inserts of a 24-well HTS-Transwell Culture System (Corning; Corning, NY) at a concentration of 1×10^5 cells/cm^2 and cultured for 21-days until transepithelial electrical resistance (TEER) was > 260 Ω*cm^2. Apparent permeability was determined by the addition of horseradish peroxidase (HRP, 39 kDa) to the apical compartment and measurement of HRP in the basal compartment over five hours using a standard HRP/TMB reaction and absorbance measurement.

Co-culture experiments were conducted by the addition of THP-1 cells (2×10^5 cells/well) to the basal compartment of day 21 C2BBe1 cultures. *E. coli* K12 lipopolysaccharide (LPS, Invivogen; San Diego, CA) was added to the apical compartment and translocation was quantified using a LAL assay (Lonza; Allendale, NJ) according to manufacturer's instructions and by THP-1 production of IL-8. Cytokine measurements were conducted using Luminex Technology (Bio-Plex MAGPIX; Bio-Rad, Hercules, CA) and comparison with a standard curve of LPS treatments.

Results: We have developed an analytical relationship between the measured TEER value and HRP permeability, Figure 1. The data indicates the permeable insert of the HTS System contributes a large amount of permeability resistance to large biomolecules as only 12% of HRP is translocated across a membrane without any cells. However, the apparent permeability decreases to 0% as the TEER value increases to 260 Ω*cm^2.
We have challenged fully-developed C2BBe1 membranes with apical treatments of LPS and other agonists and assessed the biological response of THP-1 monocytes using flow cytometry and cytokine analysis using Luminex Technology. Apical treatments of up to 500 ng/mL of LPS are prevented from translocating to the basal compartment, and THP-1 monocytes, with a 99.8% efficiency over 24 hours as determined by the analysis of inflammatory cytokines IL-8 and TNF-α. SBI contains high concentrations of bovine IgG, which we have demonstrated has high binding titers to a variety of bacterial components including LPS, flagellin, and peptidoglycan. Subsequently, we have used the co-culture model system to determine if SBI binding to LPS, or other bacterial antigens, inhibits translocation.
Conclusions: The ability to directly monitor monocyte response to apical agonist treatments has resulted in the development of a highly sensitive assay that accounts for the effects epithelial cell signaling cytokines on immune cell response. This system provides a unique methodology to study the functional neutralization aspects of SBI as well as other clinically relevant nutritional and pharmacologic products. The co-culture system will also be used to investigate compounds capable of affecting restoration of barrier function following damage to the intestinal epithelium from injury or disease.

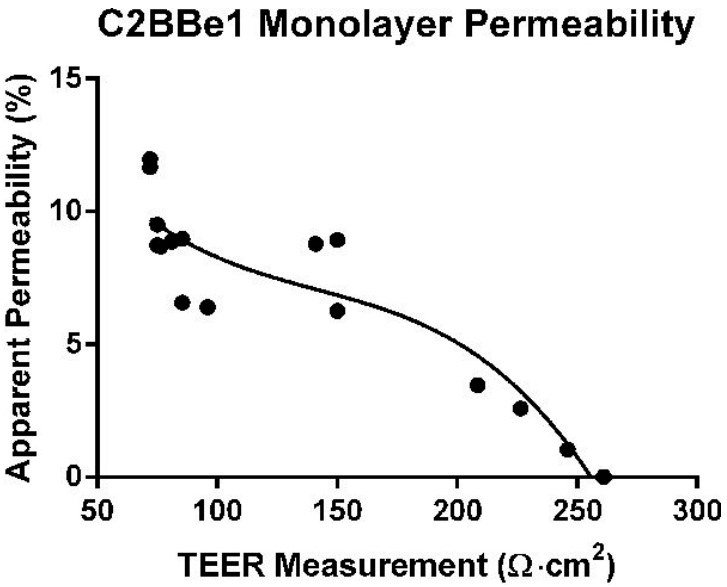

Figure 1. The relationship between measured TEER value across a C2BBe1 cell monolayer and the apparent permeability of a biological compound (HRP) can be approximated with the following equation, Permeability (%)=18.62-0.19*X+1.21*10^{-3}*X^2-2.86*10^{-6}*X^3.

96 - Relationships Between ALT, Serum Triglycerides, and BMI in a University Outpatient Pediatric Population Diagnosed With NAFLD
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University of New Mexico, Albuquerque, NM.
Purpose: Nonalcoholic fatty liver disease (NAFLD) is the most prevalent chronic liver disease in children and adolescents. Factors associated with NAFLD include BMI ≥85th percentile, large waist circumference, elevated serum triglycerides, elevated ALT and insulin resistance. Hispanic children and adolescents may be at increased risk for NAFLD. The University of New Mexico Hospital (UNMH) clinic system serves patients across the entire state of NM and therefore, offers medical care to a widely diverse and largely Hispanic and Latino population. Lack of standardized diagnostic criteria limits diagnostic capabilities and thus, many clinicians base their diagnosis on a combination of clinical, anthropometric and biochemical findings obtained during a medical examination. The goal of this study was to describe the demographic, anthropometric and biochemical data of children and adolescents

diagnosed with NAFLD during a seven-year period in an outpatient pediatric clinic and to evaluate relationships between race, BMI, ALT, triglyceride levels, age and gender with a diagnosis of NAFLD.
Methods: A retrospective medical record review of patients who attended any UNMH outpatient pediatric clinic between January 2005 and September 2012 was conducted. Inclusion criteria was age less than 18 and a billing diagnosis ICD-9 code of 571.8 (Other chronic non-alcoholic liver disease). To add specificity, it was required that records retrieved also contain an additional diagnosis from the group (BMI pediatric 85th-95th percentile; BMI pediatric ≥95th percentile; overweight; obesity NOS; hyperlipidemia NEC/NOS). Patients at UNMH are rarely biopsied to diagnose NAFLD; diagnosis is made when ALT is elevated and other causes of ALT elevation are ruled out.
Results: Forty one patients met these criteria. The majority of patients with NAFLD were male (74%) which is consistent with other studies; Hispanic (32%), Hispanic/Latino (68%). All patients were obese with an average BMI > 97th percentile and average BMI z-score of 2.3. At baseline (first clinic encounter) the mean ALT level for both males and females was 88.5 U/L and at the final clinic encounter was 73.1 U/L. At all ages, ALT levels were >40 U/L with the highest levels found in the 15-18 age group at both baseline and final clinic encounters. Mean TG at baseline for both genders was 151 mg/dL (females 161 mg/dL, males 148 mg/dL). Average TG level at the final encounter was 164.0 mg/dL (females 212 mg/dL, males 151 mg/dL). Average percentile BMI at baseline was 98.2 and at the final encounter was 98.1. There was a statistically significant difference between BMI and gender ($p>.01$) at the final encounter but no statistical difference in BMI percentile or BMI z-score.
Conclusions: The small number of patients (1%) diagnosed with NAFLD in our study is consistent with previously reported results. It appears that this condition is being under-diagnosed, especially when one looks at the overall prevalence of NAFLD in the US and in the Hispanic population in particular. This could be due to several factors including the lack of standard criteria for the diagnosis of NAFLD. The results of this study indicate that the population of this culturally diverse and high risk population has significant clinical markers which are indicative of NAFLD.

Encore: Previously published in the Journal of Pediatric Gastroenterology and Nutrition. Previously presented at NASPGHAN 2013. Republication withheld at request of author.

97 - Eosinophilic Colitis Is Associated With Functional Constipation in Children

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98 - Congenital Sucrose-Isomaltase Deficiency: An Underdiagnosed Disease in Chinese Children

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Purpose: Congenital sucrase-isomaltase deficiency (CSID) is a rare genetic disorder. The prevalence of CSID in Chinese population is unknown and no single case has been reported. We diagnosed 3 cases of CSID in Chinese children using glucose and sucrose tests.
Methods: Sucrose tolerance tests were performed in three children suspected of CSID. Glucose tolerance tests were performed to exclude glucose malabsorption. Blood glucose was measured at fasting and at 30 min, 60 min, 120 min, and 180 min of the study. Gastrointestinal symptoms were recorded up to 4 hours after the study.
Results: From December 2008 to June 2011, three children, ranging from 16 to 19 months old, were referred to our tertiary children's hospital due to chronic watery diarrhea and failure to thrive. Laboratory investigations including complete blood counts, ESR, CRP, and serum immunoglobulins were normal. Routine stool culture for bacteria and exam for parasites were negative. Upper endoscopy, colonoscopy and histology were unremarkable. All children failed lactose-free and amino acid-based formulas. All three children had flat sucrose tolerance tests and began to have watery stool 2-4 hours after feeding sucrose test solution. The glucose tolerance tests were normal and no children developed watery stools up to 4 hours after feeding glucose test solution.
Conclusions: This is the first case series of CSID in Chinese children. The diagnosis of CSID can be made based on clinical suspicion and sucrose tolerance test. CSID is probably an under-diagnosed or misdiagnosed disease in Chinese children and should be considered in children with chronic watery diarrhea.

99 - Individualized Approach to Nutrition in the Home Mechanically Ventilated Child: Opportunities for Optimal Feeding and Lean Body Mass Preservation?

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Purpose: Children with chronic respiratory insufficiency on home ventilatory support may be at risk of malnutrition. Comprehensive nutrition and metabolic assessment may allow individualized prescription of nutrients and monitoring of nutritional status in this vulnerable population. We aimed to describe the nutritional status, body composition, metabolic state and macronutrient intake in this cohort.

Methods: Children with chronic respiratory failure requiring at least 12 hours of home transtracheal mechanical ventilation were enrolled in this prospective cohort study. Patients with, FiO2 >60%, recent acute illness, or change in ventilator settings were excluded. A multidisciplinary team performed a home-based comprehensive nutritional and metabolic assessment, including, anthropometric measurements, bioelectric impedance assay (BIA), indirect calorimetry (IC) and 3-day diet recall. Mid-upper arm muscle area (MUAMA) percentile, lean body mass (LBM) and fat mass (FM) were calculated from mid-upper arm circumference and tricep skinfold, using previously published equations. LBM and FM were also obtained by BIA (noted BIA-LBM, BIA-FM) and their correlation and agreement with anthropometry based values (A-LBM and A-FM) was assessed using linear regression and Bland-Altman analysis, respectively. Measured resting energy expenditure (MREE) was obtained by IC and estimated energy expenditure (EEE) was calculated using the Schofield equation. Subjects were classified as hypometabolic (MREE:EEE <90%), normometabolic (MREE:EEE 90-110%) or hypermetabolic (MREE:EEE > 110%). Actual energy intake (AEI) to MREE ratios were used to categorize patients as underfed (AEI:MREE <90%), adequately fed (AEI:MREE 90-110%) or overfed (AEI:MREE >110%). Data are presented as frequency and means (range).

Results: Data from 11 subjects (average age 7.1yo, 5 males) were analyzed. Mean percentile for weight was 49.4th (<3 to 97th), and mean BMI and BMI z-score were 18.6 kg/m^2 (11.9-35.9) and 0.23 (-3.82-2.69), respectively. Mean MUAMA percentile was 40.5th; 5/11 (42%) of patients had MUAMA <25th percentile. Mean (range) values for BIA-LBM and A-LBM were 16.42kg (5.5-39.4) and 10.20kg (4.4-21.5), respectively. BIA-LBM and A-LBM were significantly correlated (coefficient 0.39, p<.0001, 95% CI 0.26-0.52, R^2 0.83); but agreement analysis showed a mean (SD) bias of 6.2 (7.3) and 95% CI of 8.2 - 20.6. Mean (range) values for BIA-FM and A-FM were 14.81kg (3.1-29) and 10.93kg (1.55-31.90), respectively. Correlation between BIA-FM and A-FM was significant (coefficient 1.18, p<.0001, 95% CI 0.88-1.47, R^2 0.90); but agreement analysis revealed a mean (SD) bias was 3.88 (3.10), and 95% CI of 2.20 - 9.95. Half of patients (54%) were either hypometabolic (3/11) or hypermetabolic (3/11). Nearly two-third of this cohort was either underfed (6/11, 54.5%) or overfed (18%, 2/11). Mean protein intake was 1.4 (0.76- 2.2) g/kg/day and 6/11 (54.5%) subjects received less than 1.5 g/kg/day.

Conclusions: Children on long-term home ventilation in our study were characterized by malnutrition, and risk of further nutritional deterioration due to altered metabolic state, caloric underfeeding or overfeeding, and suboptimal protein intake. LBM and FM by BIA correlated with anthropometric values but the two methods are not interchangeable, evident by wide limits of agreement. Reliable and validated methods of body composition measurement, optimal energy prescription and delivery of adequate protein must be prioritized in this vulnerable cohort.

100 - Evaluation of Risk Factors for Vitamin B6 Deficiency in Adult Hospitalized Patients: A Pilot Study

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Purpose: Vitamin B6 is a nutrient used in many body metabolic processes, including the formation of nucleic acids and glucose, amino acid metabolism, and formation of the antioxidant glutathione. Vitamin B6 deficiency has been associated with certain medications and conditions common in adult hospitalized patients, including chronic inflammatory disorders and deep vein thrombosis. This pilot study aimed to identify risk factors associated with vitamin B6 deficiency in a tertiary academic hospital.

Methods: Using analysis of electronic medical records, we conducted a retrospective, matched pair, case-control chart review, of patients admitted to Emory University Hospital (EUH) with a documented serum vitamin B6 level obtained during the hospitalization from January 1, 2010 through December 31, 2011. Demographic information,

medical history, and medication use at time of admission were assessed to identify potential risk factors for the development of vitamin B6 deficiency.
Results: A total of 100 patients (48 male and 52 female) were included in the study. Current use of home parenteral nutrition prior to the admission (odds ratio (OR) 4.95; 95% confidence interval (CI): 1.30 to 18.81, p=0.01) and patients in whom the serum vitamin B6 levels was drawn in the intensive care unit (ICU) (OR 2.57; 95% CI: 1.02 to 6.46, p=0.04) were associated with an increased risk of a below-normal serum vitamin B6 concentration. Several other factors showed a trend towards statistical significance, including the use of continuous renal replacement therapy (CRRT) (OR 4.57; 95% CI: 0.92 to 22.73, p=0.05), history of diabetes mellitus (OR 2.47; 95% CI: 0.94 to 6.46, p=0.06), and history of Crohn's disease (OR 3.91; 95% CI: 0.77 to 19.83, p=0.08), suggesting that these conditions may be associated with an increased risk of developing vitamin B6 deficiency.
Conclusions: Hospitalized patients receiving home parenteral nutrition and those admitted to an ICU may be at increased risk of concomitant vitamin B6 deficiency. Patients with diabetes mellitus, Crohn's disease, or receiving CRRT may also be at risk for developing deficiency. Further prospective investigation is needed to confirm these results and to determine potential causes (ie. Increased vitamin B6 requirements, decreased enteral/parenteral intake and/or body losses) of vitamin B6 depletion in hospitalized patients.

101 - Epigallocatechin-3-gallate Inhibits the Production and Modulates the Expression of LPS-Stimulated Cytokines and Their Transcriptional Factors in Human Colon Epithelial Caco-2 Cells
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Purpose: Epigallocatechin-3-gallate (EGCG) has been reported to have a beneficial anti-inflammatory effect on a variety of inflammatory conditions including inflammatory bowel disease (IBD). We investigated the potential of EGCG treatment to correct the LPS-induced pro-inflammatory cytokines levels in a human colon epithelial cell line (Caco-2).
Methods: Caco-2 monolayer cells (1x106 cells/well, passages 12-15) were cultured after partial digestion with 0.25% trypsin-EDTA until 80% cell confluence was achieved. Cells were incubated with lipopolysaccharide, (LPS) 10ng/mL in the presence of EGCG (0-10µg/mL). The production of pro-inflammatory cytokines IL-6, IL-12p40, IL-17A and IL-23 were measured by Enzyme-Linked Immunosorbent Assay (ELISA), and the real-time PCRs (rt-PCR) were performed to evaluate the expression of their messages. Immunoblots were done to investigate the effect of EGCG on the expression of LPS-activated transcriptional factor signaling of NF-kB, STAT3, pSTAT3, ROR-γT, and SOCS3. Cell viability was determined by MTT assay (tetrazolium salts). Cytokine expression was analyzed using the 2-ΔΔCT method. Expression levels were represented as a percentage of the control at baseline conditions (no LPS or EGCG). Statistical significance was determined by ANOVA with Bonferroni's Multiple Comparison test.
Results: EGCG inhibited the expression and release of LPS-stimulated pro-inflammatory cytokines compared with non-stimulated cells. EGCG showed a dose-dependent inhibitory effect on LPS-stimulated cytokine message expression. EGCG 5µg/ml EGCG maximally inhibited message levels as a percentage of control by 42.5% ± 14.4 for IL-6; 31.9% ± 18.6 for IL-12p40; 60.17% ± 8.08 for IL-17A; and 47.5% ± 21.0 for IL-23. At 5µg/mL, EGCG inhibited both the LPS-stimulated nuclear factors of STAT3 (20.4% ± 6.73) and LPS-induced phosphorylation of STAT3 (pSTAT3; 23.86% ± 5.45). Interestingly EGCG induced the production of LPS-stimulated suppressor of cytokine signaling (SOCS3) protein by116.67% ± 3.24. EGCG effectively reduced the LPS-induced expression of the orphan nuclear receptor (RORγt) at a concentration of 5µg/mL by 64.65% ± 8.65%.
Conclusions: These results demonstrate that anti-inflammatory activities of EGCG occur at the cytoplasmic and nuclear levels by inhibiting the release of and modulating the gene expression of several pro-inflammatory cytokines by blocking the transcriptional factors NF-kB, STAT3/SOCS3, and RORγT signaling pathways in human epithelial colon cells. These data provide additional support for EGCG as an effective therapy in IBD.

102 – Reducing Readmission for Ileostom Patients Due to Dehydration
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Healthcare System, Little Rock, AR; [4]Patient Care Service, Central Arkansas Veterans Healthcare System, Little Rock, AR.
Introduction: The use of an ileostomy in patients undergoing colon and rectal surgery has been shown to be beneficial in a number of studies1,2,3,4 . The use of ileostomies has increased at Central Arkansas Veterans Healthcare System. From 2010 through 2011 Central Arkansas Veterans Healthcare System had 8 patients readmitted after ileostomy for dehydration.
Objective: To review current practice and provide a multi-service approach that would reduce readmission due to dehydration.
1.Sakai et al. Arch Surg. 2001;136:338-42
2. Bax et al. Am J Surg. 2007;193:587-8
3. Tilney et al. World J Surg. 2007;31:1142-51
4. Paquette et al. Dis Colon Rectum. 2013;56:974-9
Methods: A committee was formed including General Surgery, Wound Ostomy Incontinence Nurse, Pharmacy and Nutrition and Food Service. The current dietitian notification process was reviewed to guarantee dietary discharge instruction. To find additional information on reducing readmission due to dehydration, a literature search was initiated. A chart review by Pharmacy was completed to determine the discharge medication profile on previous patients.
Discussion: The Advanced Practice Nurse for Wound Ostomy Incontinence Care began teaching and providing the Cleveland Clinic's "Eating Right and Avoiding Dehydration after Bowel Surgery" to ileostomy patients prior to discharge. A Dietary Consult was initiated to alert dietitians for ileostomy dietary education. Diuretic medication use was reviewed and altered or discontinued by the provider as needed prior to discharge. A commercially available electrolyte solution (™Ceralyte) was added to pharmacy stock for ileostomy patients. Nutrition and Food Service also followed up after discharge to address any problems the patient might be having at home.
Conclusions: After instituting changes at Central Arkansas Veterans Healthcare System, there was only one readmission for dehydration after ileostomy from January 2012 through August 2013. An automatic Dietary Consult is being developed for all new ileostomies. Multi-service intervention for ileostomy patients prior to discharge has proven to be beneficial for patients at Central Arkansas Veterans Healthcare System.

103 - Elevated Alkaline Phosphatase in Infants With Parenteral Nutrition-Associated Liver Disease Reflects Bone Rather Than Liver Disease
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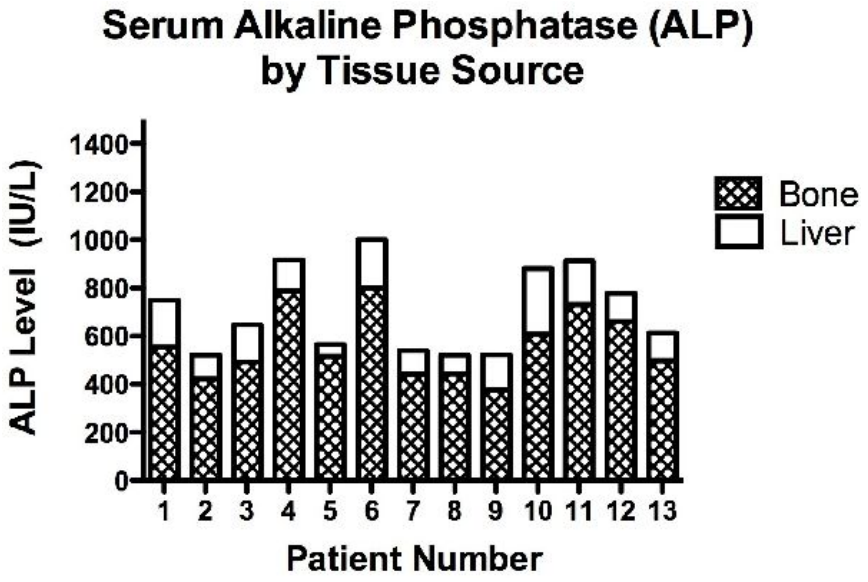
Purpose: Clinical criteria for the diagnosis of parenteral nutrition-associated liver disease (PNALD) are poorly defined and vary by institution. Biochemical markers of cholestasis are commonly used, such as elevated serum levels of direct bilirubin (DB), alkaline phosphatase (ALP), and hepatic transaminases. However, an elevated serum ALP is not specific to hepatic pathology and can also reflect bone disease, common in infants with intestinal failure. The purpose of this study is to refine the diagnostic criteria for PNALD by defining the tissue-specific levels of ALP in children with intestinal failure and PNALD.
Methods: Prospectively collected data for consecutive infants diagnosed with PNALD between December 2012 and August 2013 were reviewed. PNALD was defined by at least two consecutive DB levels greater than or equal to 2mg/dL. Fractionated serum ALP was measured in each patient, while the DB was greater than 2 mg/dL. Parathyroid hormone (PTH) and Vitamin D3 levels were recorded where available. In addition, DB, aspartate aminotransferase (AST), alanine aminotransferase (ALT), and gamma-glutamyl transpeptidase (GGT), were recorded.
Results: Thirteen patients with intestinal failure and PNALD were identified. All patients were under age 1 year. Median gestational age was 28 weeks [interquartile range (IQR) 25-31 weeks] and median birth weight was 890 grams [IQR 610-1430 grams]. Median DB at diagnosis was 5.2 mg/dL [IQR 3.4-6.1 mg/dL]. Median AST, ALT, and GGT were within the normal range at 110 IU/L [IQR 72.3-160 IU/L), 61 IU/L [IQR 36.8-70.5 IU/L], and 119 IU/L [IQR 89-193.3 IU/L], respectively. Median total ALP was elevated at 647 IU/L [IQR 545.8-854.5 IU/L] with bone-specific ALP comprising approximately 80% or more of the total ALP (Figure 1). Median PTH and Vitamin D3 levels were within normal range, at 54.5 pg/mL [IQR 16.5-127.2 pg/mL] and 39.8 ng/mL [IQR 32.8-49.5ng/mL], respectively.
Conclusions: While elevated ALP can reflect biliary stasis, the elevated ALP observed in infants with intestinal failure and PNALD may predominantly be of bone rather than hepatic origin. Unfractionated ALP should therefore

be interpreted with caution in infants with intestinal failure when considering a diagnosis of PNALD. Similarly, a persistently elevated ALP after normalization of bilirubin should raise concern for bone-related pathophysiology and may not reflect ongoing biliary dysfunction. Studies dedicated to the prevention, diagnosis, and management of occult bone disease in infants with intestinal failure should be pursued.



104 - Influence of Nutritional Status on the Therapeutic Effect of Infliximab in Patients With Crohn's Disease

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Purpose: Crohn's disease (CD) is a refractory inflammatory bowel disease of unknown etiology that is frequently complicated by malnutrition. We suspected that delayed wound healing in CD associated with malnutrition might negatively influence the therapeutic effect of infliximab (IFX). Therefore, we aimed to investigate the effects of nutritional status on IFX treatment.

Methods: Sixteen consecutive CD patients were involved in the study. We assessed the nutritional status and CD activity on the introduction of infliximab (IFX) and 6 weeks later, following the third dose. We then examined the correlation between the nutritional status and the disease activity. Nutritional status was assessed using the body mass index (BMI) and nutritional risk index (NRI), while CD activity was assessed using the Crohn's disease activity index (CDAI).

Results: All subjects with a BMI ≥18.5 kg/m2 at the time of IFX introduction met the effective criteria for the CDAI and IFX was judged successful. By contrast, the effectiveness of IFX was significantly lower in patients with a BMI <18.5 kg/m2 compared with those with a BMI ≥18.5 kg/m2 ($p = 0.002$). In addition, IFX was successful with a high level of effectiveness in all 5 subjects (31.3%) with NRI scores of 97.5 and above and no risk of malnutrition ($p = 0.037$).

Conclusions: Our results suggest that the response rate to treatment with IFX could be improved by optimizing the nutritional status in CD patients. We recommend comprehensive nutritional assessment and intervention prior to treatment schedules.

105 - The Functional Food Active Hexose Correlated Compound Suppresses the Expresssion of mRNAs Encoding Cytokines and Chemokines in Rat Hepatocytes

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Purpose: The functional food active hexose correlated compound (AHCC) is the extract from cultured mycelia of *Lentinula edodes*, a species of *Basidiomycetes* mushroom. Supplementation with AHCC improved the prognosis of postoperative hepatocellular carcinoma patients. Previously, we reported that AHCC shows an anti-inflammatory effect by suppressing nitric oxide production and inducible nitric oxide synthase (iNOS) gene expression in interleukin (IL)-1β-treated rat hepatocytes. It is assumed that a natural antisense transcript (asRNA) transcribed from *iNOS* gene is involved in this suppression and stabilizes iNOS mRNA. Here, we examined the effect of AHCC on the expression of mRNAs encoding the pro-inflammatory genes, including iNOS, cytokines, and chemokines.
Methods: Total RNA was extracted from primary cultured rat hepatocytes that were incubated with AHCC in the presence of IL-1β. Gene expression was analyzed by gene expression microarrays and the expression of various mRNAs and asRNAs were confirmed by RT-PCR.
Results: Expression of mRNAs encoding iNOS, cytokines, and chemokines were induced by IL-1β. Then, we compared mRNA levels in the presence of both AHCC and IL-1β with those in the presence of IL-1β alone. AHCC suppressed levels of mRNA encoding not only iNOS but also cytokines, including tumor necrosis factor α (TNF-α) and IL-23A, and chemokines, including CCL2 and CX3CL1. AHCC affected levels of asRNAs transcribed from these genes. Furthermore, AHCC affected the levels of several mRNAs encoding molecules in the IL-1β signaling pathway, such as type I IL-1 receptor (IL-1RI) and the transcription factor NF-κB.
Conclusions: Our findings suggest that AHCC suppresses the expression of inflammatory cytokines and chemokines, as well as iNOS. AHCC may affect stability of these mRNAs by modulating the levels of the corresponding asRNAs, which may be involved in an anti-cancer effect of AHCC.

Encore: Previously presented at ASHP 2010. Published with permission of the authors.

106 - Maintaining Mucosal Barrier in Critical Care Patients by Optimizing Parenteral Nutrition Use With Concomitant Enteral Nutrition Versus Parenteral Nutrition Alone

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Purpose: The purpose of this study is to compare patients receiving parenteral nutrition (PN) alone with patients receiving PN and low rate enteral nutrition (EN) concomitantly to identify if there are any benefits on maintaining gastrointestinal mucosal integrity and a quicker return to a functioning bowel, thereby decreasing PN days, costs and length of hospital stay.
Methods: Based on the inclusion/exclusion criteria, 9 critical care patients who were initiated on PN were identified (out of 26 screened). Informed consent was obtained from the patients in order to begin low rate EN concomitantly with their standard PN. We adjusted the percentage of EN as tolerated (baseline = 15% of total daily calories, which was determined by the clinical nutritionist), in order to wean the PN off as quickly as possible, and thus return to an oral or full enteral diet. The patients were followed daily and the total number of PN days was recorded. We also looked retrospectively at 25 patients (between 10/2009 and 03/2010) who met the inclusion criteria and compared the number of PN days between the two groups. Other advantages to using low rate EN concomitantly with PN were noted and the data was applied to develop institution specific guidelines.
Results: Prospectively, the average number of days patients received PN was 8 days. Low-rate EN was usually started within 1 to 3 days after PN had been initiated and was slowly increased towards goal. The number of days patients received both PN and EN concomitantly ranged from 1 to 7 days. PN was weaned off by the Pharmacist after patients were tolerating EN at about two-thirds of their caloric goal. Motility agents were used in 5 patients, which included Reglan and Reglan with Erythromycin.
Within the retrospective data, the average number of days patients were given PN was 16 days. EN or an oral diet was usually started more than 3 days after PN had been initiated, with the range of concomitant PN and EN or oral diet being 1 to 10 days. Motility agents, including Reglan and Reglan with Erythromycin, were used in 12 patients.
Conclusions: Between the two groups, the prospective patients received PN for a shorter duration of time than the retrospective patients. They also received concomitant EN earlier than the retrospective patients, which was our aim for this study. Based on the data, we can assume that starting early low rate EN concomitantly with PN resulted in

shorter duration of PN and caused fewer complications than with PN alone. Research has shown that the earlier a patient receives EN or an oral diet, better outcomes occur because there are fewer complications such as bacterial translocation, GI mucosal atrophy, infection and length of stay. A study with a larger sample size will be needed in order to assess the true clinical benefits of early EN when used concomitantly with PN. The concept of this study warrants more research, as we were handicapped by lack of funds, time, Physicians' approval and access to detailed research records.

107 - Factors That May Contribute to Reduced Deposition of Retinal Carotenoids

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Purpose: The dietary carotenoids lutein (L) and zeaxanthin (Z) serve many beneficial functions throughout the body, but are most often noted for their conspicuous accumulation in the macula of the retina, where they are collectively termed macular pigment (MP). There, they serve two protective functions: 1) they serve as antioxidants, quenching the many free-radical oxygen species generated by the prodigious metabolic demand of the central retina, and 2) due to their yellow coloration, L and Z effectively screen potentially damaging short-wavelength (blue) light from reaching the vulnerable photoreceptors. For reasons not yet completely understood, there is high variability in the density of MP among people, even when controlling for dietary consumption of foods that contain high levels of L and Z (e.g. leafy-greens). Moreover, there is high variability in response to supplementation of L and Z, in terms of retinal deposition; some subjects respond vigorously, as indicated by rapid increases in MP, whereas others fail to respond in the retina altogether, despite daily L supplementation levels exceeding 20 mg (10 times the average American intake of L / Z). The purpose of the present investigation was to determine factors that may be responsible for this discrepancy in levels and / or response to these important nutrients.
Methods: MP optical density (MPOD) was measured using a psychophysical visual assessment called heterochromatic flicker photometry, whereby subjects equate the brightness of two colored discs of light (blue versus green) that are flickered in counterphase. When a brightness match is achieved, subjective flicker will cease. Those subjects with higher MPOD require the blue light to be brighter in order to achieve null flicker, due to MP's ability to absorb blue light. A questionnaire was administered to determine subjects' ratings of factors that may impact MP. These factors included leafy-green vegetable intake, wheat intake, immune function, level of anxiety / stress, and general health status.
Results: Some novel, intriguing relationships were determined. First, a significant correlation between subjects perceived stress / anxiety level and MP was found ($r = -0.42$; $p < 0.001$; see Figure 1). In other words, the higher a subject's MP, the lower the perceived stress level. This finding remained significant after controlling for dietary intake of foods that contribute to MP (e.g. leafy-greens). A significant correlation between MP level and general health status was also found ($r = -0.28$; $p = 0.028$; see Figure 2). Despite controlling for diet, subjects who were sick more often were shown to have lower MP. This finding may be indicative of the body's use of L and Z in immune processes (e.g. anti-inflammatory function) rather than deposition of L and Z in target tissue, such as the retina.
Conclusions: It could be that the body's ability to deposit L and Z in the retina is somewhat compromised by systemic processes related to high stress, anxiety, and overall immune activation. There is much data in the animal literature to suggest that L and Z are used regularly in immune activities, such as anti-inflammatory function, yet there is little human work of this nature. The results of our study offer a potential way forward in the pursuit of accounting for individual differences in MP level that cannot be explained solely by diet.

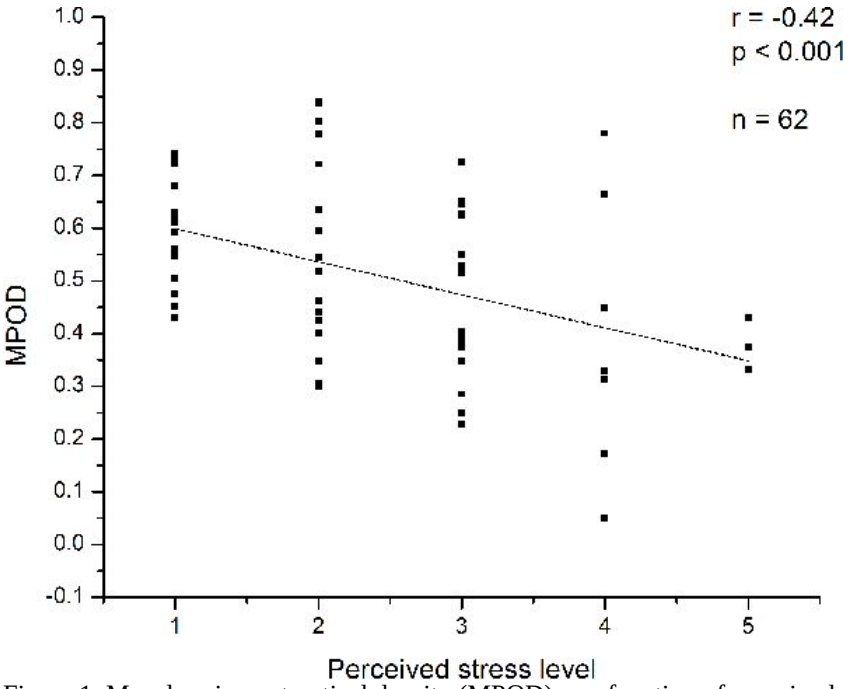

Figure 1. Macular pigment optical density (MPOD) as a function of perceived stress level. Dashed line least-squares fit to data.

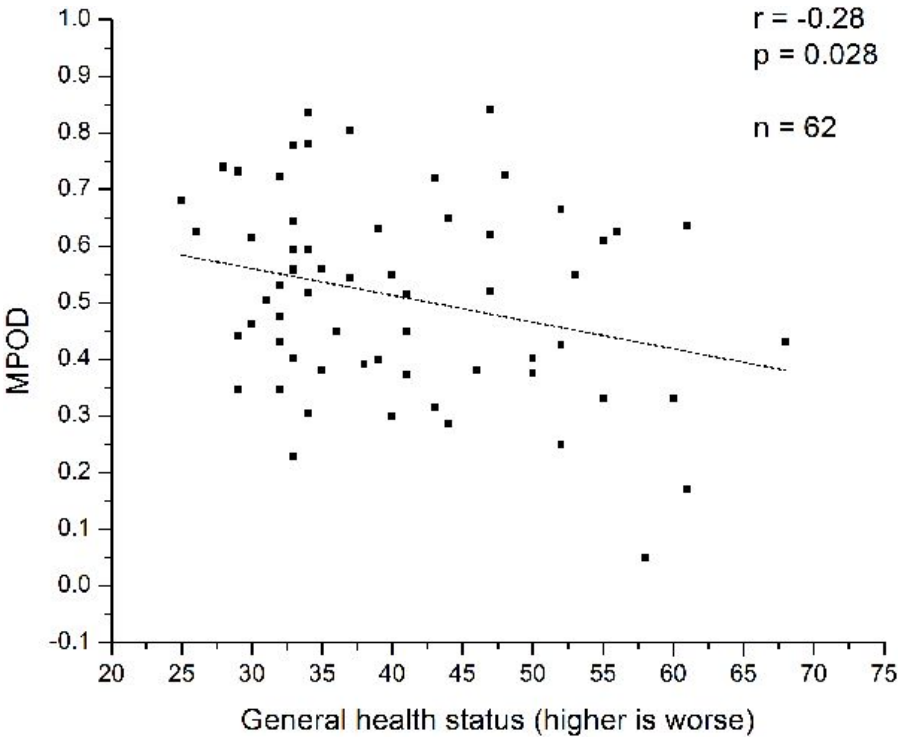

Figure 2. Macular pigment optical density (MPOD) as a function of general health status. Progressively higher general health scores indicative of suboptimal health. Dashed line least-squares fit to data.

108 - Metabolic Bone Disease Is Common During Administration of Home Parenteral Nutrition in Short Bowel Syndrome and Intestinal Dysmotility Patients

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Purpose: Metabolic bone disease(MBD) is a common co-morbidity in patients receiving long-term home parenteral nutrition(HPN) support. There are many risk factors which may contribute to the development of MBD in the long term HPN patient. The purpose of our study was to determine the incidence of MBD defined by DEXA in a long-term HPN population who either had short bowel syndrome(SBS) or intestinal dysmotility(MOT).
Methods: A retrospective chart review was conducted in patients from one home HPN provider who had received HPN for at least 12 months. Patient demographics were collected, including age, sex, and duration of time on HPN. The patients were divided into those who had SBS versus those with MOT. The DEXA study was recorded, including T-scores in the spine and hip. Osteopenia(Op) was defined as a T-score -1.5 to -2.4 and osteoporsis(OP) was defined as a T-score which more negative than -2.5. T-scores which were more positive than -1.5 were recorded as normal.
Results: There were a total of 86 patients who met the inclusion criteria. There were 68 patients with the diagnosis of SBS and 18 patients with the diagnosis of MOT. There were 23M and 45F in the SBS group. In the MOT group, there were 1M and 17F. The DEXA T-scores the SBS group were, 28 Op(41.2%), 33 OP(48.5%), and 7 normal(10.3%). The DEXA T-scores in the MOT group were, 5 Op(27.8%), 7 OP(38.9%), and 6 normal(33.3%). The overall incidence of MBD(Op + OP) in the SBS group was 61/68(89.7%) and in the MOT group was 12/18(66.7%). Only 4.2%(MOT) and 10.3%(SBS) had normal T-score readings by DEXA. There were more females in both the SBS and MOT groups with the diagnosis of MBD.
Conclusions: The incidence of MBD in both the SBS and MOT groups who receive long-term HPN was significant at 89.7% and 66.7% respectively. The incidence of OP was greater than Op in both the SBS and the MOT groups. It is important to recognize the high incidence of MBD in the long-term patient receiving HPN. Only a small percentage of patients will have normal T-score readings on their DEXA studies. Further studies should be conducted to define the incidence in larger populations and if treatment can alter the incidence of MBD.

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109 - Prevalence of Undernutrition and Overnutrition in a Tertiary Pediatric Hospital Using the New WHO Growth Charts: Implication for Quality Care Improvement

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Primary aim: To estimate the prevalence of suboptimal nutrition (undernutrition or overnutrition) using the new WHO growth charts in children admitted to medical and surgical wards of a tertiary care hospital at the time of admission (within 72 h).
Secondary aim: In children classified as having suboptimal nutrition (undernutition or overnutrition) at the time of admission, the charts will be reviewed for nutrition reporting to assess healthcare provider performance.
1)To estimate the proportion of children with any nutritional evaluation or management by healthcare providers within 1 month of admission.
2)To estimate the proportion of children classified accurately (undernutrition or overnutrition) by healthcare providers within 1 month of admission.
3)To identify factors (predictors) associated with the performance of healthcare providers. Performance will be defined as the presence of :
i.Nutritional evaluation or management in the charts
ii.The accurate nutritional classification by healthcare providers.
Methods: This is a cross-sectional study (Primary Aim) with a retrospective cohort component (Secondary Aim). The protocol was approved by the Ethics Board of the Hospital.
Children and adolescents older than 1 month of age and bellow 18 years of age, admitted to the medical and surgical wards of the Montreal Children's Hospital for at least 48hs, between May 25th and August 31st, 2012 were enrolled for the study. Patients were excluded if they had orthopedic devices, were confined to bed or too ill to be measured, presented anasarca, anorexia nervosa or were hospitalized for suicidal attempt.

Height and weight were measured at admission and plotted on growth charts: Weight-for-age, Length-for-age and Weight-for-length percentiles (for children from birth to 24 mo) and Weight-for-age, Height-for-age and BMI-for-age percentiles (for children 2 to 17 y). Gender, date of birth, gestational age at birth, date of admission, ward, diagnosis at admission and important comorbidities were recorded.
In children classified by the research team as having suboptimal nutrition (undernutition or overnutrition) at admission, the medical charts were examined to determine the extent of nutrition reporting; to describe actions taken by healthcare providers in the evaluation and management of suboptimal nutrition. These were used as measures of healthcare provider performance. Predictors of healthcare provider performance included the following variables: age (birth to 24 mo versus 2 to 17 y of age), gender, ward (surgical versus medical), nutritional status (undernutrition versus overnutrition) and severity of undernutition or overnutrition. Data was expressed as proportions (95% confidence intervals) overall, by age group and by nutritional status. Exploratory analysis identified predictors of healthcare provider performance in the children classified by the research team as having suboptimal nutrition. Chi squared test was used to test the association between individual predictors (age, gender, ward, nutritional status and severity) and healthcare provider performance.
Results: During the study period, 277 children were enrolled in the study, with a mean age of 5.9 years. Of the total, 56.7% had ≥2years, 58.1% were male and 64.6% were hospitalized in the clinical ward. Table 1 shows the Prevalence of Suboptimal Nutrition and table 2 shows the odds of Provider Identification of Suboptimal Nutrition by Predictors.
Conclusions: The prevalence of suboptimal nutrition was elevated (34.3%), with 13% of undernutrition and 21.3% of overnutrition. The children with suboptimal nutrition were at higher risk of not being identified if they were ≥2years, male, severe overnourished and hospitalized in the surgical ward.

Prevalence of Suboptimal Nutrition

	Overall	< 2 years	≥2 years
n	277	120	157
Suboptimal nutrition, n (%)	95 (34.3%)	38 (31.7%)	57 (36.3%)
Undernutrition, n (%)	36 (13%)	23 (19.2%)	13 (8.3%)
Overnutrition, n (%)	59 (21.3%)	15 (12.5%)	44 (28.0%)
Classification		Weight for length	BMI for age
Severe wasting, n (%)	6 (2.2%)	2 (1.7%)	4 (2.5%)
Wasting, n (%)	15 (5.4%)	9 (7.5%)	6 (3.8%)
Normal, n (%)	174 (62.8%)	73 (60.8%)	101 (64.3%)
Risk of overweight, n (%)	23 (8.3%)	21 (17.5%)	2 (1.3%)
Overweight, n (%)	35(12.6%)	12 (10%)	23(14.6%)
Obesity, n (%)	17 (6.1%)	3 (2.5%)	14 (8.9%)
Severe obesity, n (%)	7 (2.5%)	N/A	7 (4.5%)

Odds of Provider Identification of Suboptimal Nutrition by Predictors

Predictor	Suboptimal nutrition, n	Identified, n (%)	Undajusted OR (95% CI)
Age			
<2years	38	20 (52.6%)	
≥2 years	57	18 (31.6%)	0.42 (0.18-0.97)*
Gender			
Male	50	15 (30.0%)	
Female	45	23 (51.1%)	2.44 (1.05-5.66)*

Ward			
Medical	53	26 (49.1%)	
Surgical	42	12 (28.6%)	0.42 (0.18-0.98)*
Nutrition staus			
Undernutrition	36	26 (72.2%)	
Overnutrition	59	12 (20.3%)	0.98 (0.04-0.26)*
Severity			
Not severe	74	24 (32.4%)	
Severe	21	14 (66.7%)	4.17 (1.5-11.7)*

* P<0.05 by Chi square test

110 - Surgical Fasting Guidelines in Children: Are We Putting Them Into Practice?

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Purpose: Patients are traditionally kept fasting (NPO) from midnight prior to surgery, due to concern for aspiration while under anesthesia. NPO time is continued postoperatively, out of concern for ileus. Prolonged periods of NPO can pose a risk of malnutrition, which is of particular concern in the pediatric population. Shorter postoperative NPO times have been shown to be safe. The aim of this study was to investigate current pre- and post-operative feeding practices of children in a tertiary care hospital. By evaluating NPO times, diet orders and diet progression we hypothesized that children were experiencing unnecessary and prolonged periods of NPO
Methods: Data was collected prospectively on 53 patient charts during general, neurological, or urological procedures. Procedures were divided into complex or non complex by the surgeons. Date and time of NPO periods were recorded as well as the physician's postoperative diet orders, actual diet progression, and dietary tolerance. Data was summarized and compared to published recommendations (clear fluids allowed up to 2 hrs prior to surgery, breast milk up to 4 hrs, infant formula/non human milk/light meals up to 6 hrs). Data analysis was completed using Microsoft excel. A value of P<.05 was considered to be statistically significant.
Results: The average age of patients was 6.3±6 years. In total, 70 %(n=37) of the patients studied had preoperative NPO times greater than recommended. Complex procedure patients averaged 12.6±5.8 hours of preoperative NPO time while noncomplex patients averaged 10.8±5.2 hours (Table 1). There were no significant differences in preoperative fasting times between the groups. None of the patients received clear fluids up to 2 hours prior to surgery as current guidelines suggest. Wide ranges of NPO were observed (pre-op: 2-24hrs; post-op 0-84hrs; total NPO time: 4 - 92hrs). Patients that underwent complex procedures spent significantly (p<0.01) more time NPO postoperatively, 35±28.2 hours versus 9.3±14 hours for non complex procedures. Additionally, patients that had complex procedures experienced significantly (p<0.01) more time delay in receiving a substantial source of nutrition (time to first nutrition= time from preoperative NPO until diet advanced beyond clear fluids), 56.3±29 hours compared with non complex procedures of 30.7±20.6 hours. Total time spent NPO compared to length of stay (LOS) averaged 27%, there was no significant differences between complex or non complex patients. Postoperative nutrition interruptions contribute to total NPO time in some patients (n=7). Physicians' postoperative diet orders varied from the initial diets received by patients (Table 2), all patients received some NPO time, even when it was not included in the physician diet order. A clear fluid diet was the most common first diet given to patients in all surgical groups (31/53).
Conclusions: Observed preoperative NPO time exceeded current best practice recommendations. Postoperative NPO time in patients that underwent complex procedures was greater than patients having noncomplex procedures. Physician's postoperative diet orders should give clear direction for diet progression, in order to minimize postoperative NPO time. Knowledge translation of current evidence is needed to reduce fasting times in children undergoing surgical procedures. Reduced NPO times may contribute to avoidance of hospital induced malnutrition.

Table 1. Pre- and postoperative NPO hours in complex and non-complex surgeries.

	Mean±SD		Significance
	Complex n=10	Non-complex n=43	
Preoperative NPO(hours)	12.6±5.8	10.8±5.2	NS
Postoperative NPO(hours)	35.0±28.2	9.3±14	p≤0.01
Total NPO Time(hours)	50.5±30.7	22.7±17.8	p≤0.01
Postoperative Nutrition Interruption (hours)	28.5±0 n=1	19.0±21 n=6	NS
Time to First Nutrition(hours)	56.3±29	30.7±20.6	p≤0.01
Total NPO compared LOS* (%)	25	29	NS

* LOS: Length of Stay (length of hospitalization period); Total NPO compared to LOS: total hours of NPO during their hospitalization expressed as a percentage of LOS hrs Time to First Nutrition: number of hours that had passed since the patient went NPO preoperatively until they first received a post operative feeding by FF, EN, PN, and/ or DAT

Table 2. Initial Postoperative Physician Diet Orders and Observed time spent NPO and/or on clear fluid diet.

Initial Physician Diet Order	Final Diet	N	NPO time(hours)	Time on Clear Fluids(hours)
NPO	Nutrition Support	14	30.3±26.1[a]	2.9±6.0[d]
NPO	DAT	8	23.0±20.3[ac]	18.2±18.0[e]
NPO-to- DAT	DAT	10	4.9±4.1[b]	6.0±10.0[d]
Clear fluid-to-DAT	DAT	19	4.2±9.8[b]	16.6±15.4[e]
DAT	DAT	2	5.0±4.2[bc]	0±0[f]

Values are mean±SD. Values with different letters indicate significant differences between groups (p≤05) NPO, nothing by mouth/fasting including no parenteral or enteral support. DAT, diet as tolerated or regular diet Nutrition support included enteral or parenteral feeding

111 - Discrepancy in Length Measurement Between Measuring Tape and Recumbent Length Board in the Neonatal Intensive Care Unit (NICU)

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Purpose: Obtaining accurate anthropometric measurements is vital to the appropriate assessment of infant nutrition status and growth. Length is often the least reliable measurement in the NICU as appropriately stretching infants for measurement can be difficult to accomplish without two people and a recumbent length board. The cost of length boards along with the staffing availability to complete measurements are common barriers to the use of recumbent length boards in the NICU, despite their recognition as the goal standard for infant length measurement. The objective of the current study was to assess agreement between measuring tape lengths obtained by NICU nursing staff and recumbent length board measurements completed by NICU dietitians on the same infants, as well as determine barriers to the use of recumbent length boards.

Methods: This was a retrospective study, which was approved by the Institutional Review Board, using a convenience sample of former NICU infants from a large urban medical center who had length measurements obtained with both a measuring tape and by recumbent length board. Data were collected via electronic medical records. NICU nurses routinely obtain weekly length measurements using one person with a paper measuring tape in centimeters to the tenth decimal point. Inter-rater reliability testing was completed by NICU dietitians for length board measurements prior to implementation of routine length board usage. NICU dietitians obtained length measurements in centimeters to the tenth decimal point with two people and a recumbent length board on the same infants measured by nursing. A total of 340 length measurements (170 measuring tape and 170 length board) were collected over five months. Paired t-test was utilized to assess differences between the two measuring techniques.

Results: Length board measurements were significantly higher than the measuring tape measurements (41.97 ± 4.00

vs. 41.39 ± 3.98 cm, respectively; p<0.01). Attempts to complete length boards were successful 84.3% of the time. The most common reasons length board measurements could not be obtained included infant feeding (8.1%), unstable respiratory status (3.1%), patient not available (2.9%), or nurses requested infant not be disturbed (2.9%).
Conclusions: Recumbent length board measurements were significantly different than the measuring tape measurements completed on the same NICU infants. Feasibility of obtaining measurements was high with an 84.3% success rate. The mean difference between measuring tape and length board measurements of -0.58 cm holds clinical significance for growth and nutrition assessment in the NICU as expected weekly length growth is 0.8-1.0 cm per week. The standard deviation when comparing both types of measurements, 1.38 cm, further emphasizes the value of using recumbent length boards and the possible impact of unreliable length measurements. While requiring more resources, the use of recumbent length board is an important tool for accurate assessment of length, for subsequent nutrition prescription, which may have profound impact on growth in the NICU infants.

112 - Transitional Parenteral Nutrition Use in the Neonatal Intensive Care Unit (NICU) and Growth in Very Low Birth Weight (VLBW) Infants

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Purpose: Growth is one of the primary outcomes in NICU nutrition. Achieving appropriate growth can be difficult, particularly in very low birth weight (VLBW) infants. Advancement of EN volume and calories is done slowly in order to reduce feeding intolerance and minimize risk for development of necrotizing enterocolitis. The majority of VLBW infants initially require parenteral nutrition (PN) during their NICU stay and transition from PN to enteral nutrition (EN) is achieved as soon as the patient can tolerate EN. This often takes 9-14 days to reach goal feedings. During this transition period, infants are provided IV fluids and EN but goal calories and protein are often not achieved. Use of stock transitional PN, containing only dextrose and protein, may be a strategy to improve calories and protein delivery during this time without other PN additives. The objective of this study is to determine if infants given transitional PN during their transition off PN have better growth than those who did not receive transitional PN.
Methods: This Institutional Review Board approved retrospective study was a convenience sample of NICU patients from a large urban medical center who received transitional PN matched with historic controls. Data were collected using electronic medical records for 200 infants during the course of their initial duration on PN. All infants received PN starting day of life (DOL) 0, once EN volume reached 120 mL/kg, the historic controls (n=100) received plain intravenous fluids, whereas the transitional group (n=100) received dextrose and amino acid only PN until full volume EN feeding (140 - 150 mL/kg) was achieved. Average daily PN volume, calories and protein were collected, as well as anthropometric data at birth and one week off of PN. The Olsen growth chart was used to plot anthropometrics. Changes in anthropometrics and average PN volume, calories and protein were analyzed using t-tests.
Results: Birth gestation and weight were not significantly different between the two groups. No differences were found between anthropometrics from birth to after completion of PN. However, both groups did show a decrease in anthropometric measurements over the duration of the study. The control group received more PN volume, calories, and protein than the group receiving transitional PN (p<0.01).
Conclusions: Transitional PN use did not improve PN protein or calorie delivery in VLBW infants in this study cohort. Infants in the transitional PN group did receive less mean PN volume per day. This was due to greater fluid restriction which impacted the ability to deliver overall PN calories and protein. Both groups experienced similar decrease in anthropometric percentiles from birth to the end of PN duration. While this decrease did not bring the mean measurements below the 10th percentile, indicating growth failure, this faltering growth early on in the NICU stay is concerning for the development of future growth failure. The lack of improved caloric and protein provision associated with transitional PN suggest it may not be the best cost effective strategy; however, further research is indicated to determine a strategy to produce a better cost benefit ratio.

Table 1. Characteristics and growth of 200 NICU infants who received vs. not received transitional parenteral nutrition (PN).

	Control Group (n=100)	Transitional PN Group (n=100)
Gender Male Female	46 54	46 54

Gestational Age (weeks)	28.5 ± 2.3	28.5 ± 2.4
Birth Weight (grams)	1075.7 ± 255.9	1076.6 ± 253.7
Birth Weight Percentile	43.2 ± 28.3	41.5 ± 29.3
Birth Head Circumference Percentile	41.3 ± 31.2	43 ± 30.4
Birth Length Percentile	43.5 ± 30	44 ± 29.6
Mean PN Days	16.9 ± 12.5	15.3 ± 7.2
Mean PN Volume (mL/kg)*	99.9 ± 11.8	87.8 ± 9.6
Mean PN Calories (kcal/kg)*	70.6 ± 8.4	63.5 ± 8.4
Mean PN Protein (grams/kg)*	3.3 ± 0.4	3.2 ± 0.4
One Week Post PN Weight Percentile	25.8 ± 22.5	18.8 ± 18.3
One Week Post PN Head Circumference Percentile	20.4 ± 20.5	21.1 ± 21.8
One Week Post PN Length Percentile	25.4 ± 22.6	26.5 ± 22.1

Values reported in mean ± standard deviation *Statistically significant at $p<0.01$

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113 - Evaluation of Essential Fatty Acid Deficiency in Pediatric Patients Receiving Intermittent Fat Emulsion During Product Shortages

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114 - Implementation of Feeding Guidelines for Preterm Infants Shortens Time to Enteral Feeds

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Purpose: The Introduction and management of oral feeding for preterm infants is a major challenge for clinicians in the neonatal intensive care unit (NICU). Previous studies have shown improvement in nutritional outcomes with the implementation of feeding protocols including: decrease in time to reach full enteral feeds; reduction in total parenteral nutrition (TPN) days in extremely low birth weight (ELBW) infants; reduction in rates of infection, NEC and severe extrauterine growth restriction. The objective of this quality improvement study is to standardize the method of trophic feeding in extremely low birth weight (ELBW) infants, and reduce the median days to initiation of feeds, full enteral feeds, and days on PN by 20%.

Methods: Pre-protocol feeding outcomes at Johns Hopkins Hospital (JHH) NICU were measured using the Vermont Oxford Network (VON) database and medical chart review. Feeding data was collected for infants admitted to JHH NICU with gestational age of 32 weeks and birth weight of 1800 grams or less from October 2010 to December 2011. Post-protocol feeding outcomes at JHH NICU were collected for infants admitted to JHH NICU with gestational age of 32 weeks gestation or less and birth weight of 1800 grams or less from January 2013 to June 2013. The registered dietitians (RDs) completed weekly tracking of the neonates admitted, and forms were analyzed weekly by the medical team leader. The RDs tracked when enteral feedings(EN) were initiated, first feeding advancement, how feedings were advanced, and when they were off PN. A retrospective analysis of the following data was completed for the pre-protocol period and post protocol period; median time in days for initiation of enteral feeds, median time in days until full feeds, 120kcal/kg/day , were achieved, and median time in days on PN.

Results: 154 infants were eligible for the pre-protocol feeding analysis, and 37 infants were eligible for post-protocol feeding analysis. Initiation of EN in days (median) for all infants with a gestational age >32 0/7 wks and

≤1800g was a baseline of 6 days (n=127) and decreased to 3 days (n=37) post-protocol. Initiation of EN in days for ≤ 1000g went from 11 days (n=50) to 6 days (n=21). Initiation of EN in days for > 1000gm was unchanged (average of 3 days). Full EN in days for GA >32 0/7w and ≤1800g went from 21 days (n=119) to 16 days (n =33). Full EN in days for ≤ 1000g went from an average of 31 days (n=49) to 26 days (n=15). Full EN in days for >1000g went from an average of 15 days (n=70) to 14 days (n = 18). Days on PN GA >32 0/7wk and ≤1800g went from an average of 21 days (n =119) to 13 days (n=33).Days on PN for ≤ 1000g went from an average of 29 days (n =49) to 23 days (n=15). Days on PN for >1000g went from an average of 14 days (n=70) to 10.5 days (n=18).
Conclusions: Implementation of an enteral feeding guideline in the JHHU NICU resulted in a definite reduction in median days to infants achieving full enteral feedings, reduced days on PN, and days to initial feeding. The 20% reduction goal was met or exceeded for the majority of outcomes. A 20% reduction was not met for median days to reach full feeds for infants under 1000gm (16% reduction), median days to initiation of feeds for infants over 1000gm (7% reduction), and initiation of feeds for infant <1000gm (unchanged). This change in practice has the potential to improve overall outcomes, reduce infection, NEC and severe extrauterine growth restriction; however further analysis is needed to demonstrate improved outcomes.

115 - Assessing Serum Zinc in Supplemented and Nonsupplemented Pediatric Patients
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Purpose: Zinc deficiency can manifest as a severe skin rash, impaired night vision, anorexia, diarrhea, alterations in taste and smell, impaired immune function, alopecia and impaired wound healing. Zinc is recommended in patients with additional losses from thermal injury, hypermetabolic state such as traumatic brain injury (TBI), and in patients with excessive GI losses such as diarrhea, decubitus ulcers, and high fistula outputs. The purpose of this manuscript is to review the practice of zinc usage in patients receiving parenteral nutrition at recommended national dosing and patients not receiving zinc due to a national shortage.
Methods: This is a retrospective study assessing zinc in patients receiving parenteral nutrition (PN). Data was obtained from patients medical records and is approved by the Institutional Review Board (IRB). Three hundred and eighty patients were reviewed. Patients weighing less than 3kg were dosed at 400mcg/kg/day, those weighing less than 5kg and 25kg received 300mcg/kg/day and 100mcg/kg/day, respectively. Serum zinc was collected in certified "Trace Element-Free Transport Tubes." C-reactive protein (CRP) and serum zinc levels were evaluated to determine the CRP level at which serum zinc decreases. Alkaline phosphatase and zinc levels were evaluated to determine correlation of low levels.
Serum zinc levels for 65 patients not receiving zinc were evaluated to determine the number of days required for zinc deficiency to occur.
Results: Patients less than 3kg receiving zinc had an average serum level of 84mcg/dl (45-133 mcg/dl), patients less than 5kg averaged 71 mcg/dl (15-115 mcg/dl), and patients less than 25kg averaged 69mcg/dl (22-219 mcg/dl). Zinc levels were drawn at an average of 11days of receiving PN. The acceptable laboratory zinc range is 60-120 mcg/dl. The point at which the zinc decreased statistically, from76 to 65 mcg/dl, was a CRP of greater than 5mg/dl ($p < 0.005$). Comparing alkaline phosphatase levels to zinc levels determined low alkaline phosphatase levels were indicative of low zinc levels ($p < 0.005$). The average zinc level for low alkaline phosphatase was 47mcg/dl and normal alkaline phosphatase zinc levels were 81 mcg/dl.
There were 65 patients not receiving zinc in their PN. Patients weighing less than 3kg were assessed at 14 days (average) and the average level was 68 mcg/dl. Patients less than 5kg were assessed at 9 days (average) with a level of 79 mcg/dl. Patients less than 25kg were assessed at 8 days (average) with a level of 64 mcg/dl. Of the 65 patients, 22 had zinc levels less than 60 mcg/dl with an average of 12 days before the level was drawn.
Conclusions: Patients supplemented with standard dosing of zinc should have a serum level at 11 days of supplementation to determine need for dosing adjustment. Patients should not have zinc level drawn until the CRP is less than 5mg/dl. Patients with low alkaline phosphatase should have a zinc level drawn.
Patients not supplemented with zinc should have zinc levels drawn at 10-12 days to determine need for supplementation.

116 - Risk Factors Predictive of Chylous Effusion Following Infant Cardiac Surgery
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Purpose: In infants undergoing cardiac surgery with cardiopulmonary bypass, chylous effusions (CE) may have a significant impact on post-operative outcomes. CE results from myocardial dysfunction, capillary leak syndrome, obstruction of venous drainage, or thoracic duct injury. Given the high nutrient content of the fluid, increased drainage puts infants at risk for protein-energy malnutrition, delayed initiation of enteral nutrition, electrolyte disturbances, coagulopathy, poor wound healing, impaired immune function, and respiratory complications. The risk factors associated with CE are poorly understood. We investigated the risk factors for CE and described the effect of CE on outcomes following cardiac surgery in neonates.

Methods: A single center retrospective cohort study was conducted on 212 neonates who underwent cardiopulmonary bypass from January 2009-March 2012. Demographic variables including age, sex, race, gestational age, weight, length, complexity score, type of surgical procedure, length of stay, and nutritional management data were collected. Pleural drainage requiring a chest tube during the first 30 post-operative days was determined. The cohort was divided by the number of chest tube free days (CTFD) into low (>25), moderate (14-24) and high (<14) acuity groups. Pleural drainage was used as a surrogate to identify CE for this cohort as it is difficult to retrospectively diagnose. Any patient who died within 30 days was assigned to the high acuity group.

Results: The majority of the cohort was male 133 (62.7%), 23 (10.8%) were premature, and 23 (10.8%) had an operative weight < 2.5 kg. Of the 212 infants, 66 (31.1%) had a left sided heart lesion, 49 (23.1%) were diagnosed with transposition of the great arteries, and the remaining 97 (45.8%) had a variety of other cardiac lesions. High acuity CE (<14 CTFD) occurred in 39 (18.4%), moderate in 83 (39.2%) and low in 90 (42.5%) of the cohort. Amongst the cohort, 22 (10.4%) required extracorporeal membrane oxygenation support, 39 (18.4%) had their chest tubes replaced and 6 (2.8%) required surgical intervention to treat their drainage. The 30 day mortality rate of this cohort was 2.8% (n=6). Parenteral nutrition support was prescribed in 200 (94.3%) patients, 150 (70.7%) of which also received enteral nutrition during the first two weeks postoperatively. Of those that were enterally fed, 10 (4.7%) were treated with a medium-chain triglyceride formulation. Both patient and perioperative risk factors were associated with prolonged pleural drainage (Tables 1 and 2). Smaller, younger patients and those with the most complex postoperative course were most at risk. Patients with PPD (<14 CTFD) were significantly more likely to require chest tube replacement, have high volume CT output, and a have a longer length of stay.

Conclusions: Infants undergoing cardiac surgery are at high risk for CE. Moderate to high acuity CE occurred in over half of this sample. Identifying patients at high risk for CE may allow for development of management strategies that reduce complications associated with CE and improve outcomes for these infants.

TABLE 1
Bivariate Analysis by Acuity Level for Chylous Effusions

Descriptor (median)	Low Acuity >25 CTFD (n=90)	Moderate Acuity 14-24 CTFD (n=83)	High Acuity < 14 CTFD (n=39)	Overall Comparison (n=212) p-value*
Patient Characteristics				
Male, [n (%)]	60 (66.7)	54 (65.1)	19 (48.7)	0.1413
Caucasian, [n (%)]	54 (60)	49 (50.0)	29 (74.4)	0.2260
<37 weeks gestation, [n (%)]	7 (7.8)	5 (6.0)	11 (28.2)	**0.0018**
Extra-cardiac anomalies, [n (%)]	13 (14.4)	7 (20.5)	8 (20.5)	0.5003
Weight <2.5kg, [n (%)]	7 (7.8)	5 (6.0)	11 (28.2)	**0.0018**
Complexity score (range)	1.4 (0.4-5.0)	2.1 (0.3-4.0)	2.5 (0.4-4.0)	**0.0005**
Treatment Factors				
Cross clamp time (range in minutes)	95 (0-198)	93 (0-187)	90 (0-320)	0.7799
Cardiopulmonary bypass time (range in minutes)	162 (30-280)	183 (46-332)	191 (38-406)	**0.0051**
Vasoactive inotrope score[1,2] (range)	7.96 (0.33-17.6)	12.3 (4.2-28.9)	12.2 (2.5-44.5)	**<0.0001**
Central venous pressure[3] (range)	6.7 (1.7-11)	8.2 (5.1-12)	8.2 (2.6-11.9)	**<0.0001**
Organ perfusion pressure[3](range)	46.9 (11.6-63.3)	43.1 (31.6-59.2)	40 (5.9-53.1)	**<0.0001**
ECMO, [n (%)]	1 (1.1)	4 (4.8)	17 (43.6)	**<0.0001**
Outcomes				
Chest tube replaced, [n (%)]	2 (2.3)	20 (24.1)	17 (43.6)	**<0.0001**
Number of days with >20mL/kg/day CT output (range)	0 (0-13)	3 (0-12)	12 (1-14)	**<0.0001**
Length of stay (range)	18 (5-193)	31 (8-233)	80 (2-370)	**<0.0001**

*p-value of <0.05 indicates statistical significance
[1]average over post-operative days 1-3 [2] VIS Score={dopamine dose (ug $\cdot kg^{-1} \cdot min^{-1}$) + dobutamine dose (ug $\cdot kg^{-1} \cdot min^{-1}$)} + {100 x epinephrine dose (ug $\cdot kg^{-1} \cdot min^{-1}$)} + {10 x milrinone dose (ug $\cdot kg^{-1} \cdot min^{-1}$)} + {10,000 x vasopressin dose (U$\cdot kg^{-1} \cdot min^{-1}$)} + {100 x norepinephrine dose (ug $\cdot kg^{-1} \cdot min^{-1}$) [3]average over post-operative days 1-5.

TABLE 2
Logistic Regression Models by Acuity Level for Chylous Effusions

Descriptor	High vs Moderate & Low Acuity	
	OR (95% CI)	p-value*
Patient Characteristics		
Premature[1]	5.14 (1.42-18.50)	0.0122
Weight <2.5kg[1]	6.92 (2.01-23.85)	0.0022
Mortality score	1.44 (1.04-1.98)	0.0270
Perioperative Factors		
Cardiopulmonary bypass time	1.01 (1.00-1.02)	0.0011
Vasoactive inotrope score[2]	0.98 (0.89-1.06)	0.5884
Central venous pressure	1.11 (0.88-1.39)	0.3865
Organ perfusion pressure	0.91 (0.84-0.98)	0.0104

* P-value of <0.05 indicates statistical significance
[1] At the time of surgery [2] VIS formula: {dopamine dose (ug $\cdot kg^{-1} \cdot min^{-1}$) + dobutamine dose (ug $\cdot kg^{-1} \cdot min$)} + {100 x epinephrine dose (ug $\cdot kg^{-1} \cdot min^{-1}$)} + {10 x milrinone dose (ug $\cdot kg^{-1} \cdot min^{-1}$)} + {10,000 x vasopressin dose (U$\cdot kg^{-1} \cdot min^{-1}$)} + {100 x norepinephrine dose (ug $\cdot kg^{-1} \cdot min^{-1}$)

117 - Which Fat Emulsion Has Optimal Effects on the Intestinal Barrier and Inflammatory Function for Pediatric HSCT Patients?

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Purpose: Pediatric patients who need hemopoietic stem cell transplantation (HSCT) always need parenteral nutrition (PN) to maintain their nutrients need. Different fat emulsion supplementation is supposed to have different effects. We supplied the fish oil and olive oil emulsion to HSCT patients, and analyzed the change of intestinal barrier and inflammatory function.
Methods: 22 pediatric patients undergoing HSCT were enrolled, and they were randomly divided into 2 groups: 11 of them were in fish oil group (FO), and the other 11 were in olive oil group (OO). The dosage of fat emulsion given to both groups was 1g/kg. In FO group, fat was supplied by 0.2g/kg fish oil plus 0.8g/kg MCT/LCT. Both groups were given PN for at least 1 week. The blood samples were collected at the following time points: before PN (baseline P0), 3 days (P3) and 1 week (P7) after beginning of PN. Serum levels of intestinal fatty acid binding protein (IFABP), TNF-α and IL-1β were measured in parallel. Data were expressed as means±SD. The Mann-Whitney U test was used for significance calculations of differences between groups.
Results: There are no significant difference in two groups of Alb, Hb, Plt, ALT, TB, DB, BUN, and Cr ($P \geq 0.05$). At the beginning of PN, serum levels of IFABP, TNFα and IL-1β raised. Serum IFABP level in FO group was significantly higher than that in OO group ((15.3±9.3)ng/ml vs (7.4±3.8)ng/ml, p=0.015). Patients in FO group had lower level of serum IFABP at P3 ((13.8±10.6)ng/ml) and P7 ((3.0±1.6)ng/ml vs P0:p=0.018). A significant decrease of IFABP was found in FO group compared with OO group (p=0.008). Patients in FO group had increased serum level of TNF-α at P3, and then decreased at P7. A similar trend of change was found in serum level of IL-1β. There were no significant changes of these parameters in OO group (table 1). No significant differences in severity of GVHD and length of stay were found between this two groups.
Conclusions: Fish oil emulsion may protect the intestinal barrier function in pediatric HSCT patients, as well as reduce the serum level of inflammatory factors.

Table 1. The changes of intestinal barrier and inflammatory function in FO and OO groups.

	P0	P3	P7
IFABP (FO) (ng/ml)	15.3±9.3	13.8±10.6	3.0±1.6**
IFABP (OO) (ng/ml)	7.4±3.8*	7.0±2.5	6.2±2.6
TNF-α (FO) (ng/ml)	277.9±240.9	340.0±225.7**	192.7±147.7
TNF-α (OO) (ng/ml)	220.2±238.5	204.1±159.4	201.5±135.8
IL-1β (FO) (pg/ml)	44.8±34.3	48.1±33.5	31.3±22.7
IL-1β (OO) (pg/ml)	31.7±28.5	31.7±22.6	32.9±19.2

*: $p<0.05$, compared with the same parameter in FO group. **: $p<0.05$: compared with the same parameter at P0.
FO: fish oil emulsion group OO: olive oil emulsion group IFABP: intestinal fatty acid binding protein

118 - Prevention of Catheter Sepsis in Pediatric Patients: A New Protocol for the Delivery of Ethanol Lock Therapy

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Purpose: Catheter-related bloodstream infection (CRBSI) is a life-threatening complication of parenteral nutrition (PN) associated with morbidity, mortality, loss of venous access, and hospital readmissions for patients receiving home PN. Ethanol lock therapy (ELT) has been shown to be safe and effective in preventing CRBSI in adult and pediatric patients and boasts a low cost and no potential for resistance. In adults, ethanol (ETH) is commonly flushed through the bloodstream before starting the next home PN infusion. However, this practice is rare in pediatric patients, for whom ETH is typically aspirated from the catheter. The aim of our study was to examine the efficacy and safety of flushing ETH into the bloodstream in pediatric patients with intestinal failure (IF) and to evaluate the number of CRBSI-related hospital readmissions before and after ELT.

Methods: A retrospective chart review was completed for all pediatric home PN patients on ELT followed by our Nutrition Support Team. Data collected included primary diagnosis, weight, vascular access device and number of lumens, physician's ELT prescription compounded by the pharmacy (start date, strength, volume, dwell time, and aspirate or flush), adverse events with ELT, date of hospital readmissions for CRBSI, and causative organism(s).
Results: Five patients (ages 14 months to 12 years) had single-lumen tunneled silicone catheters and received 70% ELT. Four of the patients had gastoschisis and 1 had necrotizing enterocolitis. All patients had episodes of CRBSI (range 2-7 episodes) before starting ELT. All patients received RN education on ELT procedures. ETH was flushed in 4 patients and aspirated in 2 patients (1 patient was changed from aspirating to flushing on month 5 by physician order). The ETH volume ranged from 0.3 mL to 1 mL, and the dwell time ranged from 4 to 14 hours daily.
No adverse reactions to flushing ETH were reported by caregivers or physician/nursing providers. Four of five patients (80%) had a decrease in the occurrence of CRBSIs and fewer hospital admissions; 2/5 patients (40%) did not have CRBSIs after the start of ELT; 5/5 patients (100%) did not experience further episodes of fungemia after ELT started; and 5/5 patients (100%) had no further episodes of polymicrobial CRBSI after starting ELT. One patient had 5 CRBSIs (3 CRBSIs while aspirating ETH and 2 CRBSIs while flushing ETH); this patient received multiple IV therapies, had the least dwell time of all patients, and had compliance concerns with other IV therapies.
Conclusions: This case series report showed no adverse events (or perceived intolerances from patients or family members) with flushing ETH in pediatric patients with IF. With 80% of patients having a decrease in episodes of CRBSI-related hospital admissions and 100% having no further episodes of fungemia or polymicrobial CRBSI, this report provides more data supporting the use of ELT as a viable therapy to prevent CRBSI in pediatric IF patients.

119 - Improving Anthropometric Measurements in the Pediatric Intensive Care Unit (PICU)

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Introduction: A multidisciplinary PICU team was formed to improve nutrition and nutrition-related issues in the PICU, including pediatric anthropometry. Anthropometric data are vital to patient safety as medications, nutrition care plans and ventilation orders are all based on weight or body surface area. Furthermore, nutritional status is associated with better ICU outcomes. A hospital growth assessment policy is available for obtaining anthropometric measurements.
Anthropometric measurements (weight, stature, head circumference) are not consistently obtained on all patients in the PICU. assessment policy is available for obtaining anthropometric measurements
Methods: Prospective data were collected from electric medical records (EMR) of all PICU patients one day each week for 12 consecutive weeks (n = 536). Data points collected included age, admission weight, stature, head circumference (for patients ≤24 months of age), anthropometry orders placed in EMR, frequency of measurements, and actual measurements recorded.
Results: Mean weekly percent of patients with orders placed on admission for weight, stature and head circumference were 56%, 5% and 8%, respectively. Mean percent of patients with measurements obtained upon admission for weight, stature and head circumference were 80%, 26% and 11%, respectively. Mean percent of patients with orders placed for recurring measurements of weight, stature and head circumference were 54%, 3% and 7%, respectively. Mean percent of patients with follow-up measurements obtained for weight, stature and head circumference were 55%, 9% and 12%, respectively. Average compliance of all orders in EMR for weight, stature and head circumference were 23%, 2% and 4%, respectively.
Conclusions: Anthropometric measurements are not obtained according to the hospital's growth assessment policy. Furthermore, when orders are in place, compliance is poor. Based on the above information, problems were identified to improve EMR orders, compliance, and technique. Anthropometry measurements were built into the PICU EMR admission orders and length boards to accommodate infants through adults were purchased to obtain accurate stature. Education was implemented for all PICU staff nurses via the hospital's online mandatory education program. PICU staff was educated as to the availability of trained dietitians to assist staff with all anthropometry measurements, including patients who need non-traditional methods (knee height for contractures, etc.). Follow- up data will be collected to evaluate test of change. Ongoing education and training is necessary to help ensure the hospital's growth assessment policy is followed for the benefit of the patients' nutritional outcome.

120 - An Evaluation of Three Nutritional Feedings in Extremely Premature Infants

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Purpose: Necrotizing enterocolitis (NEC) is associated with longer length of stay, higher rates of mortality and morbidity, and higher hospital costs. The study purpose was to evaluate the effect of exclusive human breast milk and human-based human milk fortifier (HMF), human breast milk and bovine-based HMF, and exclusive premature formula on the incidence of NEC in premature infants.

Methods: Preterm infants (N =141) weighing 400 to 1250 g at birth until 34 weeks adjusted gestational age were included in one of three groups that adhered to a feeding protocol and fed exclusive human breast milk and human-based HMF, human breast milk and bovine-based HMF, or premature formula. Manually abstracted deidentified data were retrieved from the electronic medical record from July 1, 2007 to July 31, 2012 using a standardized data collection tool. Clinical and demographic variables including length of stay, total number of mechanical ventilation and central line days, antenatal steroids, parenteral nutrition, days to full feeding (130-150 mL/kg/d), Apgar score, oxygen therapy duration, and a weekly growth average calculated from body weight and head circumference measurements recorded at time of birth and discharge were collected. Infants were followed from birth to 34 weeks adjusted gestational age. Data were analyzed with descriptive and inferential statistics. A logistic regression model was used to determine a treatment effect on the likelihood of developing NEC and late-onset sepsis across the three groups.

Results: No significant findings were observed among the three groups for the incidences of NEC or late-onset sepsis. Although not significant, the bovine-based HMF group (P = 0.06) was more likely to develop NEC. Infants fed a 100% human milk diet had 89.6% lower odds of developing NEC compared to a bovine-based HMF diet. Similarly, infants fed a premature formula diet had 74.9% lower odds of developing NEC compared to a bovine-based HMF diet.

Conclusions: Study findings provide further evidence supporting the use of an exclusive human breast milk diet in premature infants. Infants fed an exclusive human milk diet had a lower incidence of NEC compared to the premature formula and bovine-based HMF groups.

Encore: Previously published in Pharmacotherapy, Volume 32, October 2012, e228. Previously presented at the Americal College of Clinical Pharmacy Midyear Meeting in October 2012. Re-publication withheld at request of author.

121 - Premixed Parenteral Nutrition Solution Use in Children. Rebecca F. Chhim, PharmD, BCPS[1,2]; Catherine Crill, PharmD, BCPS, BCNSP[1,2]

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122 - Prevalence, Severity, and Distribution of Pediatric Malnutrition at a Tertiary Care Children's Hospital

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Purpose: Illness-related pediatric malnutrition significantly impacts quality of care, resource utilization and resource allocation. Identifying malnutrition is important for targeting appropriate nutrition interventions to improve quality of care. Hospital reimbursement can be impacted with the additional diagnosis of malnutrition depending on the specific case. Pediatric malnutrition is likely underdiagnosed because medical professionals did not have a formalized method for making an accurate diagnosis. Pediatric dietitians have been using the malnutrition diagnosis of Nutrition Care Process (NCP) of the Academy of Nutrition and Dietetics until a promised revision was released. Using the recently published, etiology-based definition of pediatric malnutrition endorsed by A.S.P.E.N., the Academy of Nutrition and Dietetics and the American Academy of Pediatrics, we determined the prevalence, severity and distribution of pediatric malnutrition at the CS Mott Children's Hospital and compared them to results using our current method (CM) which is based on the NCP.

Methods: Our retrospective chart review included infants and children ages 1 month to 18 years old who plot on

standardized growth charts, were hospitalized between January 1 and August 31, 2012 and had at least one nutrition note during their randomly selected admission. Babies born prematurely were excluded until they were at least 2 years old. For each chart, we noted whether malnutrition was listed as the nutrition diagnosis using our CM. Then using available data from the same chart, we followed the recommendations of the newly published method (NM) to determine if and when the child was malnourished based on z-scores (at risk/mild: -1 to -1.99; moderate: -2 to -2.99; severe: -3 or less) and/or weight loss (a drop of in z-score of >1).
Results: From a randomized list of 4545 admissions, we screened 603 medical records to find 100 patients who met inclusion criteria. Using our CM, 4 of the 100 patients were identified with malnutrition whereas the NM identified 57 patients (99% CI; p< 0.01). Of these 57 patients, 93% were malnourished on admission (99% CI, p< 0.01): 51% at risk/mild, 21% moderate and 21% severe; 30% of these cases were acute and 70% were chronic. Of the patients with moderate or severe malnutrition on admission, 33% were on the Pediatric General service and 21% on the Pediatric Cardiology service. Applying the NM to the 28 patients who were serially assessed, 43% had no malnutrition the entire time, 11% were at risk/mildly malnourished, 7% improved to a less severe category, 28% worsened and 11% were severely malnourished the entire time. In patients diagnosed with malnutrition under the NM, "Inadequate protein-energy intake" was the most common nutrition diagnosis used in our CM (40%), followed by "No nutrition diagnosis" (19%). Admit weights were available on all 100 patients. Thirty-two percent of the patients were missing admit heights and 21% of those serially assessed were missing follow up weights.
Conclusions: Pediatric malnutrition must be identified before it can be addressed. Our study determined that pediatric malnutrition was diagnosed significantly more often using the NM compared to our CM. Missing the malnutrition diagnosis, especially on admission, can have a significant impact on both quality of care and financial reimbursement. Using timely, precise anthropometrics can help clinicians identify those at risk. Targeting specific medical services may help determine trends. Further research is needed to determine if, when and how the etiology and mechanism of malnutrition can be used to help identify appropriate nutrition interventions to prevent and treat malnutrition in hospitalized children.

123 - High Incidence of Central-Line Associated Bloodstream Infections Among Ambulatory Liver Transplant Candidates With Biliary Atresia

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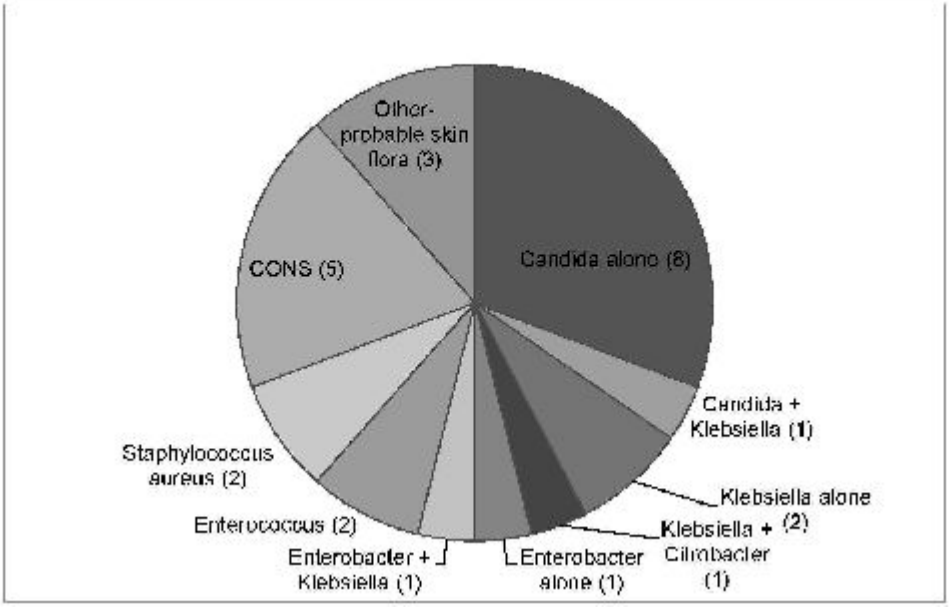
Purpose: Malnutrition is frequent among patients with chronic cholestatic liver disease but especially among children with biliary atresia. Biliary atresia is the most common pediatric indication for liver transplantation. It is also well recognized that improving the nutritional status of transplant candidates leads to better clinical outcomes. Parenteral nutrition (PN) is often required due to inadequate weight gain on enteral nutrition or if enteral nutrition is unsafe due to varices, gastrointestinal bleeding, or ongoing emesis. We investigated the incidence, epidemiology and potential risk factors associated with central-line associated bloodstream infections (CLABSI) among children with biliary atresia listed for liver transplantation at our center over a five year period.
Methods: A comprehensive chart review was conducted of all children with biliary atresia who underwent initial liver transplantation at our center from October 2007 to July 2012. Episodes of CLABSI were ascertained by blood culture results.
Results: Sixty children underwent initial liver transplantation for biliary atresia at our center between October 2007 and July 2012. Of those, 29 (48%) received PN while on the transplant list. Among patients who received PN, 16 (55%) experienced one or more CLABSI. Patients with CLABSI tended to be more often female, younger, recipients of government-sponsored health insurance, and more growth-retarded at referral than patients without CLABSI (Table 1). CLABSI was significantly associated with duration of PN exposure, but interestingly, the degree of cholestasis at time of presentation was significantly less in the CLABSI group (Table 1). There were 26 episodes of CLABSI among 16 patients and 1828 total line days or 14.2 events per 1000 line days. The microbiology of the isolates identified a high proportion of Candidal CLABSI (Figure 1).
Conclusions: CLABSI represents a significant burden in liver transplant candidates with biliary atresia who receive PN. In our large cohort, only total bilirubin and duration of PN were significantly associated with CLABSI events. Compared to typical CLABSI rates in pediatric hospitals of 1-3 CLABSI per 1000 line days, we observed 14.2 events per 1000 line days in our ambulatory cohort. Based on the high proportion of Candidal CLABSI observed, antifungals should be considered when selecting empiric antimicrobials for children with biliary atresia on PN. Although optimization of nutrition is a cornerstone of pre-transplant management, these findings suggest the decision to utilize PN should be weighed carefully against the CLABSI risk.

	CLABSI	No CLABSI	p-value
Demographics			
Male	2/16 (10%)	7/13 (54%)	NS
White	4/16 (25%)	7/13 (54%)	NS
Hispanic	5/16 (31%)	3/13 (23%)	NS
Black	5/16 (31%)	2/13 (15%)	NS
Medicaid/CHIP	12/16 (75%)	6/13 (46%)	NS
Private insurance	4/16 (25%)	7/13 (54%)	NS
English-speaking	13/16 (81%)	11/13 (85%)	NS
Spanish-speaking	3/16 (19%)	1/13 (8%)	NS
BA/Kasai	4/16 (25%)	2/13 (15%)	NS
BA/no Kasai	12/16 (75%)	11/13 (85%)	NS
Characteristics at referral			
Age (days)	138	184	NS
Length Z-score	-1.47	-0.7	NS
Weight Z-score	-1.62	-0.9	NS
Weight-for-length Z-score	-0.86	-0.66	NS
AST (U/L)	300	347	NS
ALT (U/L)	190	204	NS
GGT (U/L)	922	637	NS
Albumin (g/dL)	3.5	3.1	NS
Conjugated bilirubin (mg/dL)	3.8	5.9	NS
Total bilirubin (mg/dL)	8.5	13.9	0.046
WBC (x 1000/µL)	14.7	12	NS
Hemoglobin (g/dL)	11	10.8	NS
Platelets (x 1000/ µL)	320	298	NS
Vitamin A (µg/dL)	0.14	0.5	NS
25-OH vitamin D (ng/mL)	11	11	NS
Vitamin E (mg/L)	3.45	2.9	NS
INR	1.8	1.4	NS
BUN (g/dL)	7	7	NS
Prealbumin (mg/dL)	9.1	9.8	NS
Characteristics at transplant			
Age (days)	326	374	NS
Length Z-score	-1.57	-0.59	NS
Weight Z-score	-0.47	-0.19	NS
Weight-for-length Z-score	0.35	0.27	NS
AST (U/L)	504	268	NS
ALT (U/L)	255	148	NS
GGT (U/L)	120	183	NS
Albumin (g/dL)	2.9	2.9	NS
Conjugated bilirubin (mg/dL)	10.8	12.1	NS
Total bilirubin (mg/dL)	16	17.5	NS
WBC (x 1000/µL)	7.6	9.5	NS
Hemoglobin (g/dL)	8.5	8.9	NS
Platelets (x 1000/ µL)	77	93	NS
Vitamin A (µg/dL)	0.19	0.1	NS
25-OH vitamin D (ng/mL)	29	19	NS
Vitamin E (mg/L)	5.31	3.1	NS
INR	2	1.9	NS
BUN (g/dL)	13	13	NS
Prealbumin (mg/dL)	7.3	7.2	NS
Duration of PN exposure (days)	83	39	0.046

Table 1. Demographics, patient characteristics at time of referral to our center and at the time of liver transplantation.

Figure 1. Blood culture isolates for the 26 CLABSI observed in the cohort



124 - The Metabolism of Lipid Emulsions in Paediatric Patients Undergoing Bone Marrow Transplantation

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Purpose: Parenteral nutrition (PN) has become an integral part of the supportive care of children undergoing bone marrow transplantation (BMT). This study aims to assess the metabolic effects of an olive oil-based (OO) lipid emulsion compared with a medium chain triglycerides/long chain triglycerides (MCT/LCT, M/L) emulsion in the clinical setting of paediatric BMT patients.

Methods: Twenty paediatric BMT patients (age 1-13 years) expected to require PN support for at least 7 days, were prospectively enrolled and randomly assigned to receive either OO or M/L lipid emulsions within the PN. More than 70% of the energy requirements was supplied through PN. Clinical and laboratory investigations, plasma fatty acids profile, and peroxidation status were recorded at baseline and at the completion of PN.

Results: No statistically significant differences were found for liver enzymes and plasma lipids between the OO group and the M/L group (Table 1). The serum total superoxide dismutase (T-SOD) concentration increased with the serum malondialdehyde (MDA) level decreased in the OO group compared to the M/L group at the end of the study period. However, there were no statistically significant differences between the two groups (Table 1).

Docosahexanoic acid (DHA) and eicosapentanoic acid (EPA) levels increased significantly at the completion of PN in the OO group, and the OO group showed higher DHA and EPA levels (statistically significant difference, $P<0.05$) when compared to the M/L group (Table 2).

Conclusions: OO lipid emulsion trended to lower in peroxidation status and a favorable plasma lipid profile. In this study, short-term use of OO intravenous lipid emulsions was well tolerated in paediatric BMT patients requiring PN.

Table 1 Liver function, plasma lipids and peroxidation status in the M/L and OO groups

		At baseline		At the completion of PN	
		M/L (n=10)	OO (n=10)	M/L (n=10)	OO (n=10)
Liver function	ALT (umol/L)	27.9±22.54	15.33±3.77	33.9±34.1	38.77±46.77
	AST (umol/L)	21.3±11.44	19.55±8.73	27.30±11.46	37.88±28.96
Plasma lipids	TC (mmol/L)	3.55±0.95	3.81±0.34	3.93±1.36	3.92±0.62
	TG (mmol/L)	1.4±0.78	1.52±0.92	1.91±1.51	2.29±1.23
	HDL (mmol/L)	0.78±0.35	0.79±0.23	0.54±0.31	0.55±0.19
	LDL (mmol/L)	1.95±0.65	2.34±0.32	2.27±0.91	2.49±0.73
Peroxidation status	T-SOD (U/ml)	21.38±4.28	19.40±12.14	20.90±8.20	21.89±15.34
	MDA (nmol/ml)	21.94±3.87	17.50±7.62	22.25±14.92	14.39±7.45

Table 2 Plasma fatty acids in the M/L and OO groups

	At baseline		At the completion of PN	
	M/L (n=10)	OO (n=10)	M/L (n=10)	OO (n=10)
C14:0	44.02±29.30	28.76±20.52	56.78±28.16	49.67±26.99
C16:0	946.6±476.3	794.03±303.12	1087.56±517.99	1261.7±432.4
C16:1n-7	88.06±43.22	73.10±61.68	108.52±76.84	117.38±67.58
C16:1n-9	22.14±22.67	18.18±14.00	21.43±19.31	48.22±44.53
C18:0	473.7±406.8	318.85±247.16	418.70±374.72	512.08±323.14
C18:1n-7	38.76±13.54	44.15±7.38	54.41±25.31	74.69±33.70
C18:1n-9	646.6±267.2	652.89±273.78	825.39±291.46	1254.3±495.2
C18:2n-6	841.84±483.0	781.66±244.63	965.1±512.7	1145.2±280.7
C18:3n-3	35.45±39.97	25.50±20.12	45.17±44.85	63.27±29.96
C18:3n-6	27.79±15.69	22.31±24.54	36.35±37.14	31.80±19.34
C20:0	56.89±68.43	51.65±81.99	84.67±130.00	108.45±113.54
C20:1n-9	7.9±5.0	6.41±3.9	8.14±5.34	11.43±5.38
C20:3n-6	43.45±13.69	37.42±16.61	40.98±21.79	35.20±17.33
C20:4n-6	148.86±34.42	177.10±39.37	163.49±53.69	201.80±41.50
C20:5n-3	14.1±13.1	9.82±6.64	6.10±1.99*	10.79±4.92*
C22:0	18.89±7.32	17.85±4.11	16.44±5.53	19.76±3.77
C22:1n-9	5.50±2.03	7.69±2.60	8.45±4.03	8.87±3.47
C22:4n-6	9.32±5.49	7.23±3.84	10.13±5.57	12.24±5.71
C22:5n-3	22.4±12.73	15.31±5.47	21.45±12.43	23.88±12.35
C22:5n-6	29.77±22.54	16.26±9.81	22.26±13.02	35.06±29.56
C22:6n-3	48.76±19.84	57.03±19.20	46.40±13.51*	67.10±18.50*
C24:0	35.31±31.93	21.92±14.19	33.74±29.42	35.26±23.81
C24:1n-9	32.89±8.23	39.87±11.07	41.08±13.88	50.35±16.54

*P<0.05

PosterAbstract of Distinction

125 - Early Enteral Fat Supplement and Fish Oil in Premature Infants with a High or Low Enterostomy: Intestinal mRNA Expression

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Purpose: Premature infants with bowel resection/an enterostomy due to necrotizing enterocolitis or spontaneous intestinal perforation often malabsorb enteral nutrition. Parenteral nutrition, including Intralipid, improves growth but is associated with cholestasis. A nutritional intervention that promotes bowel adaptation could reduce the risk of cholestasis. Based on pre-clinical studies indicating that high fat diet with long chain polyunsaturated fatty acids promotes post-resection bowel adaptation, we conducted a randomized interventional clinical trial to provide the premature infants with an enterostomy early enteral fat supplementation with Microlipid and fish oil. The study aim was to investigate whether this supplementation is associated with changes of intestinal mRNA expression.

Methods: Premature infants (< 2-month-old) who had an enterostomy and tolerated enteral feeding at 20 ml/kg/day were randomized to usual care (control = 18) or early enteral fat supplement and fish oil (treatment = 18). Intravenous lipid was decreased as enteral fat intake was increased. Daily weight, clinical and nutrition data, and weekly length and head circumference were recorded. A specimen was collected during bowel reanastomosis from the proximal functional stoma and the distal non-functional end. Intestinal mRNA expression was screened in proximal stoma from 16 infants (8 from each group) by microarray, and mRNA expression of 14 selected genes was quantified by real time PCR. The mean in control and treatment groups were compared using Student's t-test separately for infants with high ostomy (defined as jejuno- to proximal ileostomy), and low ostomy (defined as mid- to distal ileostomy).

Results: 1. Clinical outcomes (Table 1). Treatment infants had higher enteral nutrition intake, less days using intravenous lipid, and lower proportion of feeding days requiring central line among those with a low ostomy in the feeding period before bowel reanastomsis; and greater post-reanastomosis weight and length gain than controls. 2. Intestinal mRNA expression. Fourteen genes selected from microarray screen were confirmed by RT-real time PCR in all RNA samples from 12 infants with a high ostomy (6 controls, 6 treatments) and 22 infants with a low ostomy (11 controls, 11 treatments). The expressions of BTG2, CTGF, CYR61, EGR1, FOS, JUN, NR4A1, PTGS2 and THBS1 were down-regulated and that of LAMC2 was up-regulated in the proximal stoma of treatment infants with a low ostomy (Figure 1A). Similar trends were seen in the distal end in treatment infants with a low ostomy, but only AFT3, BTG2, EGR1 and PTGS2 were markedly down-regulated. Treated infants with a high ostomy only had VIP down-regulated in the proximal stoma (Figure 1B) and none of 14 genes were expressed differently from controls in the distal end.

Conclusions: Early enteral fat supplement and fish oil enhances enteral nutrition, decreases the exposure to intravenous lipid and central line before bowel reanastomosis, and improves weight and length gain after reanastomosis in premature infants with an ostomy. These clinical improvements are associated with down-regulated mRNA expression of BTG2, CTGF, CYR61, EGR1, FOS, JUN, NR4A1, PTGS2, and THBS1 and up-regulated LAMC2 in treatment infants with a low ostomy, but down-regulate VIP in those with a high ostomy in the proximal functional stoma site, implying that different gene regulation mechanism(s) maybe involved in these groups.

Table 1. Patients characteristics and clinical outcomes.

	High ostomy Control (n=6)	High ostomy Treatment (n=7)	Low ostomy Control (n=12)	Low ostomy Treatment (n=11)
Characteristics				
Gestational age (week)	29.7 ± 3.7	26.7 ± 3.4	26.5 ± 3.5	26.0 ± 1.7
Birth weight (g)	1107 ± 514	1030 ± 504	911 ± 442	819 ± 213
Male, n (%)	5 (83)	5 (71)	9 (75)	4 (36)
Etiology of ostomy, n (%)				
Necrotizing enterocolitis	4 (66)	4 (57)	5 (42)	3 (27)
Spontaneous intestinal perforation	1 (17)	2 (29)	7 (58)	8 (73)
Small bowel atresia	1 (17)	1 (14)	0 (0)	0 (0)

Clinical Outcomes				
Pre-reanastomosis				
Feeding (day)	39 ± 14	45 ± 26	51 ± 24	62 ± 16
Hyperalimentation (day)	37 ± 13	36 ± 18	37 ± 19	30 ± 18
Intralipid (day)	37 ± 13	13 ± 5*	30 ± 18	10 ± 8*
Enteral nutrition volume (ml/kg/d)	35 ± 13	63 ± 25*	83 ± 26	110 ± 18*
Enteral nutrition calorie (% of tot)	20 ± 9	48 ± 17*	56 ± 20	79 ± 10*
Total calorie (cal/kg/d)	108 ± 8	117 ± 7*	111 ± 5	124 ± 6*
Ostomy output (ml/kg/d)	21 ± 4	20 ± 16	15 ± 5	15 ± 5
Weight gain (g/day)	28 ± 8	21 ± 5*	20 ± 6	19 ± 2
Direct bilirubin before closure (mg/dl)	3.4 ± 0.8	2.3 ± 1.6	2.6 ± 2.5	1.1 ± 1.1
Septic work-up (times/infant)	0.7 ± 0.8	0.6 ± 0.5	2.0 ± 2.2	0.6 ± 0.8
Antibiotics use (days/infant)	8.3 ± 15.8	3.8 ± 3.9	11.6 ± 14.3	3.3 ± 5.2
Central line use (% of feeding days)	100 ± 0	91 ± 23	85 ± 27	58 ± 30*
Post-reanastomosis				
Hyperalimentation (day)	27 ± 23	16 ± 18	6 ± 3	5 ± 1
Intralipid (day)	21 ± 18	7 ± 7*	6 ± 3	4 ± 1
Total calorie (cal/kg/d)	112 ± 14	117 ± 13	117 ± 7	111 ± 10
Weight gain (g/d)	14 ± 4	23 ± 5*	23 ± 10	32 ± 11*
Length gain (cm/week)	0.6 ± 0.8	2.2 ± 1.6*	1.1 ± 1.6	2.1 ± 1.5*
Head circumference gain (cm/week)	0.8 ± 0.9	1.2 ± 0.8	1.3 ± 0.6	1.6 ± 1.2

Figure 1A Infants with a low ostomy

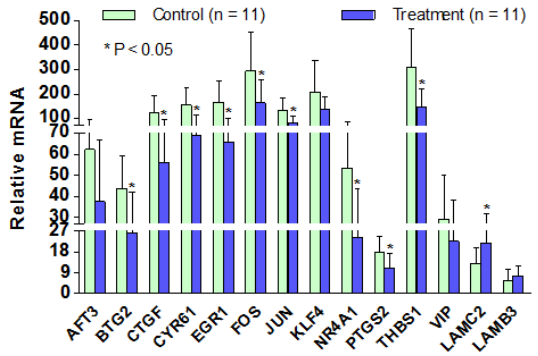
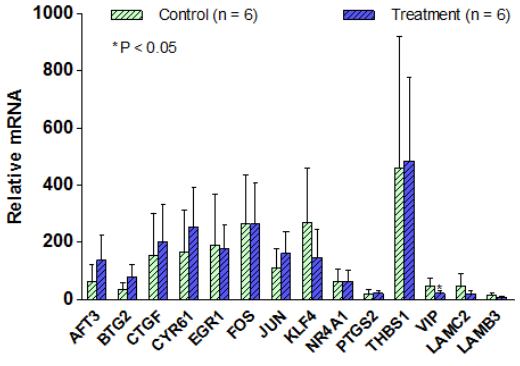


Figure 1B Infants with a high ostomy



Encore: Previously presented at the University of Michigan Hospital's Infant and Pediatric Specialty Nutrition Conference, November 4-5, 2013. Published with permission of the authors.

126 - MTool©: Diagnosing Pediatric Malnutrition From Z to A

Sandra Bouma; Sandhya Padiyar; Kate M. Ludwig; Kila Ahlijian; Jenna Beehler; Katie Byrne
Patient Food and Nutrition Services, University of Michigan Health System, Ann Arbor, MI.

Introduction: Early identification of malnutrition followed by timely interventions could improve patient outcomes and capture reimbursement dollars for the health care organization. Pediatric malnutrition is likely underdiagnosed because a uniform definition remained elusive. Mehta et. al. recently published an etiology-based definition of pediatric malnutrition which has been endorsed by A.S.P.E.N., the Academy of Nutrition and Dietetics and the American Academy of Pediatrics (JPEN, July 2013). The pediatric dietitians at the University of Michigan Health System operationalized the new definition by creating MTool©, Michigan's malnutrition diagnostic tool, which incorporates the new definition into the standardized language of the Nutrition Care Process (NCP) of the Academy. A retrospective chart review at our children's hospital found that the NCP process alone diagnosed malnutrition in 4% of our patients compared to 58% when MTool© was used. In October 2013, MTool© was launched hospital-wide and prospective data is being collected.

Description: MTool© provides the user a systematic method to analyze data that is routinely gathered during a nutrition assessment. The four step MTool© process helps the user navigate through the gathered data and move seamlessly from "Signs and Symptoms" (S) to "Etiology" (E) to "Problem" (P) in order to create a standardized nutrition diagnosis PES statement: "Malnutrition (acute, chronic) (mild, moderate, severe) related to (medical condition, dietary intake, socioeconomic factors, inflammation) as evidenced by (z scores, growth velocity, nutrition focused physical findings)."

The JPEN paper defines pediatric undernutrition as "an imbalance between nutrient requirement and intake, resulting in cumulative deficits of energy, protein, or micronutrients that may negatively affect growth, development, and other relevant outcomes." The MTool© user starts to look for evidence of this imbalance by examining the child's z scores for weight, height and BMI. At risk/mild malnutrition is defined as a z score of -1 to -1.99, moderate -2 to -2.99 and severe -3 or less. If serial measurements are available, the user then explores growth velocity and the presence of weight loss. If a child has a z-score above -1 (i.e. no malnutrition based on z scores), the child may still be diagnosed with malnutrition in situations of unintended weight loss over a relatively short period of time or suboptimal growth rate over a prolonged period. Finally, the user examines the patient to look for nutrition focused physical findings that strengthen the diagnosis.

This evidence is invaluable, but is only part of the diagnostic toolbox and prompts the question: "Why?" In looking for an etiology, the user explores four domains: medical condition, dietary intake, socioeconomic factors and presence of inflammation. Dietitians, with their training in nutrition assessment, are uniquely positioned to utilize the necessary skills to obtain pertinent information and provide the medical team with a nutrition related etiology. After reviewing the relevant data, the user is ready to make the diagnosis of malnutrition: mild, moderate or severe based on z scores and/or growth velocity and acute or chronic based on duration.

When reassessing patients, the MTool© steps are repeated to determine if malnutrition has developed, or is continuing, improving or worsening.

Conclusions: Dietitians have the training and skills to lead the campaign to aggressively treat malnutrition. MTool© provides a diagnostic method to efficiently make an accurate, uniform nutrition diagnosis. Since diagnosing pediatric malnutrition is an evolving process, MTool © must be periodically reviewed and revised to reflect current literature.

INTERNATIONAL POSTER SHOWCASE.

Abstracts # I-1 through I-43.

NORTH AMERICA
Canada

I-1 - A Canadian Survey of Perceived Barriers to Initiation and Continuation of Enteral Feeding in Pediatric Intensive Care Units

Amanda Leong, BSc[2]; Kristina Cartwright, N/A[2]; Gonzalo Garcia Guerra, MD, MSc[3]; Ari Joffe, MD, FRCPC[3]; Vera Mazurak, PhD[2]; Bodil Larsen, PhD, RD[1]
[1]Nutrition Services, Stollery Children's Hospital, Edmonton, AB, Canada; [2]Agricultural, Food and Nutritional Sciences, University of Alberta, Edmonton, AB, Canada; [3]Pediatrics, Stollery Children's Hospital, Edmonton, AB, Canada.

Purpose: Clinicians believe nutrition support is important, however, delivery of enteral nutrition (EN) may be delayed or interrupted due to a lack of guidelines or perceived contraindications to administration. The aim of this national survey was to examine the knowledge and perceived barriers among clinicians which prevent EN administration to pediatric intensive care unit (PICU) patients.
Methods: The survey consisted of 23 questions (19 primary, 4 branching). The survey was validated using a semi-structured pilot test by three pediatric critical care intensivists and two pediatric critical care registered dietitians external to the study team. The acceptable participant survey response rate was 50%, as previously published ICU surveys of clinicians has been found to range from 14% to 41%. The survey was electronically distributed to 162 PICU clinicians, including 96 staff intensivists, 8 clinical assistants, 36 fellows and 22 registered dietitians from PICUs across Canada. Responses from participants were anonymised. Due to the low response rate of clinical assistants and fellows, these groups were collapsed with the staff intensivists to form a physician group. The responses between physicians and dietitians were compared using the Fisher Exact Method ($p<0.05$).
Results: The survey was administered from January to March 2013. The participant response rate was 50% (55 staff intensivists, 2 clinical assistants, 9 fellows, 15 registered dietitians). At least one clinician from each of the 15 PICU sites participated in the study. Most of the respondents (69%) had >5y experience in the PICU. There was substantial variability among clinicians regarding reasons to delay or interrupt EN. High variability ($\leq$70% agreement and $\geq$10% disagreement or vice-versa) was found for some reasons to delay or interrupt EN, including: hypoplastic left heart syndrome, CT/MRI scan, high gastric residual volumes, and lactates (rising or >2mmol/L or >4 mmol/L) (Figure 1). Furthermore, 68% of clinicians reported no feeding protocol in their PICU (Figure 2).
Conclusions: Overall, the results of our survey demonstrate that there is substantial variability amongst clinician practice regarding acceptable procedural and clinical barriers to EN administration. Further research must be conducted regarding these barriers to provide clinicians with evidence to support their practices for EN administration. The implementation of a PICU-specific EN algorithm may result in better nutrition delivery to children.

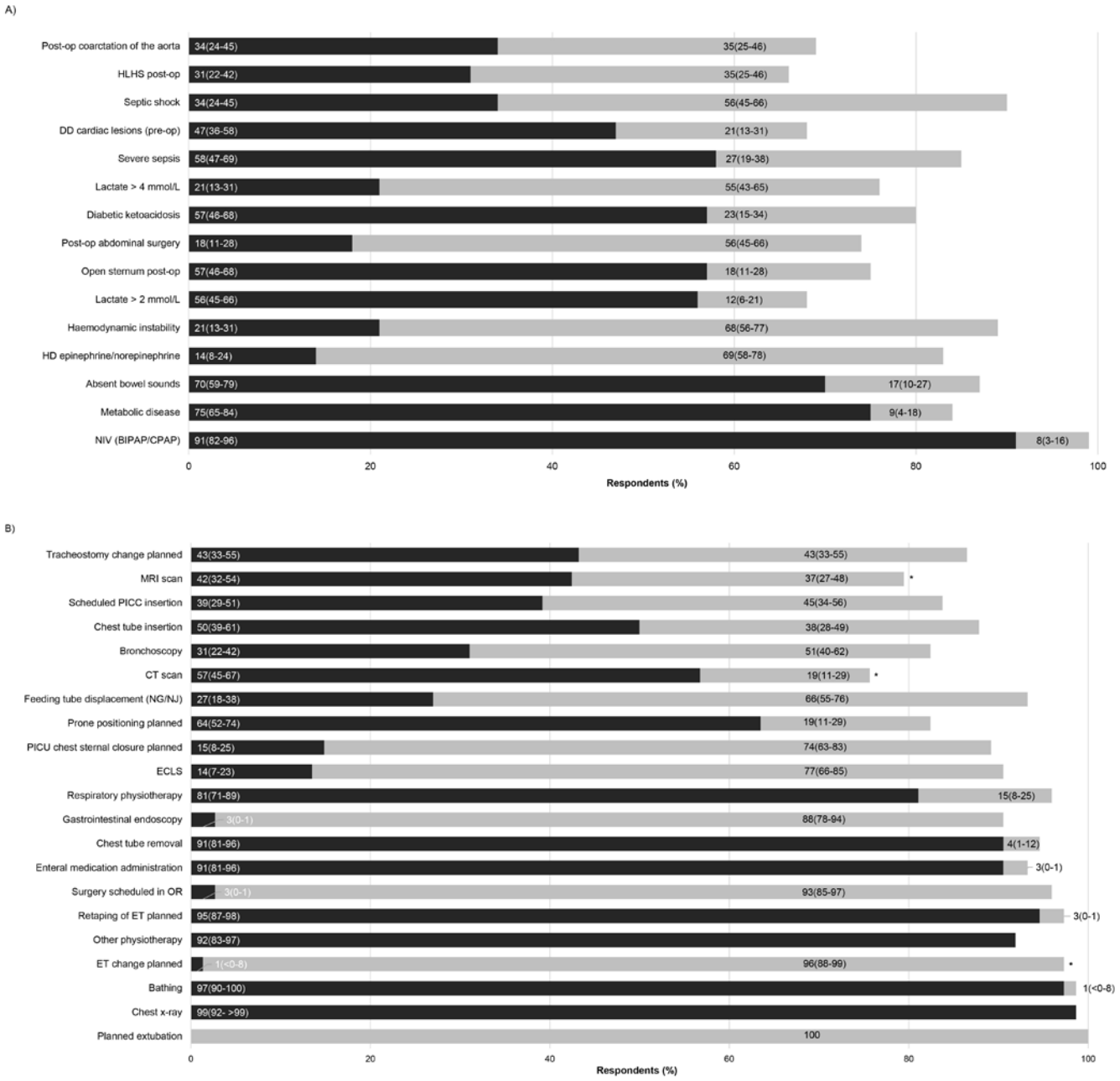


Figure 1. A. Perceived contraindications to early enteral nutrition initiation in pediatric intensive care unit patients according to clinicians. B. Perceived procedural reasons for which clinicians would stop enteral nutrition in the intubated pediatric intensive care unit patient. When the graph does not reach 100%, the remainder of responses were 'neutral'. (SD/D (Dark Grey): strongly disagree/disagree to early enteral feeding; SA/A (Light Grey); strongly agree/agree to early enteral feeding). *p<0.01 HLHS, hypoplastic left-heart syndrome; DD, duct-dependent; HD, high dose; NIV, non-invasive ventilation; MRI, magnetic resonance imaging; PICC, peripherally inserted central catheter; CT, computed tomography; NG, nasogastric; NJ, nasojejunal; PICU, pediatric intensive care unit; ECLS, extracorporeal life support; OR, operating room; ET, endotracheal tube.

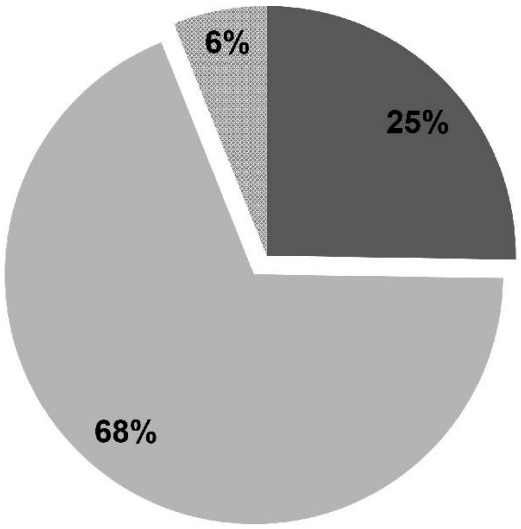


Figure 2. Proportion of clinicians reporting that written protocols are present in their pediatric intensive care unit. Uncertain (light grey), 6%; No (medium grey), 68%; Yes (dark grey), 25%).

I-2 - Epidemiology of Interruptions to Nutrition Support in Critically Ill Children in the Pediatric Intensive Care Unit

Alysha Keehn, MD (in progress)[2]; Christina O'Brien, BSc[2]; Vera Mazurak, PhD[2]; Kim Brunet-Wood, MSc, RD[4]; Ari Joffe, MD, FRCP(C)[1,3]; Allan de Caen, MD, FRCP(C)[1,3]; Bodil Larsen, PhD, RD[1,4]
[1]PICU, NICU, Stollery Children's Hospital, Edmonton, AB, Canada; [2]Agriculture, Life and Nutritional Sciences, University of Alberta, Edmonton, AB, Canada; [3]Medicine, University of Alberta, Edmonton, AB, Canada; [4]Nutritional Services, Alberta Health Services, Edmonton, AB, Canada.

Purpose: Nutrition support is often delayed or interrupted. The aim of this study is to identify reasons for and quantify time spent without nutrition in a mixed medical-surgical-cardiac Pediatric Intensive Care Unit.
Methods: Data was prospectively collected to describe the patient cohort (anthropometrics and diagnostic category), and nutritional practices (time to nutrition initiation; frequency, duration and causes of interruptions; and overall caloric intake). Descriptive statistics were used; comparisons of groups were performed using independent t-test and $p<0.05$ as significance.
Results: The mean (standard deviation) time to nutrition initiation was 22.8 (16.6) hrs following admission; 35% of patients were initiated after >24 hrs. Nutrition was interrupted 1.2 (2.0) times per patient. Time spent without nutrition due to interruptions was 11.6 (23.0) hrs, up to 102 hrs. Patients spent 42.4% (28.2%) of their median (range) PICU admission of 2.9 days (0.25-39 days) without any form of nutrition. Patients aged 0-6 months had significantly higher mean number and duration of interruptions ($P=0.001$; $P<0.001$ respectively) compared to children >6 months. Interruptions due to surgery and planned extubation lasted significantly longer than all other interruptions ($P<0.001$; $P=0.001$ respectively). Pediatric Risk of Mortality (PRISM) III scores were not correlated with percentage of length of stay spent without nutrition ($r=0.137$).
Conclusions: Prolonged time to nutrition initiation and interruptions in delivery caused pediatric patients to spend a high proportion of admission without nutrition support preventing most from meeting energy requirements. Further research addressing specific patient outcomes is required to define optimal initiation times and appropriate procedural-specific fasting times.

Table 1. Time to initiation of nutrition therapy

Variable	Mean (SD) time to nutrition initiation following admission, hrs.
Time to Initiation	22.8 (16.6)
Diagnostic Category	
Cardiac Surgery	24.2 (15.3)
General Surgery	18.1 (16.4)
Other Admission	23.4 (17.6)
Age category	
<6 months	22.5 (17.6)
7-36 months	22.4 (16.6)
>36 months	23.7 (15.2)
CDC growth chart percentile category	
<5th percentile	20.6 (19.5)
5th – 95th percentile	23.2 (13.6)
>95th percentile	22.7 (23.1)
PRISM III Score category	
<6	17.7 (15.3)*
6-12	27.8 (17.4)
>12	33.8 (10.9)*

SD, standard deviation; CDC, Centre for Disease Control; PRISM III, pediatric risk of mortality.
*Statistically significant difference in initiation times amongst patients with PRISM III scores <6 versus those with scores >12 (P= 0.045).

Table 2. Frequency and duration of interruptions to nutrition therapy per admission for patients (n=42) who experienced interruptions to nutrition

Variable	Mean (SD) number of Interruptions	Mean (SD) duration of time without nutrition due to interruptions, hrs.
Mean for all patients	1.2 (2.0)	11.6 (23.0)
Diagnostic Category		
Cardiac Surgery	1.4 (2.5)	13.2 (26.1)
General Surgery	1.2 (2.0)	10.8 (20.0)
Other Admission	0.9 (1.4)	10.2 (20.1)
Age category		
<6 months	2.4 (2.9)*	23.0 (30.2)**
7-36 months	0.6 (1.2)	3.6 (8.0)
>36 months	0.8 (1.3)	11.2 (23.7)
CDC growth chart percentile category		
<5th percentile	1.2 (1.9)	13.7 (21.7)
5th –95th percentile	1.1 (2.1)	9.2 (23.6)
>95th percentile	1.5 (1.9)	18.4 (21.3)
PRISM III Score category		
<6	1.1 (1.9)	12.2 (23.1)
6-12	1.1 (2.2)	8.6 (20.6)
>12	1.8 (2.1	17.1 (27.0)

SD, standard deviation; CDC, Centre for Disease Control; PRISM III, pediatric risk of mortality.
n= 42.*P=0.001 compared to 7-36 months; P= 0.009 compared to >36 months. ** P<0.001 compared to 7-36 months; P= 0.064 compared to >36 months

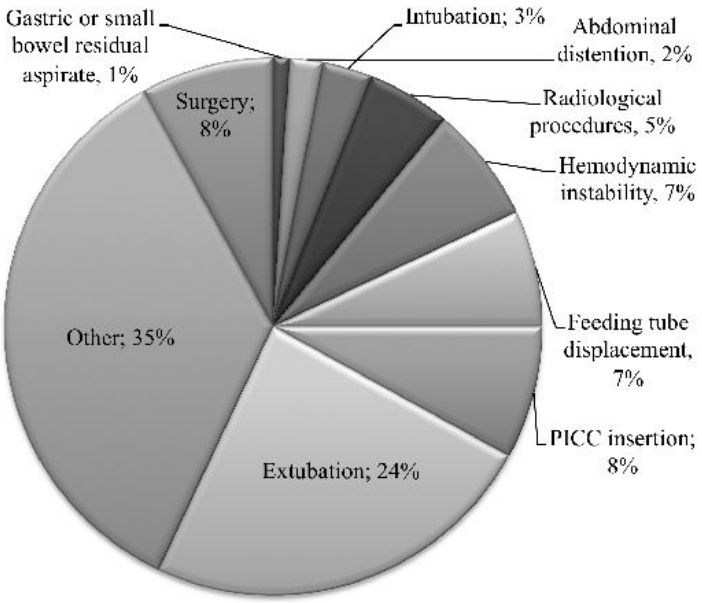


Figure 1. Frequency of causes of interruptions to nutrition therapy

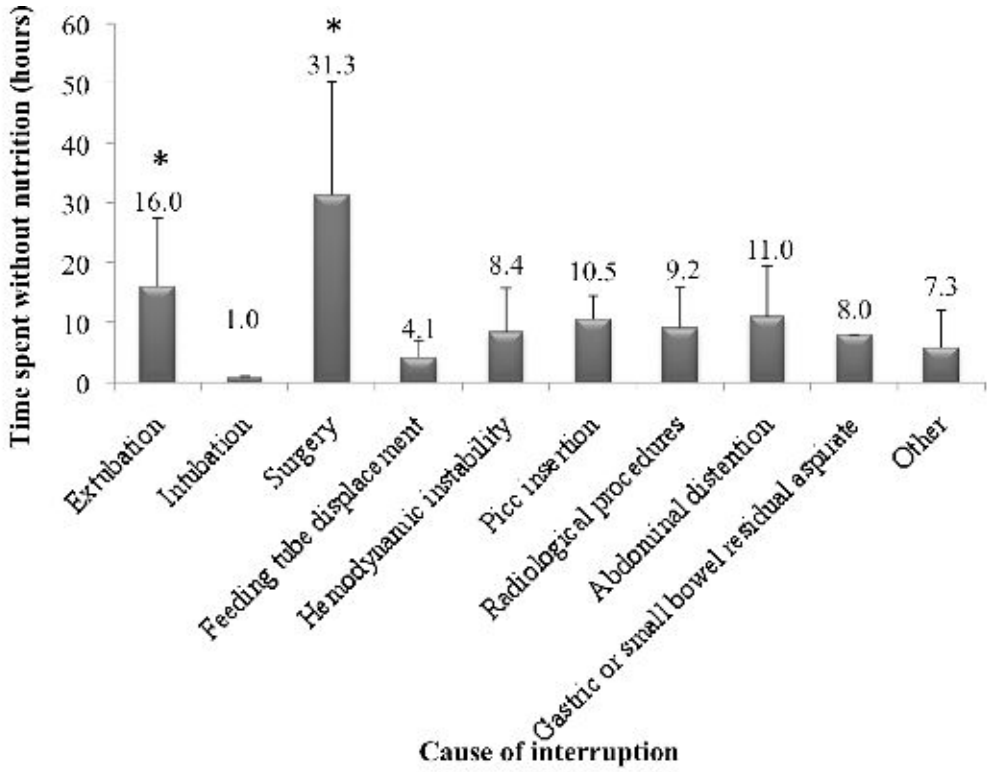


Figure 2. Mean (SD bars) duration of time spent without nutrition due to identified interruptions. The mean duration of interruptions for surgery ($p<0.001$) and extubation ($p=0.001$) were significantly longer than mean duration for all other interruptions.

Poster Abstract of Distinction

I-3 - Prevalence of Inadequate Vitamin D Status and Associated Factors in Children With Cystic Fibrosis

Laura Norton, BSc, RD[1,2]; Sarah Page, BSc, RD[1,2]; Melissa Sheehan, BSc, RD[1]; Vera Mazurak, PhD[2]; Kim Brunet-Wood, MSc, RD[1]; Bodil M. Larsen, PhD, RD[1]

[1]Stollery Children's Hospital, Alberta Health Services, Edmonton, AB, Canada; [2]Faculty of Agriculture, Life and Environmental Science, University of Alberta, Edmonton, AB, Canada.

Purpose: Vitamin D is important to the cystic fibrosis population who are at risk for inadequate 25-hydroxyvitamin D [25(OH) D] levels due to impaired absorption of fat soluble vitamins. The objective of this study was to determine the prevalence of inadequate serum 25(OH) D levels in a pediatric Canadian CF population and to assess effectiveness of a vitamin D supplementation protocol on improving vitamin D status. A secondary aim was to analyze factors that may be associated with inadequate vitamin D status.

Methods: 25(OH)D levels, amount of vitamin D supplemented and factors that may be associated with vitamin D status were collected for two consecutive years (2010 and 2011) through a retrospective chart review of 96 patients aged 1-18 years at a single pediatric CF clinic in northern Canada. Adequacy of 25(OH) D was set at ≥ 75 nmol/L. Subjects identified as having inadequate 25(OH)D levels in 2010 were supplemented with an additional 400 IU/day for levels between 60 nmol/L to 75 nmol/L or by 1000 IU/day for levels < 60 nmol/L.

Results: Inadequate 25(OH) D levels were observed in 26% of patients in 2010 and 23% in 2011 (table 1). Reported mean intake of vitamin D supplementation was 1100 IU in 2010 and 1127 IU in 2011 (table 2). After supplementation was increased for those with inadequate Vitamin D status in 2010 (n=20), a significant increase in 25(OH) D levels was observed (P=0.03). Adequate status was achieved in 50% of these patients (n=10) (figure 1). Of the factors studied, there was a significant negative association between age and 25(OH) D levels in both years (P=0.002) (figure 2). A significant positive association was also observed between Forced Expiratory Volume in one second, and 25(OH) D levels in 2011 (P=0.03) (table 2).

Conclusions: While vitamin D supplementation was effective at increasing serum 25(OH)D levels in some patients, the current supplementation protocol was unable to achieve optimal serum 25(OH) D levels in a quarter of the patient population. Of the factors studied, increasing age had the strongest association to inadequate 25(OH) D levels. Current supplementation protocols may require re-evaluation based on emerging evidence and revised CFF guidelines.

TABLE 1: Demographics

	2010 (n=82)	2011 (n=87)
Age [a]	8.5 ± 5.1	8.8 ± 5.0
Gender (%)		
Female	53.7	56.3
Male	46.3	43.7
BMI percentile [a]	51.6 ± 27	51.1 ± 28

[a] Mean ± standard deviation

TABLE 2: Variables associated with serum 25(OH)D concentration in a pediatric cystic fibrosis population

A. Continuous variables	2010			2011		
	N	Mean [a]	P value	N	Mean [a]	P value
Vitamin D Supplementation, IU	82	1100 ± 789	N/A	87	1127 ± 860	N/A
Age, years	82	8.5 ± 5.1	0.002[b]	87	8.8 ± 5.0	<0.0001[b]
BMI percentile	82	51.6 ± 27	NS	87	51.1 ± 28	NS
DEXA						
Lumbar 1-4, g/cm^2	35	0.795 ± 0.18	0.065	11	0.809 ± 0.20	NS
Total BMD, g/cm^2	35	0.955 ± 0.13	0.044[b]	10	0.910 ± 0.15	NS
BMD z-score	34	0.156 ± 0.98	NS	9	0.056 ± 0.98	NS
FEV1%	53	100 ± 39	NS	57	97 ± 26	0.029[b]
25(OH) D, mmol/L	82	88 ± 25	N/A	87	89 ± 26	N/A

B. Categorical variables	2010				2011			
	N	<75nmol/L (%)	≥75nmol/L (%)	P value	N	<75nmol/L (%)	≥75nmol/L (%)	P value
Residence				**0.87**				**0.25**
≤ 52nd degree	52	13(25)	39(75)		53	10(19)	43(81)	
> 52nd degree	30	7(23)	23(77)		34	10(29)	24(71)	
Pancreatic enzyme				**0.42**				**0.71**
Yes	74	18(24)	56(76)		80	18(23)	62(77)	
No	8	3(38)	5(62)		7	2(29)	5(71)	
Steroids				**0.68**				**0.86**
Yes	50	12(24)	38(76)		61	13(21)	48(79)	
No	32	9(28)	23(72)		26	6(23)	20(77)	
CFRD				**0.42**				**0.43**
Yes	2	1(50)	1(50)		2	0(0)	2(100)	
No	80	20(25)	60(75)		85	20(24)	65(76)	
Hospital days				**0.27**				**0.02**[b]
≥1 days	10	4(40)	6(60)		7	4(57)	3(43)	
No days	72	17(24)	55(76)		80	15(19)	65(81)	

BMD= Bone Mineral Density; CF= Cystic Fibrosis; CFRD= Cystic Fibrosis Related Diabetes; DEXA= Dual X-ray Absorptiometry scan; FEV1%= Forced Expiratory Volume in one second; IU= International Units; N/A= Not Analysed; NS= No Significance; [a] Mean ± standard deviation; [b] statistically significant results (P<0.05).

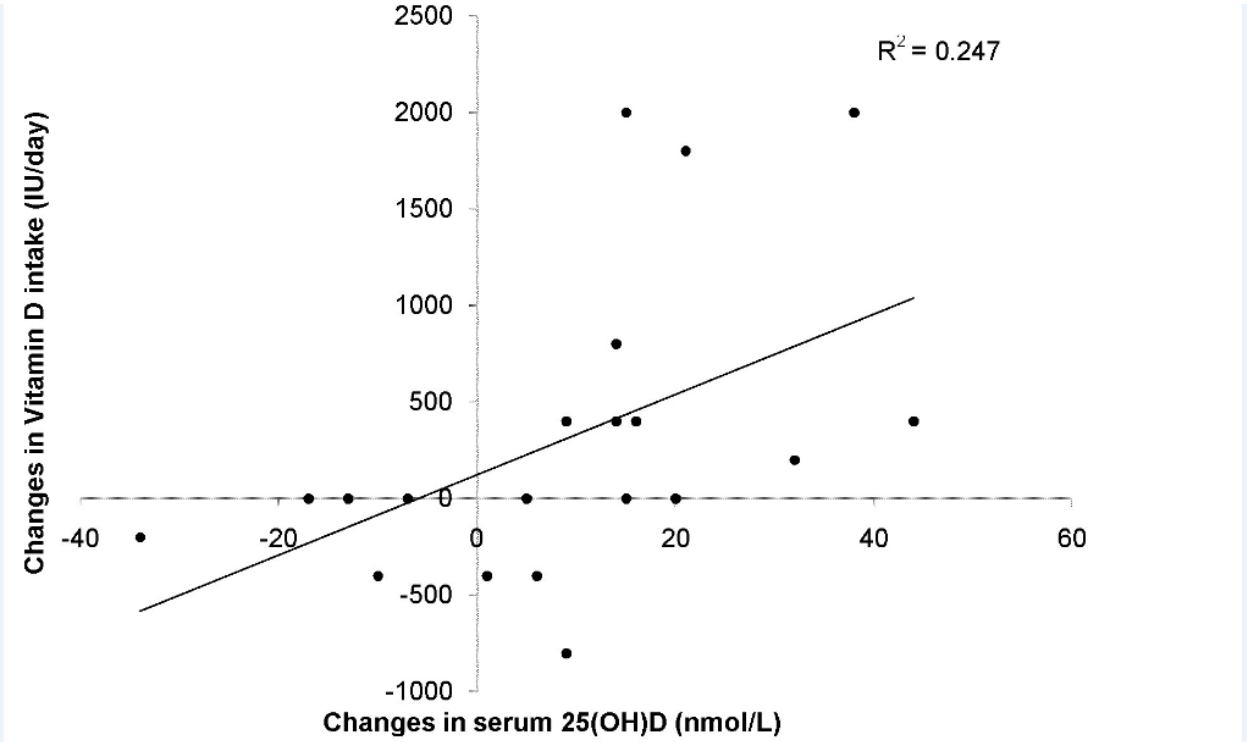
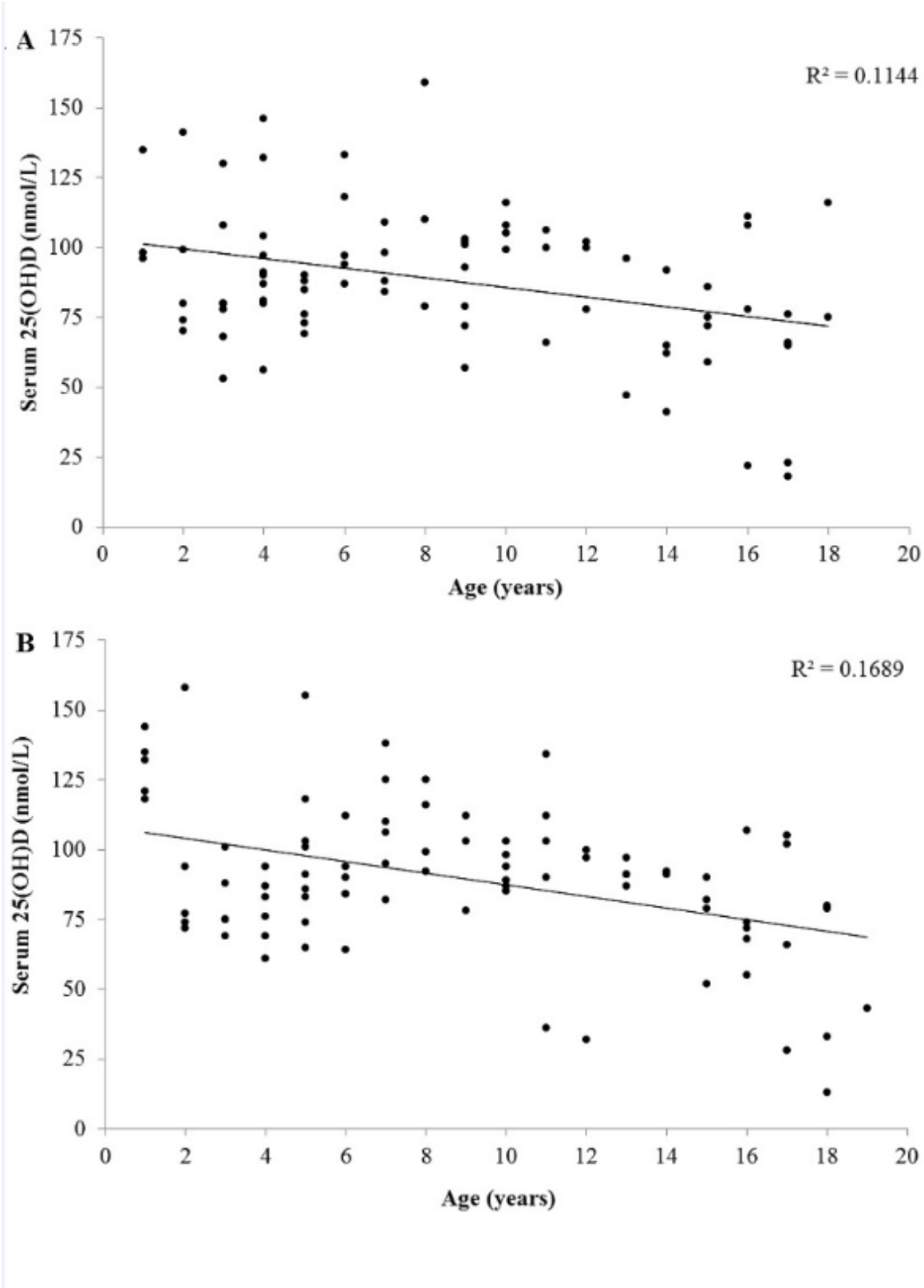


FIGURE 1. A Change in serum 25(OH) D status and supplementation over one year in a subgroup of CF patients with inadequate vitamin D status in 2010 (n=20). A positive correlation (P=0.03) between an increase in supplementation and serum levels in 2011 was observed, with 50% of the patients reaching concentrations ≥75nmol/L.


A
175
150
125
100
75
50
25
0
R² = 0.1144
Serum 25(OH)D (nmol/L)
0
2
4
6
8
10
12
14
16
18
20
Age (years)
B
175
150
125
100
75
50
25
0
R² = 0.1689
Serum 25(OH)D (nmol/L)
0
2
4
6
8
10
12
14
16
18
20
Age (years)

I-4 - Enhanced Recovery After Surgery and Nutritional Adequacy: A Single Academic Center Experience

Chelsia Gillis, PDt, MSc[1]; Thi H. Nguyen, MSc[2]; Sender Liberman, M.D.C.M[3]; Franco Carli, M.D., M.Phil[1]
[1]Anesthesia, McGill University Health Center, Montreal, QC, Canada; [2]School of Dietetics and Human Nutrition, McGill University, Montreal, QC, Canada; [3]Surgery, McGill University Health Center, Montreal, QC, Canada.

Purpose: Enhanced Recovery After Surgery (ERAS) programs employ multidisciplinary, evidence-based, perioperative interventions to modulate the surgical stress response and reduce morbidity. Implementation of ERAS pathways for patients undergoing elective colorectal surgery has significantly reduced length of hospital stay, yet colectomy remains one of the general surgeries with the greatest proportion of adverse outcomes. It has been proposed that patient-related factors that contribute to poor preoperative functional capacity, including nutritional status, may be important determinants in the measure of recovery and outcome after surgery. Although, preoperative patient counseling, including explanation of expectations and the patient's role during hospitalization, is a fundamental component of ERAS, nutritional counseling is not part of the preparations for surgery. A quality improvement investigation was thus initiated to determine whether the addition of a preoperative nutritional component is warranted at our institution by investigating the incidence of nutritional risk before surgery and assessing nutritional adequacy of patient-selected food choices after colorectal surgery.

Methods: Patient-Generated Subjective Global Assessment (PG-SGA) was used to screen all preoperative clinic (n=70) patients scheduled for elective colorectal surgery at the Montreal General Hospital, Quebec, between February and June 2013. Energy and protein intake was evaluated in a sub-sample of consecutive patients (n=40) for the first three postoperative days by estimating total energy and protein intake from leftover food at each meal based on standard hospital portions with food composition tables. Nutritional requirements were calculated individually as 25 calories/kg and 1.5g protein/kg. Achievement of 60% of estimated requirements was considered acceptable. A food access questionnaire provided a rationale for observed food intake. All patients received ERAS care, including initiation of ad libitum oral intake on the first postoperative day and nutritional supplements with meals, as well as the room service system.

Results: Eighty-three percent of cases were cancerous and stage III tumors accounted for 60% of these cases, which were surgically removed using a laparoscopic approach (87%). The median length of stay was 4 days. Before surgery, 63% of patients were considered well-nourished (A), 29% suspected or moderately undernourished (B), and 8% severely undernourished (C). According to the PG-SGA, 52% of patients scored 4-8 or >9, indicating requirement for dietary intervention or symptom management. Patients met, on average, 77+27%, 63+28%, 92+39% of energy requirements on postoperative day 1, 2, and 3 respectively; conversely, 55+24%, 43+16%, 45+12% of protein requirements were met. Food access questionnaire revealed that 80% of patients felt they had sufficient information to make appropriate food choices. Most common reasons for missed meals included loss of appetite and feelings of fatigue or worry.

Conclusions: A third of patients scheduled for elective colorectal surgery were identified as undernourished. Although patients made their own food choices, and reported having adequate information to make appropriate choices, dietary protein consumption did not meet 60% of requirements on the first three postoperative days. Preoperative, dietitian-lead, group teaching, could be a successful addition to ERAS to disseminate knowledge and empower patients to make optimal food choices before and after surgery to mitigate potential nutritional deficits to facilitate recovery.

I-5 - Are Patients at Risk of Contaminant-Induced Toxicity Following Long-Term Infusion of a Fish Oil Emulsion?

Pierre-André Dubé, B.Pharm, MSc[3]; Maxime Thibault, B.Pharm, MSc, CNSC[1]; Valérie Marchand, MD, FRCPC[2]; Christina Nguyen, B.Pharm, MSc[1]; Mathieu Valcke, PhD[3]
[1]Pharmacy, CHU Sainte-Justine, Montreal, QC, Canada; [2]Gastroenterology, hepatology and nutrition, CHU Sainte-Justine, Montreal, QC, Canada; [3]Institut national de santé publique du Québec, Québec, QC, Canada.

Purpose: Fish oil lipid emulsions are increasingly used as treatment for parenteral nutrition-associated liver disease (PNALD) in pediatric patients receiving long-term parenteral nutrition.

The off-label dose for this indication is generally a 1 g/kg/day infusion, which is five to ten times higher than the 0.1-0.2 g/kg/day dose approved in Europe. Because of the large discrepancy between these doses, some clinicians are concerned that patients could be exposed to significant amounts of potential contaminants found in fish oil. This concern was also expressed with over-the-counter fish oil supplements.

We performed this study to determine the level of potentially toxic contaminants found in a fish oil emulsion, and to evaluate the level of exposure in patients receiving the product in treatment of PNALD.

Methods: A 100 ml sample of a highly purified fish oil emulsion (Omegaven®, Fresenius-Kabi Pharma Austria

GmbH, batch 16EE0057, manufacture date 08-05-2011, expiry date 08-11-2012) was sent to Quebec Toxicology Centre (Quebec, Canada) for analysis.
Trace metals were analyzed by inductively coupled plasma mass spectrometry (ICP-MS) and organic compounds were analyzed by gas chromatography-mass spectrometry (GC-MS).
To evaluate the potential risks for patients receiving the emulsion, two exposure scenarios were evaluated. The "reasonable" scenario considered only the analytes for which concentrations above the limit of detection (LOD) were measured, whereas the "conservative" scenario attributed half the LOD to the undetected analytes. Total polychlorinated biphenyls (PCBs), toxaphenes (Parlar) and chlordanes were computed. Both exposure scenarios assumed an infusion of 1 g/kg/day of the fish oil emulsion. For each analyte (or group of analytes), the exposure dose was compared to the lowest reference value found between WHO's tolerable daily intake (TDI) and US EPA's reference dose.
Results: Most trace metals levels were under the LOD and the limit of quantification (LOQ), with the exception of potassium at 13 µg/g, and sodium at 73 µg/g, which are not of particular health concern.
28 organic compounds were found to be < LOD. However, 11 substances exhibited concentrations >LOD (LOD range: 0.19 - 0.58 µg/kg): PCB-138 (0.52 µg/kg), PCB-153 (0.95 µg/kg), PCB-180 (0.26 µg/kg), PCB-187 (0.25 µg/kg), Parlar-26 (0.53 µg/kg), Parlar-50 (1.4 µg/kg), cis-nonachlor (0.25 µg/kg), trans-nonachlor (0.52 µg/kg), α-chlordane (0.43 µg/kg), hexachlorobenzene (0.65 µg/kg), p,p'-DDE (1.8 µg/kg).
For the reasonable scenario, this resulted in an exposure dose varying between 0.65 ng/kg/day of hexachlorobenzene (HCB) and 1.93 ng/kg/day of total Parlar, while total PCBs dose was 1.72 ng/kg/day. This latter value corresponds roughly to one fourth of the average background exposure of Canadians. For the conservative scenario, corresponding numbers were 0.65 ng/kg/day (HCB) and 14 ng/kg/day (total PCBs).
For the reasonable scenario, the resulting "exposure dose/reference value" ratio varied between 0.36% (p'p-DDE) and 8.6% (total PCBs). Corresponding numbers for the conservative scenario were 0.05% (Mirex) and 72% (total PCBs) (table 1). Thus, even in the highly unlikely worst case scenario, the total PCB exposure corresponds to less (i.e.72%) than the WHO's TDI for the sum of PCBs congeners.
Conclusions: Even when accounting for the absence of first-pass effect in PN, the calculated exposure dose appeared sufficiently low as compared to the oral reference values to suggest that the analyzed sample of fish oil lipid emulsion did not bring out particular toxicological concerns, for patients receiving a 1 g/kg/day infusion for the treatment of PNALD. However, further analyses on a larger number of samples are required to confirm this statement.

Table 1. Exposition dose to contaminants detected in a fish oil emulsion and comparison to reference values, according to "reasonable" and "conservative" scenarios.

Contaminant	Toxicological reference values (ng/kg/day)	Reasonable scenario			Conservative scenario		
		Concentration (µg/kg lipid emulsion)	Exposition dose (ng/kg/day)	Exposition / Reference value ratio	Concentration (µg/kg lipid emulsion)	Exposition dose (ng/kg/day)	Exposition / Reference value ratio
Aldrin	100	-	-	-	1.0	0.1	0.10%
BDE	N/A	-	-	-	26.7	2.67	-
β-HCH	20	-	-	-	2.9	0.29	1.45%
Total chlordanes	500	12.0	1.2	0.24%	13.9	1.39	0.28%
Total PCBs	20	17.2	1.72	8.6%	143.4	14.34	71.7%
DDE+DDT	500	18.0	1.80	0.36%	35.3	3.53	0.71%
HCB	160	6.5	0.65	0.41%	6.5	0.65	0.41%
Mirex	200	-	-	-	1.0	0.1	0.05%
PCB-153	N/A	-	-	-	1.9	0.19	-

Total Toxaphenes (Parlar)	200	19.3	1.93	1.0%	22.2	2.22	1.11%

I-6 - A Revised Questionnaire to Assess Barriers to Adequate Nutrition in the Critically Ill

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Purpose: Despite the abundance of nutrition guidelines for the critically ill adult, underfeeding in ICU patients is still prevalent. Over recent years, there have been attempts to gain insights into the types of barriers that exist around feeding critically ill patients. In 2011, within the context of an International Nutrition Survey, a questionnaire was administered to multiple ICUs around the world to assess these barriers. However, several problems were identified with respect to the reliability and interpretation of the questions which could impact the validity of the observed results.

The objective of this study was to develop and evaluate a revised questionnaire to assess barriers to providing adequate nutrition, specifically enteral nutrition (EN), in critically ill adults. A secondary objective is to report the actual barriers that exist in a pilot group of ICUs.

Methods: In a convenience sample of 3 ICUs from our Critical Care Nutrition Network, a revised barriers questionnaire was administered to a random sample of the nursing staff. A barrier was defined as "something that hinders your ability to deliver adequate amounts of EN" and respondents were presented with a list of 20 items that have been previously identified as barriers to feeding critically ill patients. Respondents were asked to rate each item based on the degree to which it hinders the provision of EN in their ICU on a scale of 0-6 where 0 means ‘not at all' (you believe that it is not a barrier) and 6 means ‘an extreme amount' (you believe that the provision of EN is severely affected by this factor). The barriers questionnaire was further evaluated by a second questionnaire aimed at eliciting feedback on understandability and clarity of the questions and the time taken to complete the survey. Data on personal characteristics and suggestions for improvements to the questionnaire were also collected. The data pertaining to the evaluation of the questionnaire was reported qualitatively and the barriers were aggregated as common themes and reported as frequency and percentages. Medians and ranges were reported for the data on time to complete the survey while top barriers scores were reported as means and standard deviations.

Results: A total of 81 nurses from 3 ICUs from Canada and US completed the revised barriers questionnaire. Majority of these respondents were full time staff, age 33 yrs or less with 6-10 years of ICU experience. A total of 72/73 (99%) respondents felt that the questionnaire was easy to understand and 64/73 (88%) felt that the individual questions were clear. Minor modifications were made to the wording to improve clarity of some questions. The reported time to complete the survey was 5 minutes (median) range 2-10 minutes. When asked about additional barriers to add, 47/67 (70%) indicated none while others suggested a few additional items that related to existing barriers. One additional barrier was added to the list on the questionnaire that related to enteral feeds being held for bedside procedures, such as physio, turns, and administration of certain medications. The rating for individual barriers is shown in the table 1, ranked by highest mean score.

Conclusions: The revised questionnaire to assess barriers to enteral nutrition seems acceptable, clinically sensible and now appears to comprehensively list all possible modifiable barriers to delivering EN. This questionnaire needs further study to see if by measuring barriers with this questionnaire, it can translate into improved EN delivery to critically ill patients.

Table 1. Summary of Barriers to Delivery of Enteral Nutrition from all patients (n=81) (on a scale of 0-6, 0='not at all" 6='an extreme amount').

Barriers to Delivery of Enteral Nutrition	N	Mean	SD
In resuscitated, hemodynamically stable patients, other aspects of patient care still take priority over nutrition.	81	2.4	1.4
Delay in physicians ordering the initiation of EN.	81	2.3	1.3
Frequent displacement of feeding tube, requiring reinsertion.	81	2.3	1.2
Feeding being held too far in advance of procedures or operating room visits.	81	2.2	1.6

Delays and difficulties in obtaining small bowel access in patients not tolerating enteral nutrition (i.e. high gastric residual volumes).	77	2.1	1.5
Waiting for physician/radiology to read x-ray and confirm tube placement.	81	1.8	1.4
Delays in initiating motility agents in patients not tolerating enteral nutrition (i.e. high gastric residual volumes).	81	1.8	1.1
No or not enough dietitian coverage during evenings, weekends and holidays.	80	1.8	1.4
Not enough time dedicated to education and training on how to optimally feed patients.	80	1.8	1.3
Non-ICU physicians (i.e. surgeons, gastroenterologists) requesting patients not be fed enterally.	80	1.6	1.4
Lack of familiarity with current guidelines for nutrition in the ICU.	80	1.4	1.4
Enteral formula not available on the unit.	81	1.3	1.4
No or not enough feeding pumps on the unit.	80	1.2	1.4
Nurses failing to progress feeds as per the feeding protocol.	81	1.1	1.1
Fear of adverse events due to aggressively feeding patients.	81	1.0	1.1
Waiting for the dietitian to assess the patient.	80	0.9	0.9
Feeds being held due to diarrhea.	81	0.9	1.2
Nutrition therapy not routinely discussed on patient care rounds.	80	0.8	1.1
General belief among ICU team that provision of adequate nutrition does not impact on patient outcome.	81	0.8	1.1
Dietitian not routinely present on weekday patient rounds.	79	0.7	1.2

I-7 - The Inter-rater Reliability of Bedside Ultrasounds of the Femoral Muscle Thickness in Critically Ill Patients

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Purpose: Critical illness myopathy is common complication in the intensive care units affecting 25-100% of patients and has been associated with patient morbidity, mortality and long-term loss of functional autonomy. Our previous work has shown that there is a strong inter-reliability and intra-reliability of bedside ultrasounds of the femoral muscle measuring muscle thickness (QMLT) in healthy volunteers. The objective of this study is to examine the inter-reliability of femoral ultrasounds in intensive care unit (ICU) patients with BMI <25 and ≥35 across France, Canada and the United States.

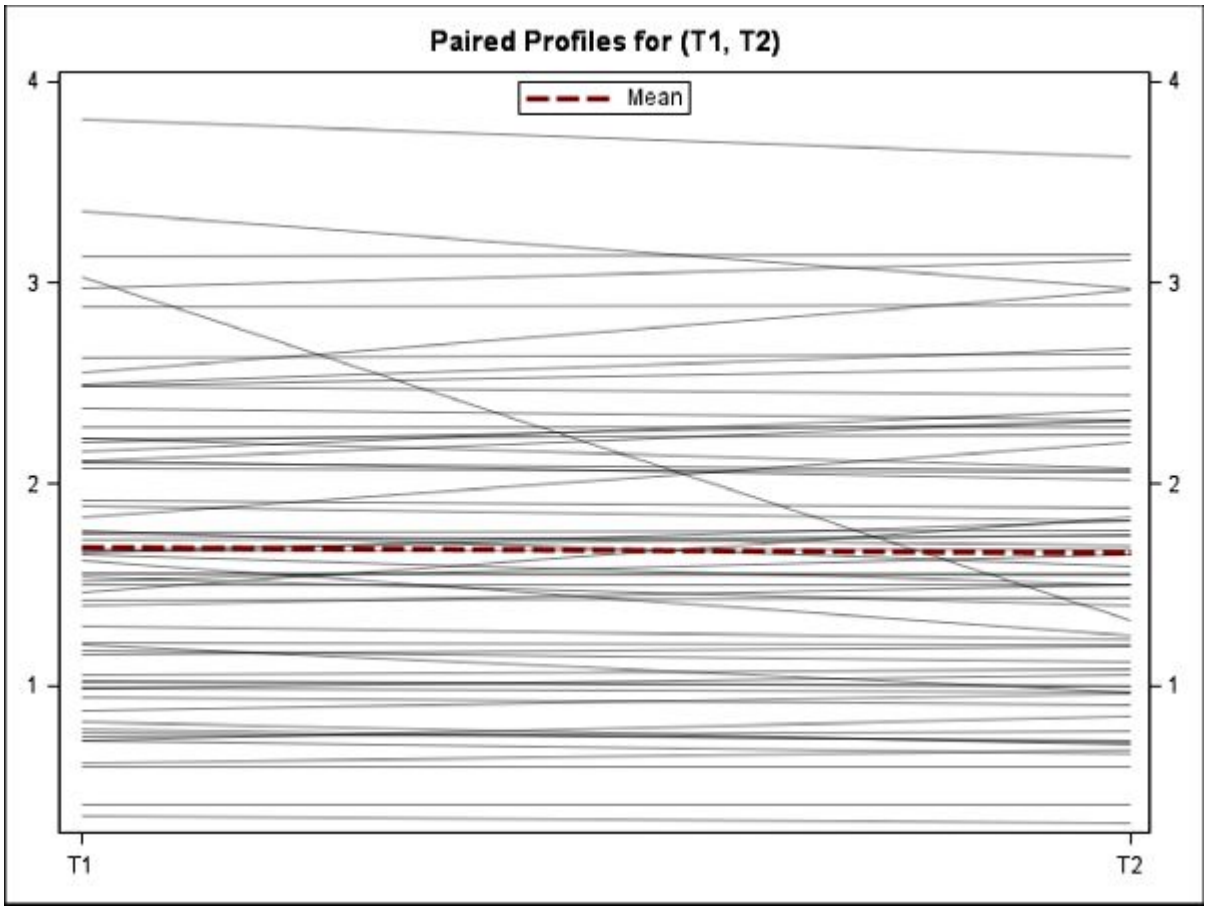
Methods: The ultrasounds were conducted as part of a multicentred randomized control trial (A Randomized Trial of Supplemental Parenteral Nutrition in Under and Over Weight Critically Ill Patients: The TOP UP Trial). Intensive care unit patients with a BMI <25 or ≥35 were randomized to a EN only arm or a EN plus PN arm. QMLT was measured weekly as well as after every CT scan up to ICU discharge or a maximum of 28 days.

Operators were instructed to perform the ultrasound according to a specified protocol and then have the measurement repeated by a second operator for each patient.

The QMLT was measured at the border between the lower third and upper two-thirds between Anterior Superior Iliac Spine (ASIS) and upper pole of the patella as well a reading at the midpoint between the ASIS and the upper pole of the patella. The overall muscle thickness was calculated as the average across the 2/3 and midpoint readings, and then averaged over the right and left legs

The inter-class correlation (ICC) that measures how consistently two operators agreed when measuring the same subject (i.e. Inter-rater) was used. A paired t-test was used to determine the mean difference between the operators

(Figure 1) and right and left legs.
Results: There were 63 patients with an overall mean age of 59.4 (+15.6) years. APACHE score of 19.9 (+7.8) and 54% females. There were 31 patients in the lower BMI group and 32 in the higher BMI group with a respective mean BMI of 20.5 (range 14-24) and 45.3 (range 36-73).
There were 63 pairs of between operator measurements with overall ICC of 0.944.
As a subgroup analysis, the results were divided into the high and low BMI groups. There were 31 pairs were in the <25 BMI group and 32 if the ≥35 BMI group with a respective ICC of 0.888 and 0.976.
Conclusions: There is strong inter-reliability of ultrasound measurements of the femoral muscle to determine overall muscle mass in critically ill patients with a BMI <25 or ≥35. Ultrasound measurements may be an effective tool to assess muscle mass in this population. Further validation studies are need and are underway.



BEST INTERNATIONAL POSTER, Poster Abstract of Distinction

I-8 - Differential Effects on Intestinal Adaptation Following Exogenous Glucagon-Like Peptide 2 Treatment in Neonatal Short Bowel Syndrome With And Without Remnant Ileum

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Purpose: To study the effectiveness of systemically administered glucagon-like peptide 2 (GLP-2) on intestinal growth and adaptation in a piglet model of short bowel syndrome (SBS). SBS is a severe condition that results from the resection of significant amounts of small intestine, leading to disruptions in growth and development. We believe that the intestinotrophic potential of GLP-2 can be of benefit for neonatal SBS.

Methods: Piglets aged 3-5 days were block randomized to either saline or GLP-2 treatment (11 nmol/kg/day) for 7 days following a 75% small intestinal resection or no resection (sham control group). Two anatomical models of intestinal resection, either 75% mid-intestinal (JI anatomical group) or 75% distal intestinal (JC anatomical group), were used to represent the full spectrum of neonatal SBS, that preserving ileum and not. Post-surgery, all piglets were maintained on 100% PN support. Intestinal length was measured pre- and post-resection and at the end of the study. Structural adaptation ex vivo was assessed by histopathological analysis and measurement of mucosal weights. Data are expressed as means ± SE and compared by two-way ANOVA for a 2x2 factorial design of surgery and treatment factors. Post-hoc testing was performed by Bonferroni's method. Kruskal-Wallis one-way ANOVA with post-hoc Mann Whitney U tests were used when variances were unequal.

Results: Exogenous GLP-2 treatment did not result in significant bowel lengthening ($p = 0.39$). There was a difference in weight per length of bowel between the JI and sham groups as a whole ($p = 0.022$). There was no difference in jejunal or ileal mucosal weights with GLP-2 treatment. On a histologic level, there were significant differences within surgery groups between saline and GLP-2 treatment, and within treatment blocks between surgery groups. GLP-2 treatment resulted in an increase in jejunum villus height in both the sham ($p < 0.0001$) and JC ($p = 0.0486$) groups compared to saline treatment but not in the JI group. This trend was also seen with jejunum crypt depth. Amongst all saline-treated animals, the JI group had significantly increased jejunum villus height ($p < 0.0001$). This difference was not observed in parallel surgery groups receiving GLP-2. There was also a difference in jejunum crypt depth amongst all three GLP-2-treated groups, increasing from sham to JI to JC ($p < 0.0001$), but not in saline-treated groups. Histologic analysis of remnant ileum in the sham and JI groups revealed no difference in crypt depth but an increase in villus height when GLP-2 was given compared to saline ($p < 0.0001$). In both treatment blocks, ileum villus height was relatively greater in the JI group compared to the sham group ($p < 0.0001$).

Conclusions: The histopathological differences observed suggest that exogenous GLP-2 treatment in a non-fed piglet model of SBS can promote intestinal adaptation. The two anatomical models used in this study are relevant because endogenous GLP-2 is largely produced in the ileum. In the absence of GLP-2 treatment, the JI group having ileum adapts but the JC group lacking ileum does not. However, when GLP-2 is exogenously administered, there is increased jejunum villus height and crypt depth in the JC group and expectedly no difference in the JI group. This is significant because the JC anatomical model represents human neonates with the most severe form of SBS, when all ileum is removed. In JI piglets, GLP-2 treatment appears to augment intestinal adaptation most in the remnant ileum, as exogenous GLP-2 treatment increased villus height in the ileum but not jejunum in this group. Nevertheless, these two models highlight the utility of exogenous GLP-2 treatment in promoting intestinal adaptation in the full spectrum of neonatal SBS.

Outcome Measures (n ± SE)	Sham Group [a]		JI Anatomical Group [b]		JC Anatomical Group [c]		p-value
	Saline [d] Treatment (n = 4)	*GLP-2 [e] Treatment (n = 4)*	*Saline [f] Treatment (n = 5)*	*GLP-2 [g] Treatment (n = 5)*	*Saline [h] Treatment (n = 4)*	*GLP-2 [i] Treatment (n = 4)*	
Morphology							
Change in small bowel length (% change)	-19.88 (± 1.72)	-12.89 (± 5.34)	-23.87 (± 2.59)	-22.40 (± 6.35)	-27.95 (± 6.43)	-27.29 (± 6.04)	0.394 (NS)
Bowel weight per length (g/cm)	0.1492 (± .0049)	0.1869 (± .0155)	0.204 (± .0089)	0.2399 (± .0177)	0.1975 (± .0264)	0.2063 (± .0176)	0.022 [ab]
Jejunal mucosal weight (g/20 cm)	1.290 (± .0719)	1.657 (± .2382)	1.805 (± .1598)	2.156 (± .1812)	1.772 (± .2714)	1.948 (± .2602)	0.146 (NS)
Ileal mucosal weight (g/20 cm)	1.152 (± .0152)	2.011 (± .3678)	1.796 (± .1504)	1.998 (± .2683)	*N/A*	*N/A*	0.0873 (NS)
Histology							
Jejunum Villus Weight (0.1 cm)	4.835 (± .1746)	5.8 (± .1271)	6.226 (± .1831)	6.004 (± .1881)	5.318 (± .1674)	5.7424 (± .1303)	< 0.0001 [de, hi, df, fh]
Jejunum Crypt Depth (0.1 cm)	1.66 (± .0574)	1.433 (± .0635)	1.556 (± .0358)	1.664 (± .0435)	1.623 (± .0393)	1.93 (± .0785)	< 0.0001 [de, hi, eg, ei, gi]
Ileum Villus Height (0.1 cm)	5.033 (± .1180)	6.063 (± .2649)	7.528 (± .2695)	8.594 (± .2784)	*N/A*	*N/A*	< 0.0001 [de, fg, df, eg]
Ileum Crypt Depth (0.1 cm	1.523 (± .0290)	1.598 (± .0537)	1.546 (± .0567)	1.464 (± .0673)	*N/A*	*N/A*	0.4019 (NS)

Superscripts refer to differences; NS: non-significant.

Table 1. Results

I-9 - Vitamin D Supplementation and Bone Health in Adults With Diabetic Nephropathy: Preliminary One Year Follow-Up Data From A Six Month RCT

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Purpose: Routine vitamin D supplementation is often needed in patients with diabetes (DM) and chronic kidney disease (CKD) due to suboptimal vitamin D intake and the high prevalence of metabolic bone disease. The study purpose was to assess the effect of six months of higher dose vitamin D supplementation on markers of vitamin D status and bone health after one year.

Methods: Twenty adults (18-80 years; 15M/5F) with DM and CKD who participated in a six month vitamin D supplementation study (effective vitamin D supplementation dose: 1333 IU/d) were followed-up at one year. Variables examined included anthropometric (weight, BMI), demographic (age, gender, DM type/duration, co-morbidity type/number) and vitamin D supplementation use, bone health parameters (absolute and t-scores for hip, femoral neck (FN), spine and whole body bone mineral density (BMD)), and dietary intake (3-day food intake records). Fat mass (FM), fat-free mass (FFM) and BMD were measured using Dual-energy X-ray absorptiometry. Laboratory variables included routine clinical blood work hemoglobin A1c, glucose, estimated glomerular filtration rate (eGFR), parathyroid hormone (PTH), phosphorus, calcium, 25-hydroxyvitamin D (25(OH)D), 1,25-dihydroxyvitamin D ($1,25(OH)_2D$), bone turnover markers (osteocalcin;OC, bone alkaline phosphatase; BAP, fibrobrast growth factor-23;FGF-23).

Results: Mean age, BMI, and DM duration (mean ± SD) in participants was 64.4 ± 9.2 yrs, 32.5 ± 6.1 and 16.4 ± 10.5 yrs, respectively. At baseline, 11 participants had Stage 1-2 CKD (eGFR ≥60ml/min/1.73m2) and 9 had Stage 3-4 (eGFR 15-60ml/min/1.73m2). Mean vitamin D intake by diet (161 ± 87 IU/d (baseline) vs 194 ± 201 IU/d (1 yr); p=0.51), vitamin D supplementation (963 ± 622 IU/D (baseline) vs 1165 ± 995 IU/d (1 yr); p=0.44) or combined diet with vitamin D supplementation (1129 ± 644 IU/D (baseline) vs 1356 ± 1067 IU/d (1 yr);p=0.41) at one year did not differ from baseline (p>0.05). No significant differences in anthropometric (wt, BMI, FM, FFM) or demographic (age, DM duration, co-morbidity type/number), routine laboratory variables, bone turnover markers (BAP, OC or FGF-23) or CKD stage (eGFR) was observed after 1 year (p>0.05). Thirty-five percent (7 out of 20) of patients had T-scores < -1 at spine, FN and hip sites; while 15% (3 out of 20) had whole body T scores <-1 at

baseline and after 1 year ($p>0.05$). While plasma levels of 1, 25 $(OH)_2$ D significantly increased (115 ± 50 (1 yr) vs 81 ± 41 (baseline) nmol/L; p=0.040) after one year, no significant differences in 25(OH)D were observed (89 ± 32 (1 yr) vs 87 ± 34 (baseline) nmol/L; p=0.9). Vitamin D supplementation was positively associated with plasma levels of 1,25$(OH)_2$D (r^2=0.21; p=0.007) and absolute FN / FN T-score FN (r^2=0.58, p=0.006) and absolute spine BMD (r^2=0.31; p=0.01), particularly in patients with stage 3-4 CKD.
Conclusions: Vitamin D supplementation in patients with DM and CKD in excess of 1300 IU/D may positively impact both vitamin D status and some parameters of bone health, particularly those with more severe CKD.

I-10 - Is the Use of Metformin Associated With Vitamin B12 Deficiency in Hospitalized Patients?
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[1]Food and Nutritional Sciences, Brescia University College at Western University, London, ON, Canada; [2]Physical Medicine and Rehabilitation, Schulich School of Medicine, Western University, London, ON, Canada; [3]Critical Care Trauma Centre, London Health Sciences Centre, London, ON, Canada.
Purpose: As of 2009, 2.4 million Canadians were diagnosed with diabetes and this number is increasing. The 2013 Canadian Diabetes Association Clinical Practice Guidelines recommend metformin as the initial hypoglycemic agent of choice for the treatment of type 2 diabetes. Metformin, which is widely used, has been shown to result in vitamin B12 (B12) malabsorption in approximately 10-30% of users. B12 deficiency can lead to serious complications including anemia and neurological changes and if not treated, may result in irreversible nerve damage. B12 deficiency can go undiagnosed as a result of mandatory folate fortification, which can mask deficiency by correcting macrocytosis. The purpose of this study was to examine the association between metformin use and B12 deficiency and to determine prevalence of B12 deficiency among metformin users in high-risk patients.
Methods: Charts from 710 patients admitted from January 2010 and December 2012 to the emergency, critical care & trauma, neurology, and spinal cord & stroke rehabilitation units of 3 university-affiliated hospitals in Southwestern Ontario, were reviewed. Data collection included: admission serum B12 concentration, metformin use, gender, age, hospital site, reason for admission, clinical signs of B12 deficiency, and documented in-hospital B12 supplementation. Due to the unavailability of supplementary serum methylmalonic acid, a more sensitive marker of true B12 status, a cut-off value of ≤258pmol/L was used to indicate deficiency. Differences in mean vitamin B12 concentrations and in the proportion of patients who were deficient between metformin users and non-users, were estimated.
Results: There were no differences in age and gender distribution between metformin users (n=108) and non-users (n=602). B12 values were documented for 80 (74%) of the metformin users. Mean (±SD) age of metformin users was 73.3 ±13.3 years and 49% were female. There were no differences in mean serum B12 concentrations between metformin users and non-users (430.2 ±296.5 vs. 403.2 ±252.1 pmol/L, p=0.776), although more than half (54%) of metformin users exhibited at least one clinical sign of B12 deficiency. Thirty-seven percent of patients who were deficient were supplemented with B12. Among patients who were B12 deficient, there was no difference in the percentage who were metformin users vs. non-users (39% vs. 22%, p=0.077). Metformin users with B12 deficiency were more likely to receive B12 supplementation compared with non-users (p=.025).
Conclusions: Despite the potential for metformin use to result in B12 deficiency, not all patients in this study were screened. Although there was no association between B12 deficiency and metformin use, more than a third of metformin users were B12 deficient. Of these patients, more than half exhibited at least one clinical sign of deficiency and 63% were not supplemented with B12. Results from this study warrant a broader discussion regarding the need for B12 screening and supplementation in diabetic patients using metformin. Further research is needed.

I-11 - Preoperative Enteral Feeding Practices and Postoperative Clinical Outcomes of Infants With HLHS Undergoing the Norwood Procedure
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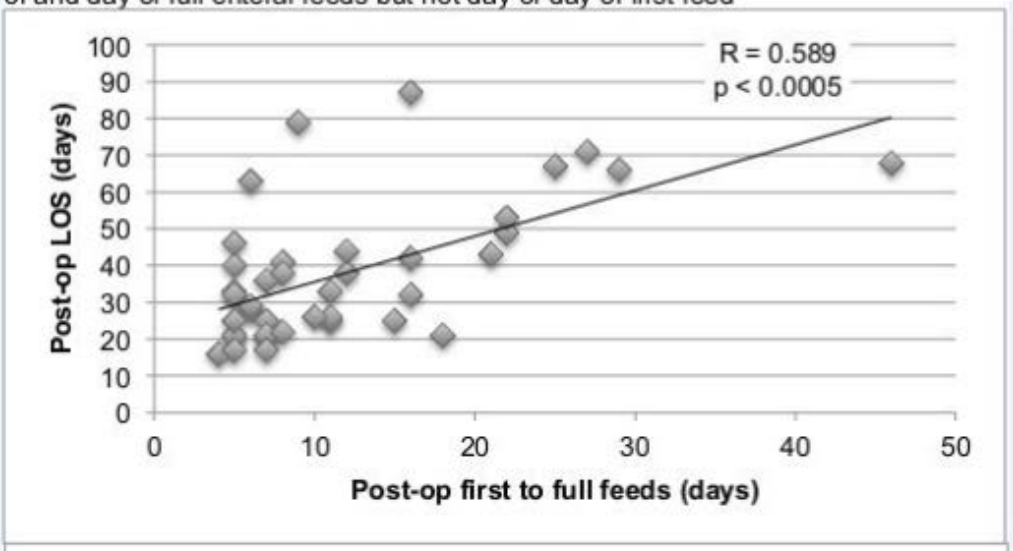
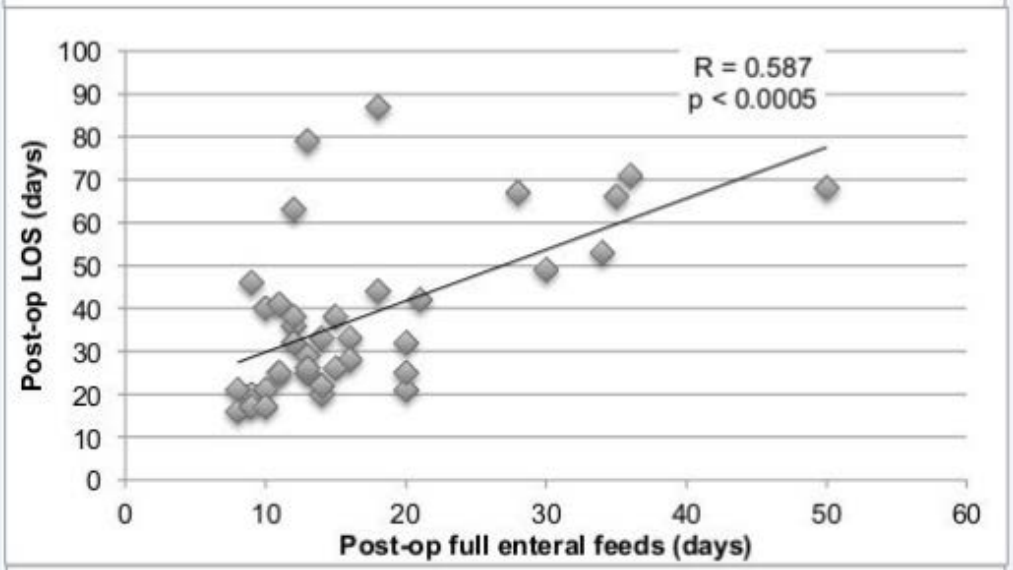
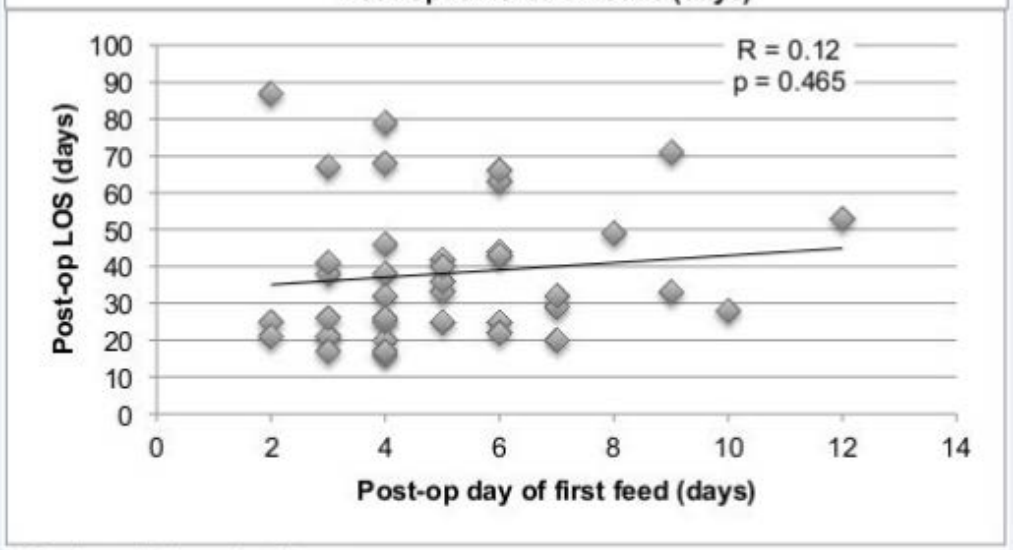
Purpose: Hypoplastic left heart syndrome (HLHS) is a congenital disease requiring palliative surgery shortly after birth and is associated with significant morbidity and mortality, including necrotizing enterocolitis (NEC). Avoidance of early enteral feeds is common practice despite current evidence suggesting they are associated with

decreased infection risk and length of stay (LOS). This study aimed to describe practices of pre- and post-operative enteral feeding and determine their association with post-operative LOS, time to first and full enteral feeds (EN), and days on parenteral nutrition (PN).
Methods: A retrospective chart review was conducted of infants undergoing the Norwood or Norwood-Sano procedure from 2007 to 2012 at the Stollery Children's Hospital (n=40). Infants were excluded with diagnosis other than classic HLHS. Variables included demographics, pre-op lactate levels, LOS, days on PN, and EN received (full EN = 100ml/kg/d). Statistical analysis using Student t test, Pearson's correlation and Fisher's exact test were performed where appropriate with SPSS 20.
Results: Baseline demographics were similar between infants who received no pre-op EN vs. those who did (gestational age 39 ± 1.8 vs. 39 ± 1.1 weeks, $p = 0.87$; birth weight 3.3 ± 0.5 vs. 3.2 ± 0.6 kg, $p = 0.38$). Pre-op serum lactate levels were significantly higher in infants who received no EN (3.7 ± 2.1 vs. 2.5 ± 0.8mmol/L, $p = 0.02$). Post-op LOS was positively correlated with time from first to full enteral feeds ($R = 0.6$; $p < 0.0005$) and post-op day at full enteral feeds ($R = 0.6$; $p < 0.0005$) while no correlation was found between post-op LOS and post-op day of first enteral feed ($R = 0.12$; $p = 0.46$) (figure 1). A significant change in practice was observed whereby pre-op EN was given to no infants in 2007-08 (n = 8) vs. 53% in 2009-12 (n = 32) ($p = 0.01$) and post-op EN was initiated earlier in 2009-12 (6.9 ± 2.9 vs. 4.5 ± 1.9 days, $p = 0.007$). Post-op LOS, time on TPN or progression to full enteral feeds did not differ between groups receiving pre-op EN vs. no pre-op EN (figure 2).
Conclusions: Despite a significant change in practice to earlier enteral feeding, there was no association with changes in post-operative clinical outcomes measured. Current evidence suggests early feeds may be beneficial although clinical assessment regarding safety of enteral feeds remains imperative. As post-op LOS and progression of enteral feeds were found to be positively correlated, future studies may consider more progressive feeding practices for this population.

Figure 1 Post-operative LOS is positively correlated with post-operative progression of and day of full enteral feeds but not day of day of first feed

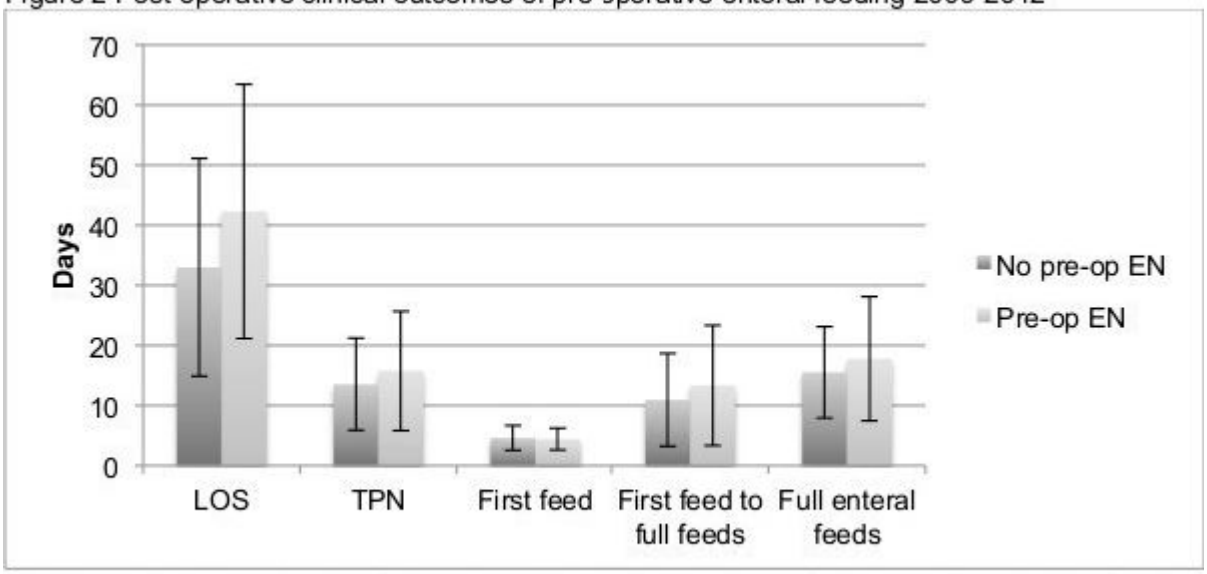






LOS, hospital length of stay

Figure 2 Post-operative clinical outcomes of pre-operative enteral feeding 2009-2012



Pre-op En, pre-operative enteral nutrition; LOS, post-operative hospital length of stay; TPN, total parenteral nutrition

I-12 - Examining the Association Between Vitamin B12 Deficiency And Dementia in a High-Risk Hospital Cohort

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Purpose: According to the Alzheimer's Society of Canada (ASC), 500,000 Canadians have dementia. By 2031 this number will rise to 1.4 million and annual health costs will reach $293 billion in 2040; therefore, strategies to reduce the burden of dementia should be considered. As Canada's population ages, the prevalence of dementia will also increase. Several studies reported an association between serum vitamin B12 (B12) deficiency and dementia; however, the exact relationship is unknown. B12 is essential for the maintenance of nerve function and deficiency can lead to permanent neurological deficits. In addition, older adults are at high risk of developing B12 deficiency due to reduced production of stomach acid (atrophic gastritis). The purpose of this study was to explore the association between B12 deficiency and dementia in hospitalized patients at high risk for B12 deficiency. We hypothesized that patients with dementia would more likely be B12 deficient.

Methods: A chart review of 666 adult patients admitted from January 2010 to December 2012 to the emergency, critical care & trauma, neurology, general medicine, and spinal cord & stroke rehabilitation units of two university-affiliated hospitals in Southwestern Ontario, was conducted. Data collection included: reason for admission, gender, age, clinical signs and symptoms of B12 deficiency, admission-level serum B12 concentration, and B12 supplementation. Patients with dementia were identified based on their medication profile and medical history. B12 deficiency was defined as serum concentration ≤258 pmol/L due to the absence of methylmalonic acid (MMA) and homocysteine values. Comparisons between study groups (dementia vs. no dementia) of patients who were B12-deficient were examined using parametric and non-parametric tests.

Results: Two hundred and sixty-two patients in the cohort were identified with a history of some form of dementia. Patients with dementia were older compared to patients without dementia (82 ± 9.5 vs. 67 ± 6.7 years, p=0.001). There were no differences in gender distribution between groups (55% vs. 45% female, p=0.51). Serum B12 values were available for 399 (60%) patients, of whom 125 (31%) were B12-deficient. Patients with dementia were less likely to be B12 deficient (36/125 (29%) vs. 89/125 (71%), p=0.0082), although there were no differences in the mean B12 concentrations between groups (192.8 ± 40.6 and 203.6 ± 41.3 pmol/L, p=0.12). Based on documentation, 56/125 (45%) patients with B12 deficiency did not receive therapeutic B12 supplementation, of whom 18/56 (32%) had dementia.

Conclusions: Contrary to our hypothesis, in this sample of hospitalized patients, those with dementia were less likely to be B12 deficient compared with patients without dementia; however, the mean serum B12 concentrations were well below the normal value for patients in both groups. Despite the fact that many of the patients were considered to be at high risk for B12 deficiency, including those with a history of dementia, 40% were not screened for B12 deficiency and 45% of those with B12 deficiency did not receive supplementation. These findings support one of the recommendations of the ASC to continue research efforts identifying risk factors associated with dementia, which could include designing and implementing a screening and supplementation protocol for B12 deficiency and dementia.

CANADA & AUSTRALIA

I-13 - OPTimal Nutrition by Informing and Capacitating Family Members of Best Practices: The OPTICs Feasibility Study

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Purpose: Adequate nutrition is important for recovery but nutrition intake is inadequate for 31-42% of hospitalized patients. During and following critical illness nutrition requirements are increased simultaneously with suboptimal nutrition delivery. Poor nutrition delivery may be associated with poor outcomes. Family Centred interventions aimed at improving nutrition delivery may prove to be promising but have not been studied in the critically ill.
Methods: This mixed methods study evaluated the feasibility of two novel family-centred interventions designed to promote optimal nutrition intake in critically ill patients. A low-intensity intervention included a short, focused nutrition education session, a structured nutrition history from the family and a printed resource that encouraged family to ask nutrition-related questions. A moderate-intensity intervention included the low-intensity intervention plus a daily nutrition diary, to be completed by the family during a two-week period following extubation. Recruitment to the study occurred in the first 48 hours following admission to the ICU. Family members of patients ≥18 years of age and anticipated to require mechanical ventilation for at least 48 hours were eligible. Feasibility will be determined through the ability to recruit participants within a 3 month time period and to retain at least 80% of patients/families until hospital discharge. Intervention acceptability will be determined through interview and survey data collected from patients and families on hospital discharge or 14 days after extubation, whichever came first. Health care professionals were interviewed at the end of recruitment to the low-intensity and then the moderate-intensity intervention to elicit their views about the intervention.
Results: 710 patients/families were screened, 107 (15.3%) were eligible and 30 enrolled in the study (Table 1). Consent was not obtained for 71 (66.4%) eligible families. Only 12 (11.2%) refused consent (Table 2). Data were available from 10 families in the low-intensity intervention (retention rate 67%) and from 13 families in the moderate intensity intervention groups (retention rate 87%).
All family participants indicated that they would participate in a similar study again and would recommend the nutritional education program to others. A total of 22 (88%) family participants found the nutrition information easy to understand and were comfortable with receiving information and acting as an advocate for best nutrition practice. A total of 21 (83%) family participants reported that health care professionals were responsive to nutrition-related questions with 23 (92%) participants rating their satisfaction as ≥8 on a ten-point scale. Satisfaction with nutrition care in the ward area was 50.0%. Of the 13 patients interviewed post extubation, 12 (92.0%) viewed their families participation in the study as acceptable.
Health care professionals (4 physicians, 2 dietitians, 10 nurses) participated in focus group interviews. Nurses and dietitians expressed more support and acceptance of families advocating for optimal nutrition than physicians. Three of the four physicians interviewed did not support the notion of families advocating for best practice and viewed their role as supportive and to provide information to the health care team when requested.
Conclusions: Based on the preliminary data, intervention was acceptable to family members and some Health Care Providers. Further data will inform patient/family and health care providers' perception of intervention acceptability.

CANADA

Poster Abstract of Distinction

I-14 - Assessment of a Novel Nutrition Screening Tool for Critically Ill Patients

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Purpose: Observational studies have revealed that critically ill patients are consistently underfed with significant calorie and protein deficits occurring within the first week of intensive care unit (ICU) stay. Yet existing nutrition screening tools have not been developed with the critically ill patient in mind. Current tools are either impractical, treat all ICU patients the same regardless of presence of acute or chronic starvation or inflammation and do not give a visual depiction of daily calorie/protein deficit. To overcome these deficiencies and to help monitor nutritional adequacy in ICUs in real time, an electronic Bedside Nutrition Monitoring Tool was created.
The objective of this paper is to assess the effectiveness of the Bedside Nutrition Monitoring Tool in improving the calorie and protein deficit in ICU patients.

Methods: The Bedside Nutrition Monitoring tool was originally developed in 2012 for the The PEP uP (Enhanced Protein-Energy Provision via the Enteral Route Feeding Protocol) Nutrition Collaborative. Features of the tool included cumulative calorie and protein adequacy graphs generated in real time and built in prompts to assist the ICU dietitian in making decisions about modifying the rate and volume of overall nutrition received. Participating ICUs collected data on baseline APACHE, SOFA score, inflammatory markers, history of weight and oral intake, comorbidities, timing of start of nutrition, calorie and protein prescription and daily amounts received. From the baseline data, the Nutrition Risk Assessment in Critically ill Patients Score (NUTRIC Score) and Malnutrition Screening Tool (MST) score were calculated by the tool and any risk of malnutrition was identified. Endpoints included calorie and protein adequacy and initiation of enteral nutrition compared to guidelines. Energy and protein adequacy was compared between patients with a high (>5) vs. a lower NUTRIC score (<5) and those with a high MST score (2 or more) vs. low MST score (0-1).

Results: From September 2012 to August 2013, a total of 15 ICUs participated and collected data for 152 patients for a total of 1199 days. Twenty-two patients had an APACHE score <15, 46 patients scored 15-19, 51 patients scored 20-28, and the remaining 33 patients scored >28. The average SOFA Score was 11.1 ± 5.2. On average, the time from ICU admission to initiation of EN was 0.8 (+1.8) days and patients received 61.9% of prescribed calories, 58.2% of prescribed protein and accumulated an average deficit of 633 kcals/day and a 39.2 gms protein/day. A total of 70.4% of patients had a high NUTRIC score (>5) and 42.8% of patients were identified as being at risk of malnutrition according to the MST. Patients with a high NUTRIC score received 63.4% prescribed calories and 59.3% prescribed protein compared to patients with a low NUTRIC score (58.6% cals and 55.6% protein, p=0.28 and 0.37 respectively). Patients with a high MST score received 64.9% prescribed calories and 63.0% prescribed protein compared to patients with a low MST score (59.8% cals and 54.7% protein, p=0.10 and 0.01 respectively).

Conclusions: Despite being fed within 48 hours of ICU admission, suboptimal delivery of energy and protein continues to be an issue in critically ill patients. Energy and protein adequacy was no better in higher risk patients as determined by the NUTRIC score and only slightly better in patients with a high MST score. Based on these results, the Bedside Nutrition Monitoring Tool is not effective in improving calorie and protein deficits in the critically ill. Further insight is needed into the barriers surrounding the use of this tool and optimizing energy and protein intake in this population.

I-15 - Nutritional Adequacy and Long-Term Survival in Critically Ill Patients Requiring Prolonged Mechanical Ventilation

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Purpose: While the provision of adequate nutrition support in critically ill patients has been shown to have an impact on short-term outcomes, such as intensive care unit (ICU) and hospital mortality, relatively little is known about subsequent long-term outcomes. The objective of this study was to examine the association between short-term nutritional adequacy received while in the ICU and six-months survival in critically ill patients with prolonged mechanical ventilation.

Methods: The study was conducted as a retrospective cohort study on data collected prospectively in the context of

a multicenter randomized controlled trial (the REDOXS study) in critically ill patients with multiorgan failure. Randomized patients who stayed in ICU and were mechanically ventilated for more than eight days were included. Nutritional adequacy was obtained from the average proportion of prescribed calories received during the first eight days where the patients were mechanically ventilated in the ICU. Patients were categorized into three groups according to nutritional adequacy: low, <50%; moderate, ≥50 and <80%; and high, ≥80%. Patients were followed prospectively to determine the survival at six months. Kaplan-Meier survival curves and Cox proportional hazards regression modeling were used to analyze group differences in survival.

Results: Of the 1223 patients enrolled in the randomized controlled trial, 475 met the inclusion criteria for this study (Figure 1). For critically ill patients with >8 days of ICU stay and mechanical ventilation, survival time in those who received low nutritional adequacy was significantly shorter than those who received high nutritional adequacy while adjusting for important covariates (adjusted hazard ratio (HR) =1.67; 95% confidence interval (CI), 1.06-2.64; P = 0.03) (Table 1). When restricting the analysis to patients who were mechanically ventilated and in ICU for >12 days, the association between nutritional adequacy and six-month survival remained statistically significant (adjusted HR = 1.91; 95% CI, 1.23-2.95; P = 0.004) comparing low nutritional adequacy group to high nutritional adequacy group) (Table 1). Consistent results were obtained when treating nutritional adequacy as a continuous predictor (Table 1).

Conclusions: Higher nutritional adequacy (receiving >80% prescribed energy) is associated with longer survival time in critically ill patients requiring prolonged mechanical ventilation.

Figure 1. Patient Flow Chart

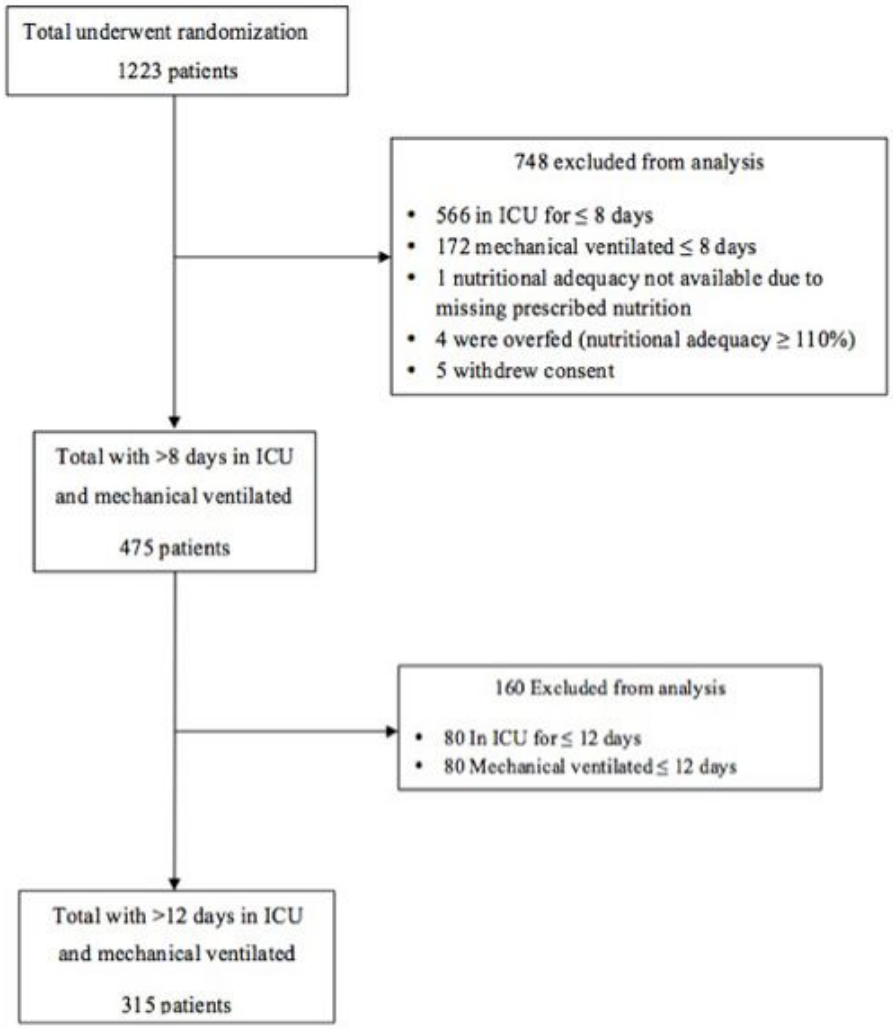

Table 1. Hazard ratio estimates of the effect of nutritional adequacy on 6-months survival

Model	Low vs. High		Moderate vs. High		Continuous per 25% decrease	
	HR (95% CI)	*p*	HR (95% CI)	*p*	HR (95% CI)	*p*
Main analysis: >8 days stayers (n=475, deaths=173)						
Crude	1.13 (0.73, 1.75)	0.59	1.08 (0.66, 1.77)	0.75	0.98 (0.84, 1.15)	0.85
Adjusted[a,b]	1.67 (1.06, 2.64)	0.03	1.30 (0.74, 2.26)	0.36	1.14 (0.99, 1.33)	0.08
Secondary analysis: >12 days stayers (n=315, deaths=120)						
Crude	1.23 (0.85, 1.77)	0.28	1.07 (0.72, 1.58)	0.74	1.02 (0.83, 1.24)	0.88
Adjusted[a,b]	1.91 (1.23, 2.95)	0.004	1.49 (0.87, 2.52)	0.14	1.21 (1.01, 1.46)	0.04

[a]Adjusted for age, APACHE II score, baseline SOFA, Charleson Comorbidity Index, admission category, primary ICU diagnosis, body mass index, and region;
[b]The overall model used 19 degrees of freedom

Poster Abstract of Distinction

I-16 - Nutritional Adequacy and Health-Related Quality of Life in Critically Ill Patients Requiring Prolonged Mechanical Ventilation

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Purpose: The objective of this study was to examine the association between nutritional adequacy and health-related quality of life (HRQoL) in six-month survivors requiring prolonged mechanical ventilation in the intensive care unit (ICU).

Methods: The study was conducted as a retrospective cohort study on data collected prospectively in the context of a multicenter randomized controlled trial (the REDOXS study) in critically ill patients with multiorgan failure. Patients survived to six-months follow-up and were mechanically ventilated for more than eight days in the intensive care unit were included. Nutritional adequacy was obtained from the average proportion of prescribed calories received during the first eight days of mechanical ventilation in the ICU. HRQoL was prospectively assessed using Short-Form 36 Health Survey (SF-36) questionnaire at three-months and six-months post ICU admission.

Results: At six-months follow-up, 302 of the 475 patients who were mechanically ventilated and remained in the ICU for > 8 days, were alive and therefore eligible for inclusion (Figure 1). Among these survivors, the increases in scores for Physical Functioning (PF), Role Physical (RP), and Physical Component Scale (PCS) of the SF-36 from three-months to six-months were statistically significant. At three-months follow-up, a 25% increase in nutritional adequacy was associated with improvements in PF, RP, and PCS of 7.29 (P = 0.02), 8.30 (P = 0.004), and 1.82 (P = 0.07) points respectively (Table 1). At six-months follow-up, a 25% increase in nutritional adequacy was associated with improvements in PF, RP, and PCS of 4.16 (P = 0.14), 3.15 (P = 0.25), and 1.33 (P = 0.19) points respectively (Table 1). A stronger association with nutritional adequacy was found at three-months compared results obtained at six-months. Consistent results were obtained after performing multiple imputation on missing values.

Conclusions: Nutritional adequacy is associated with HRQoL in six-month survivors requiring prolonged mechanical ventilation in the ICU. Increasing nutritional intake can help facilitate faster physical recovery.

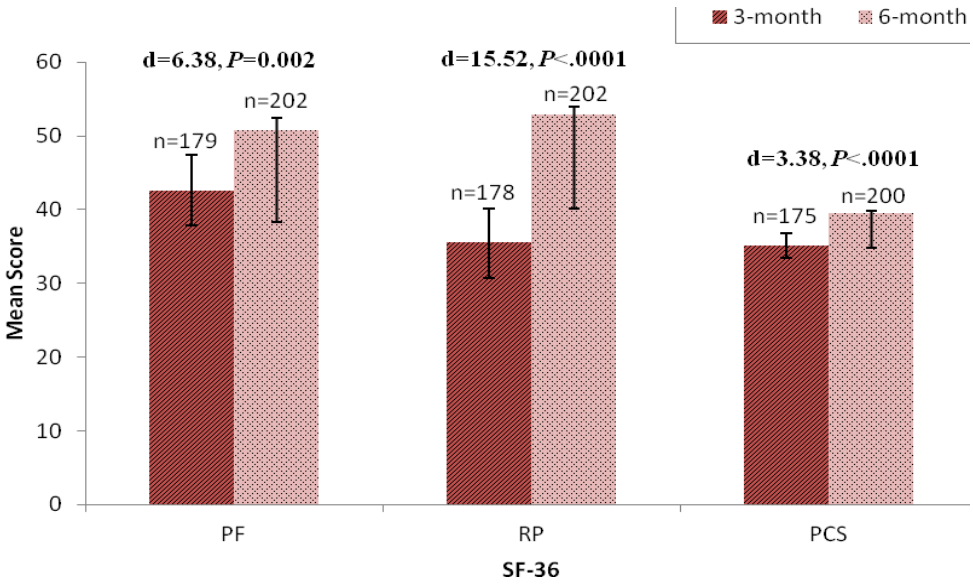

Table 1. Parameter estimates of the effect of nutritional adequacy on SF-36 scores.

SF-36		Nutritional Adequacy[a] per 25% increase			
		Crude Estimate[b] (95% CI)	p-value	Adjusted Estimate[b,c] (95% CI)	p-value
Physical Functioning	3-month (n=179)[d]	7.71 (2.29, 13.14)	0.006	7.29 (1.43, 13.15)	0.02
	6-month (n=202)[d]	5.25 (0.03, 10.47)	0.05	4.16 (-1.32, 9.64)	0.14
Role Physical	3-month (n=178)[d]	8.27 (3.03, 13.52)	0.002	8.30 (2.65, 13.95)	0.004
	6-month (n=202)[d]	5.00 (-0.16, 10.16)	0 .06	3.15 (-2.25, 8.54)	0.25
Physical Component	3-month (n=175)[d]	1.82 (-0.07, 3.70)	0.06	1.82 (-0.18, 3.81)	0.07

Scale	6-month (n=200)[d]	1.77 (-0.15, 3.69)	0.07	1.33 (-0.65, 3.31)	0.19

[a]Proportion of caloric prescription received by enteral nutrition and parenteral nutrition over first 8 days of mechanical ventilation and intensive care unit stay; [b]The estimate provides the change in SF-36 scores for every 25% increase in nutritional adequacy; [c]Adjusted for age, APACHE II score, baseline SOFA, Functional Comorbidity Index, admission category, and region; [d]n provides the number of responders for each SF-36 score.

I-17 - Is There a Relationship Between Proton Pump Inhibitor Therapy and Vitamin B12 Deficiency in an Inpatient Hospital Setting?

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Purpose: Vitamin B12 (B12) deficiency increases with age, occurring in up to 46% of older adults. Proton pump inhibitors (PPIs), medications used to treat gastroesophageal reflux, peptic ulcer disease and nonspecific gastrointestinal symptoms, are commonly prescribed for the elderly. While PPIs are effective at reducing gastric acid secretion, which is necessary for the digestion and absorption of B12 from food, their prolonged or unmonitored use may lead to B12 deficiency, which may lead to irreversible neurological damage. Moreover, mandatory folic acid fortification may contribute to undiagnosed B12 deficiency by correcting macrocytosis, while neurological damage progresses. The purpose of this study was to examine the relationship between PPI use and B12 deficiency in adults in a high risk in-patient setting.
Methods: A chart review was conducted of 710 adults admitted to emergency, critical care & trauma, spinal cord & stroke rehabilitation and neurology units of two regional hospitals in Southwestern Ontario, between January 2010 and December 2012. Data collection included: demographics, clinical signs & symptoms of B12 deficiency, admission-level serum B12, mean corpuscular volume (MCV), PPI use and in-hospital B12 & multivitamin supplementation (MVM). Since methylmalonic acid values, which can aid in the detection of subclinical B12 deficiency were not available, serum B12<258pmol/L was used to identify B12 deficiency. Comparison between patients who were B12-deficient between study groups (PPI users vs. PPI non-users) were examined using parametric and non-parametric tests.
Results: Three hundred and seventy-six patients were admitted with a documented history of PPI use. The mean age of PPI users and non-users was similar (70.2+17.7 vs.71.5±18.4 years, p=0.210) as was the gender distribution (47% vs. 50% female, p=0.401). Serum B12 values were available for 258 (69%) of PPI users. Of these patients, 73 (28%) were B12 deficient. Overall, PPI users had significantly higher mean B12 concentrations compared to non-users (435.2±283 vs. 369.9±219.6 pmol/L, p=0.001). Excluding patients who received B12 and/or MVM supplementation, there was no difference between groups in the proportion of patients who were B12 deficient (29% vs. 27%, p=0.696), although mean B12 concentrations in PPI users remained significantly higher compared with non-users (438.9±281.5 vs. 370.7±212.3 pmol/L, p=0.017). When patients less than 60 years were excluded, mean B12 concentrations were not significantly different between PPI users and non-users (447± 316.4 vs. 392.4±248.2 pmol/L, p=0.59). Forty-one patients (56%) with B12 deficiency received B12 supplementation. Among PPI-users, 64 (88%) patients with B12 deficiency did not have an elevated MCV (<100fL), after excluding those with documented folic acid supplementation.
Conclusions: In this hospital sample of high-risk patients, although PPI users had higher B12 concentrations compared with non-users, the proportion of patients who were B12 deficient was similar between groups. Nevertheless, it has been suggested that dietary B12 intake may mitigate the effects of PPIs. In addition, with the absence of macrocytosis and low risk of B12 supplementation, screening and supplementing this population may be prudent to prevent irreversible neurological damage. Further research is needed.

SOUTH AMERICA

Brazil

I-18 - Yacon Effects in Fecal pH and Short Chain Fatty Acids in Preschool Children

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Purpose: Yacon (Smallanthus sonchifolius) is an Andean root with prebiotic proprieties, due its high fructooligosaccharides (FOS) levels. End products of the FOS fermentation by intestinal microbiota are short-chain-fatty acids (SCFAs), primarily acetate, propionate, and butyrate. These end products help to maintain the colonic mucosa by providing their metabolic requirements. The concomitant decrease in pH may contribute to the reduction of intestinal pathogens. The aim of this study was to evaluate the effect of yacon flour on faecal pH and SCFA in preschool children.

Methods: Preschool children aged 2 to 5 years from a full-time public nurserie were recruited for this study (n=20). The children received yacon flour in preparations for 18 weeks at a quantity to provide 0.14 g/kg/day of FOS. Parents were asked to take fecal samples from their children before and after the intervention period. Feces were homogenized in phosphate buffered saline solution and the pH was measured using a glass pH electrode. Short chain fatty acids analyses were carried out by liquid chromatography. The results were expressed as µmol/g feces. The parameters before and after the intervention were evaluated using the paired t test (α =5%). The data were analyzed using SPSS, version 19.0 (IBM SPSS Statistics Base, DMSS, São Paulo, SP, Brasil).

Results: There were no significant changes in faecal pH before and after the intervention period (6.76±0.43 vs. 6.91±0.45, respectively). The yacon intake, compared with the period before the intervention, resulted in increased levels of butyric acid (0.09±0.05 vs. 0.12±0.07 µmol/g, $p < 0.05$) with no differences ($p > 0.05$) in the acetic and propionic acid levels (0.36±0.11 vs. 0.38±0.15 µmol/g; 0.09±0.05 vs. 0.12±0.07 µmol/g, respectively).

Conclusions: This study demonstrates that the yacon intake leads to increased butyric acid concentrations in healthy children. Future studies should look for the changes in bacterial population, including butyrogenic species.

Financial Support: FAPES.

Mexico

I-19 - Validating of a Predicting Energy Expenditure Equation in Overweight and Obese Mexican Patients

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Purpose: The prevalence of overweight and obesity in Mexico is around 70% and obtaining a reliable measurement of the Resting Energy Expenditure (REE) in these patients is greatly important. The aim of the study was to obtain a prediction equation of REE in outpatients with overweight or obesity in the Mexican population.

Methods: The study was conducted at Instituto Nacional de Ciencias Médicas y Nutrición "Salvador Zubirán". Consecutive outpatients (18-70 year old) at the Nutrition Clinic were evaluated between March 2010-August 2012 after being diagnosed with overweight or obesity (BMI $\geq$ 25 kg/m2). Patients with any disease that could affect the measurement of gas exchange were excluded. Participants were evaluated by indirect calorimetry (IC), bioelectrical impedance analysis (BIA) and anthropometric measurements to design the REE prediction equation. Two groups were evaluated: one group for derivation and another group for validation. Additionally the REE was estimated by using the equations of Harris-Benedict, Mifflin St-Jeor, Ireton-Jones, Carrasco, and Owen, assessing current weight, ideal weight and adjusted weight. An equation of REE was obtained by multiple linear regression based on the variables that were evaluated, and those that gave the best precision to the model were selected. Then, the real REE and the estimated REE were compared with Student's t-test. To highlight differences between the pairs of measurements were further analyzed by the Bland & Altman plot. Pearson correlation coefficient and the coefficient of determination (R2) between REE measured by IC with the REE estimated by various formulas were performed.

Results: 77 patients were included in the derivation group: 38 men (49.4%) and 39 women (50.6%), mean age was

48.5 ± 13.9 years and BMI 34.7 ± 5.7 kg/m2. 50 participants were included in the validation group: 16 men (32%) and 34 women (68%), the average age was 48.5 ± 15.5 years and BMI 34.2 ± 5.2 kg/m2. The baseline characteristics of both groups were homogeneous (table 1). The IC reported an average of 2001 ± 552 kcal and a respiratory quotient (RQ) 0.75 ± 0.04. The new equation that resulted from the statistical model had R2 = 0.52 and a bias of ± 3.39 kcal (table 2). When the REE obtained from IC was compared with the REE estimated by the new formula, there wasn't significant difference between the results and had a correlation of 0.71 ($p < 0.0001$) for all participants. The difference between the new formula and the REE measurement by IC when analyzed by the Bland-Altman method (figure 1) the bias was 3.39 ± 384 kcal. Furthermore, a correlation was obtained between the real and estimated REE by different equations, the most accurate correlation with the new formula was the Owen's formula (r=0.712).

Conclusions: The new formula had an acceptable correlation with REE measurement by IC in patients with overweight and obesity in Mexican population. This equation may represent a useful tool for health care professionals who do not have access to IC equipment for the estimation of REE.

Table 1. Clinical and demographic characteristics of study participants.

Variable	Derivation (n= 77)	Validation (n= 50)	p**
Age, *years*	48.5 ± 13.9*	48.5 ± 15.5	0.992
Height, *m*	1.61 ± 9.0	1.60 ± 10	0.351
Actual weight, *kg*	91.2 ± 20.5	87.7 ± 17.2	0.323
Ideal weight, *m*	58.3 ± 8.0	56.7 ± 8.7	0.244
Adjusted weight, *m*	66.6 ± 10	64.4 ± 9.9	0.231
Waist circumference, , *cm*	111 ± 14	110 ± 13.8	0.668
Hip circumference, *cm*	114 ± 12.3	114 ±11.6	0.972
Mild arm, *cm*	36.7 ± 4.6	36.3 ± 4.0	0.520
Demispan, *cm*	84.2 ± 5.3	83.2± 5.8	0.283
Calf circumference, *cm*	40.8 ± 4.5	40.0 ± 3.9	0.280
Wrist circumference, *cm*	17.4 ± 1.5	16.9 ± 1.4	0.06
Body mass index, kg/m^2	34.7 ± 5.7	34.2 ± 5.2	0.605
Percentage of fat	38.2 ± 7.5	39.0 ± 7.6	0.526
Percentage of fat-free mass	61.8 ± 7.5	60.9 ± 7.6	0.508

Table 2. Equation for estimating the Resting Energy Expenditure of Mexican patients with overweight and obese

Equation	R	R^2	Bias	SD of bias	IC 95%
12.204(AW) -244.892(1) +83.954 (WC) –402.204	0.714	0.52	-3.39	384.4	-756 a 750

AW: Actual weight, kg; WC: Wrist circumference, cm; 1: if female and 0 if male. The multiple regression analysis steps to get the new formula and then residual analysis was performed by the Bland-Altman method.

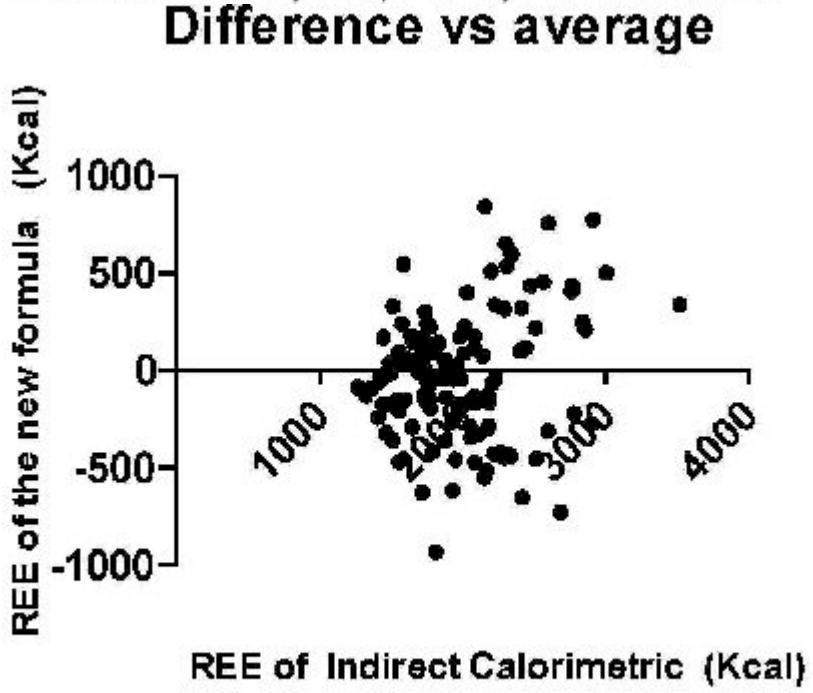

Figure 1: Comparison of the Resting Energy Expenditure (REE) measured by indirect calorimetry vs the REE estimated by the new formula in overweight and obese subjects

Brazil

I-20 - Home Parenteral Nutrition: A Two-Decade Experience of a Tertiary Hospital in São Paulo, Brazil
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Purpose: Short bowel syndrome can be a severe condition, and in some cases, home parenteral nutrition (HPN) is the only method that patients have to maintain their nutritional status. The aim of this study is to analyze the epidemiological data of patients on home parenteral nutrition of an ambulatory of short bowel syndrome of a public tertiary referral hospital in São Paulo, Brazil.
Methods: This was a retrospective study that evaluated patient files from January 1991 to April 2013.
Results: A total of 30 cases were recorded: 20 (66%) males and 10 (33%) females, with a mean age of 39.9 ± 16.6 years. Seven of them, had the indication to initiate HPN because of intestinal pseudo-obstruction and 23 patients

suffered intestinal resection. The most common underlying disease category that led to the short bowel syndrome was acute abdominal vascular emergencies (11, 47,8%). Three patients had less then 60cm of remnant small bowel length with ileocecal valve preserved and 20 patients had no ileocecal valve. From these 20 patients, 3 (15%) had <100cm of remnant small bowel length, 12 (60%) patients 99-50cm and 5(25%) patients <50cm. During the period of the study, 10(33%) patients died, and in 80% the cause of death was infections related to the catheter. In the same period, 11 (37%) patients were able to discontinue HPN. The mean length of HPN was 26 months +- 36 (range from 2 months to 118 months). The number of patients on oral nutritional supplements was 18 (60%), on enteral nutrition 3 (10%) and 4 (13%) patients received both. Forty per cent (12) of the patients gain weight during the treatment, 36%(11) lost and in 16% (5) it didn't change (2patients had no weight registry).
Conclusions: This first analysis of the epidemiological data of our patients shows that the major part of the patients were male, the most common underlying disease category that led to the short bowel syndrome was acute abdominal vascular emergencies and 37% of the patients were able to discontinue the home parenteral nutrition in the period.

ASIA

China

I-21 - Malnutrition, Inadequate Energy Intake, and Their Relationship to Clinical Outcomes in One Tertiary Pediatric Intensive Care Unit

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Purpose: Malnutrition and its impact on clinical outcomes may be underestimated by physicians in Pediatric Intensive Care Unit (PICU). The aim of this study was to assess the nutritional status of critically ill children, evaluate the adequacy of energy intake and associated risk factors during PICU stay, as well as to describe their relationship to clinical outcomes.
Methods: Prospective observational study conducted in consecutive patients staying longer than 3 days in the medical ICU of a University Children' Hospital. Demographic data, time to feeding, route, energy prescription and delivery, and outcomes were recorded.
Results: In total, 127 patients were enrolled into this study. The incidence of malnutrition increased from 43.3% at PICU admission to 48.0% at PICU discharge, and z-scores for the anthropometric measurements significantly decreased during PICU stay. About 65% of the patients and 60% of the recorded days were underfed during the first 10 days of PICU stay. Age ≥2 yrs, malnutrition, PRISM score ≥10, underprescription, initiation to enteral nutrition over than 24 hours after admission, mean duration of EN interruption per day and use of ventilation were all associated with lower percentage energy intake. Malnutrition was a risk factor for 60-day mortality and the length of PICU stay, inadequate energy intake was a risk factor for Multiple Organ Dysfunction Syndrome (MODS).
Conclusions: Malnutrition and hospital underfeeding are prevalent among children admitted to PICU, and the nutritional status of these children deteriorates during hospitalization. Factors that affect the adequacy of energy intake are multiple. Malnutrition and underfeeding are associated with some adverse clinical outcomes.

I-22 - Bacalin Alleviates Intestinal Ischemia Reperfusion Injury via Nrf2 Pathway Activation in Rats

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Purpose: The purpose of this study was to investigate the protective effects of bacalin on intestinal ischemia-reperfusion injury and the role of Nrf2 pathway activation on this process in rats.
Methods: Thirty-two male Wistar rats were randomly divided into four groups, control(SO), bacalin(BA), IIR, and bacalin+IIR(BA+IIR) groups (8 rats in each group).The IIR model was created by clamping superior mesenteric artery (SMA) for 60 minutes and restoring blood supply for two hours. The rats in SO and BA groups underwent laparotomy, and the SMA was separated without occlusion. The rats in BA and BA+IIR groups were given bacalin (100mg/kg,1ml) by intraperitoneal injection, at 30 minutes before model creation, respectively. The rats in SO and

IIR groups, normal saline (1ml) were given by intraperitoneal injection, respectively. Intestinal histopathologic changes were examined. Serum SOD, MDA levels were determined by WST and thiobarbituric acid method, plasma D-lactic acid level was assayed by Elisa. The Nrf2 and HO-1 of intestinal tissue were determined by immunohistochemistry and western blot.
Results: In IIR group, the Chiu's scores of intestinal mucosa, serum MDA level, plasma D-lactic acid level were significantly higher than that in SO group (P<0.01,respectively).Nrf2 and HO-1 expression of intestinal tissues in IIR group were higher than that in SO group (IHC:P<0.05&WB:P<0.01). In IIR group, serum SOD activity decreased significantly when compared with SO group (P<0.01). In BA group, Nrf2, HO-1 expression in intestinal tissues increased significantly in comparison with SO group(IHC:P<0.05, WB:P<0.01). Compared with IIR group, intestine tissue injury was significantly reduced in IIR+ BA group, serum MDA level and plasma D-lactic acid decreased significantly(P<0.01, respectively), serum SOD activity and Nrf2, HO-1 expression in intestinal tissues increased significantly(P<0.01, respectively).
Conclusions: The data suggests that bacalin alleviate intestinal ischemia reperfusion injury by activating the Nrf2 pathway.

Indonesia

I-23 - Lactate as Energy for Penumbra Area in Rat Model Intracerebral Hematoma
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Purpose: Intracerebral Hematoma (ICH) has high mortality and morbidity rate. The problem in ICH are decreased cerebral blood flow (CBF), ischemia and metabolic supression which subsequently cause energy deficit. Lactate, as product of aerobic and anaerobic metabolism, is a potential therapy modality. The aim of this study is to discover the role of lactate as energy source which in turn will act as neuroprotector by measuring Adenosine triphosphate (ATP) level in penumbra area after compression by ICH
Methods: This is a true experimental study, using randomized post test control only design. Having approval from the research ethic committee, 32 rats were randomly divided into two groups, i.e. HSL group (n=16) and NaCl 3% (n=16) as control group. Both groups were anesthetized using conversion-dose pentothal. Arterial line was attached in the tail and blood glucose, lactate, PaO2, PaCO2, SaO2, HCO3, Hb, Sodium and temperature were measured as baseline. Burrhole was done afterwards and 20 µL of autologous blood was injected for 10 minutes in the left and right lobus. Both groups were given bolus and maintenance infusion 1.5 cc/kg (conversion dose) for 360 minutes respectively. Blood glucose, lactate, PaO2, PaCO2, SaO2, HCO3, Hb, sodium, and temperature were measured at thirty and 360 minutes respectively. ATP level was analyzed using t-test. MCT-1 and necrotic area was analyzed using Mann Withney test.
Results: ATP level in HSL group is higher compared to control group (p=0.031). MCT-1 in HSL group is also higher than control group (p=0.010). Necrotic area is less extensive in the HSL group than control group (p=0.000). Lactate levels at T30 and T360 are increased in HSL group while in control group it increased up to T30 than decreased gradually until T360.
Conclusions: Exogenous lactate in HSL solution has an effect as energy source and neuro protector in rat model with ICH

Japan

I-24 - Simple Predictors of Nonrecovery From Nutritional Disorder After Operation for Colorectal Cancer
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Purpose: Colorectal cancer (CRC) is one of the most commonly seen cancers in the world, and in Japan, we also see a lot of patients with CRC who need surgical treatment such as colectomy or proctectomy. Because surgery for CRC is an invasive procedure and requires removal of part of the alimentary tract, most patients who undergo the

surgery experience nutritional disorder for days, sometimes for weeks after surgery. The delay of nutritional recovery may lead to a prolonged hospital stay and excessive medical costs.
The aim of our study was to determine simple factors which can predict non-recovery from post-surgical nutritional disorder in patients who underwent surgery for CRC.
Methods: A total of 142 Japanese patients who underwent colectomy or proctectomy for CRC at our hospital between December 2009 and December 2012 were enrolled in this study: 77 men and 65 women; mean age, 73.4±10.5 years (range 42-95 years). Patients who had other organ metastasis or who experienced a major complication after surgery including massive bleeding, anastomotic leak, and severe intestinal obstruction were excluded from this study. We chose serum albumin levels as a nutritional index and defined it as nutritional non-recovery when the albumin level at baseline (one or two days before surgery) was higher than that at two weeks after surgery. The following variables as possible predictors of nutritional non-recovery were determined in each patient and evaluated: gender, age, BMI, the serum albumin level at baseline, the minimum albumin level during two weeks after surgery, Δalbumin (the albumin level at baseline minus the minimum albumin level during two weeks after surgery), laparoscopy use, cancer site (colon or rectum), regional lymph node metastasis, and the number of days of no food intake after surgery. For the statistical analysis comparing the two groups, we used Fisher's exact test and unpaired t test, then we also conducted univariate and multivariate analyses.
Results: Of all the 142 patients, 78 patients showed nutritional recovery and 64 patients showed non-recovery. In the comparison between these two groups, there were significant differences in gender ($p = 0.042$), BMI ($p = 0.006$), the albumin level at baseline ($p < 0.001$), and Δalbumin ($p < 0.001$).
From a univariate analysis, odds ratios of male, BMI ≧22kg/m2, the albumin level at baseline <3.5g/dL and Δalbumin ≧1.0g/dL for nutritional non-recovery were 2.08 (1.06 - 4.09), 2.53 (1.28 - 4.99), 0.09 (0.02 - 0.39) and 12.78 (5.41 - 30.18), respectively. After carrying out a multivariate analysis, age ≧75years, BMI ≧22kg/m2 and Δalbumin ≧1.0g/dL were proved to be independently significant predictors of nutritional non-recovery, and odds ratios were 2.90 (1.09 - 7.68), 3.05 (1.20 - 7.70) and 15.85 (5.62 - 44.67), respectively. The albumin level at baseline <3.5g/dL was a negative predictor with odds ratio 0.13 (0.02 - 0.74).
Conclusions: We found that among the Japanese people who underwent surgery for CRC, age ≧75 years, BMI ≧22kg/m2 and serum albumin decrease during two weeks after surgery ≧1.0g/dL, were independently significant predictors of nutritional non-recovery within two weeks after surgery. Patients who meet at least one of these criteria should be considered to receive nutritional intervention before or soon after surgery.

I-25 - Enteral Feeding via Ileostomy Causes Ileal Rather Than Jejunal Gut Associated Lymphoid Tissue (GALT) Atrophy due to Inflammatory Changes in the Ileum

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Purpose: Our previous study demonstrated feeding tube tip position to affect the size of GALT, a center of systemic mucosal immunity. Enteral feeding via a proximal site in the GI tract preserved GALT cell number more than that via a distal site. However, the precise mechanism remains unclear. We evaluated GALT size and the gut cytokine milieu on the oral (jejunum) and anal (ileum) sides of the small intestine in mice fed via jejunostomy or ileostomy.
Methods: Exp.1) Male ICR mice received tube feeding of a standard complex enteral diet via jejunostomy (n=9) or ileostomy (n=9). After 5 days of continuous tube feeding (19.2 kcal/body/day), whole small intestines were harvested. The small intestines were cut in half (jejunum and ileum). GALT lymphocytes from Peyer's patches (PPs), intraepithelial spaces (IE) and the lamina propria (LP) were isolated from each portion. Exp.2) Another set of mice (Jejunostomy:n=11, Ileostomy: n=9) were fed as in Exp. 1. Cytokine levels in plasma and the homogenates of each portion (jejunum and ileum) were measured using a cytometric bead array kit.
Results: PP cell numbers were maintained regardless of whether the tip of the feeding tube was in the jejunum or the ileum. However, ileostomy reduced IE and LP cell numbers in the ileum but not in the jejunum, as compared with jejunostomy. Ileostomy increased pro-inflammatory cytokine levels in the ileum.
Conclusions: Enteral feeding via ileostomy causes inflammatory changes in the ileum, possibly thereby reducing ileal IE and LP GALT cell numbers.

Exp.1. GALT Lymphocyte number (x 10^6).

	Jejunostomy		Ileostomy	
	Jejunum	Ileum	Jejunum	Ileum
PPs	10.9±1.4	9.4±0.8	7.2±0.8	10.8±1.0
IE	1.4±0.4	1.2±0.3	0.7±0.1	0.4±0.2*
LP	5.7±1.0	4.1±0.4	4.4±1.0	1.3±0.4*

Means ± SE, *p<0.05 vs. Jejunostomy

Exp.2. Cytokine levels in plasma and intestinal homogenates (pg/mL).

		IL-12	TNF-α	IFN-γ	MCP-1	IL-10	IL-6
plasma	Jejunostomy	1.0±0.4	3.7±0.7	0.6±0.1	0.5±0.5	ND	20.0±11.1
	Ileostomy	3.0±1.6	5.2±1.2	0.8±0.4	0.7±0.7	0.2±0.2	7.1±1.4
jejunum	Jejunostomy	5.2±1.1	3.5±1.2	0.9±0.1	9.8±3.4	1.8±1.2	4.9±1.5
	leostomy	3.5±1.0	2.8±1.2	0.6±0.2	7.0±3.8	3.8±3.8	1.5±0.6*
ileum	Jejunostomy	2.9±0.7	3.0±0.5	1.0±0.9	4.2±2.1	4.9±2.6	1.6±0.4
	Ileostomy	6.9±1.5*	6.6±1.4*	1.2±0.3	20.0±5.2*	8.9±4.8	3.4±0.7*

Means ± SE, ND: not detected, *p<0.05 vs. Jejunostomy

I-26 - Effects of Active Hexose Correlated Compound (AHCC) on Survival in a Murine Peritonitis Model and on Macrophage Function

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Purpose: AHCC is an extract of the mycelia of a basidiomycete mushroom. AHCC has been found to have an alleviating effect on chemotherapeutic drug-induced side effects, an immune modulating action, a protective action against infections, and an anti-inflammatory effect. However, the influence of AHCC on peritoneal host defense has not been elucidated. We investigated the influences of AHCC on peritonitis survival and macrophage functions in mice.

Methods: Experiment 1) Seven-week-old male C57BL/6J mice (n=13) were randomly assigned to the control (n=7) or the AHCC group (n=6). The AHCC group was given a 0.4% AHCC-supplemented diet ad libitum, while the control group received a normal diet. After 7 days on one of these diets, the mice underwent cecum ligation and puncture. Survival was observed for 48 hours.

Experiment 2) Mice (n=21) were randomized into 3 groups (control: distilled water only, n=7, AHCC60: AHCC 60mg/kg/day, n=7, AHCC300: AHCC300mg/kg/day, n=7), and were given the respective treatments once a day via gavage for 7 days. The mice then were killed, and peritoneal macrophages were harvested. Their phagocytic ability was evaluated employing fluorescent beads.

Experiment 3) Murine macrophages were cultured in vitro with AHCC (0, 100, 1000, 3000 ug/ml) for 24 hours. Nitric oxide (NO) and interleukin (IL)-12 levels in culture supernatants were then measured.

Results: Experiment 1

Pre-experimental body weights and body weight changes after treatment were similar in the two groups. The AHCC group showed significantly better survival than the control group (log-rank test, p=0.02).

Experiment 2

The macrophages from the AHCC300 group showed significantly higher phagocytosis than those from the control group (p=0.02).

There was no significant difference in phagocytosis between the control and AHCC60 group macrophages.

Experiment 3

There were no significant differences in either NO or IL-12 levels in supernatants between the 2 groups.
Conclusions: AHCC supplementation improved survival in a murine peritonitis model. A possible mechanism is enhanced phagocytic capacity of macrophages without an excessive inflammatory response.

Figure 1. Survival curves in Exp.1.

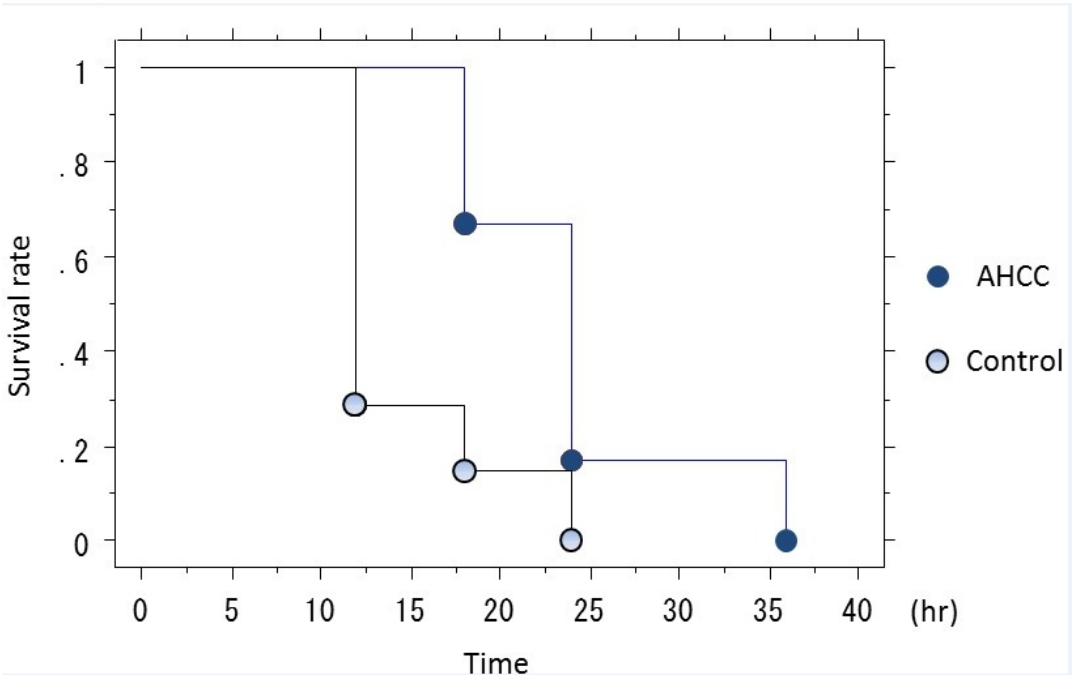

Table 1. The phagocytic rate of peritoneal macrophages in Exp.2, and NO and IL-12 levels in culture supernatants in Exp.3. Values are means±SD.*P<0.05 vs. control.

	Control		AHCC 60	AHCC 300
Phagocytosis (%)	20.2±3.54		21.4±2.64	27.1*±4.45
	Control	AHCC 100	AHCC 1000	AHCC 3000
NO (microM)	1.47±0.41	1.14±0.52	1.6±0.37	0.92±0.44
IL-12(p70) (pg/ml)	1.82±0.11	2.26±0.64	1.68±1.81	1.92±0.53

I-27 - Low Energy Intake Is Associated With Reduced Duration of Mechanical Ventilation in Critically Ill Underweight Patients

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Purpose: Critical illness is associated with a hypercatabolic state, increased oxidative stress, insulin resistance, and alterations in neuroendocrine and sympathetic nerve function. Some researchers therefore recommend energy restriction to avoid accelerating these undesirable responses to stress. This is supported by some evidence in which better outcomes were observed with lower energy intake in critically ill patients. These studies were, however, generally conducted with normal body weight patients. The aim of this study was to determine how energy intake influences mortality and morbidity of critically ill, underweight patients.
Methods: This study was a single-center retrospective chart review. All consecutive patients who were admitted to the emergency intensive care unit (EICU) between August 2011 and December 2012 were screened for eligibility. Patients older than 18 years of age, with a body mass index (BMI) of less than 20.0 kg/m2, who were mechanically ventilated within the first 48 h of admission, and who stayed in the EICU for more than 72 h were enrolled in this study. Patients were categorized into four groups according to their initial Sequential Organ Failure Assessment (I-SOFA) score and their average daily energy intake during EICU stay up to 7 days; Group M-1: I-SOFA ≤8 and <16 kcal/kg/day; Group M-2: I-SOFA ≤8 and ≥16 kcal/kg/day; Group S-1: I-SOFA >8 and <16 kcal/kg/day; Group S-2: I-SOFA >8 and ≥16 kcal/kg/day. Clinical outcomes were compared between M-1 and M-2, and between S-1 and S-2. Data were provided as median and interquartile range for continuous variables and number and percentage for categorical variables. The Mann-Whitney U test was used for continuous data and Fisher's exact test was used for categorical data.
Results: Of 971 patients screened for eligibility, 51 were enrolled for the study. Of these, 10 were categorized in Group M-1, 9 were in M-2, 10 were in S-1, and 22 were in S-2 (Figure 1). Demographics and clinical characteristics were not significantly different between M-1 and M-2, or between S-1 and S-2. Patients included in M-1 and S-1 received nutrition support later than those in M-2 and S-2, respectively (Table 1).
Outcomes are shown in Table 2. There was no significant difference in the all-cause mortality or the length of stay between M-1 and M-2, or between S-1 and S-2. The mechanical ventilation duration (MVD) was significantly shorter in M-1 than in M-2 (2.7 (1.0-5.7) vs 9.2 (4.2-17.4) days; P = 0.040). Similar results were obtained between S-1 and S-2 (3.1 (0.7-6.0) vs 8.8 (6.1-23.1) days; P = 0.013). The number of patients who underwent tracheostomy during their hospital stay was significantly lower in M-1 than in M-2 (20% vs 32%; P = 0.002). No significant difference was observed in M-1 and M-2 or in S-1 and S-2 in the duration of antibiotic therapy, serum levels of C-reactive protein, insulin therapy, or in the incidences of liver dysfunction, renal dysfunction, or hypoglycemia.
Conclusions: In patients whose BMI <20.0 kg/m2, the average energy intake <16 kcal/kg/day during the first week in EICU was associated with reduced MVD regardless of their I-SOFA score, and in those with an I-SOFA score >8 there was a lower requirement of tracheostomy for those who received <16 kcal/kg/day.

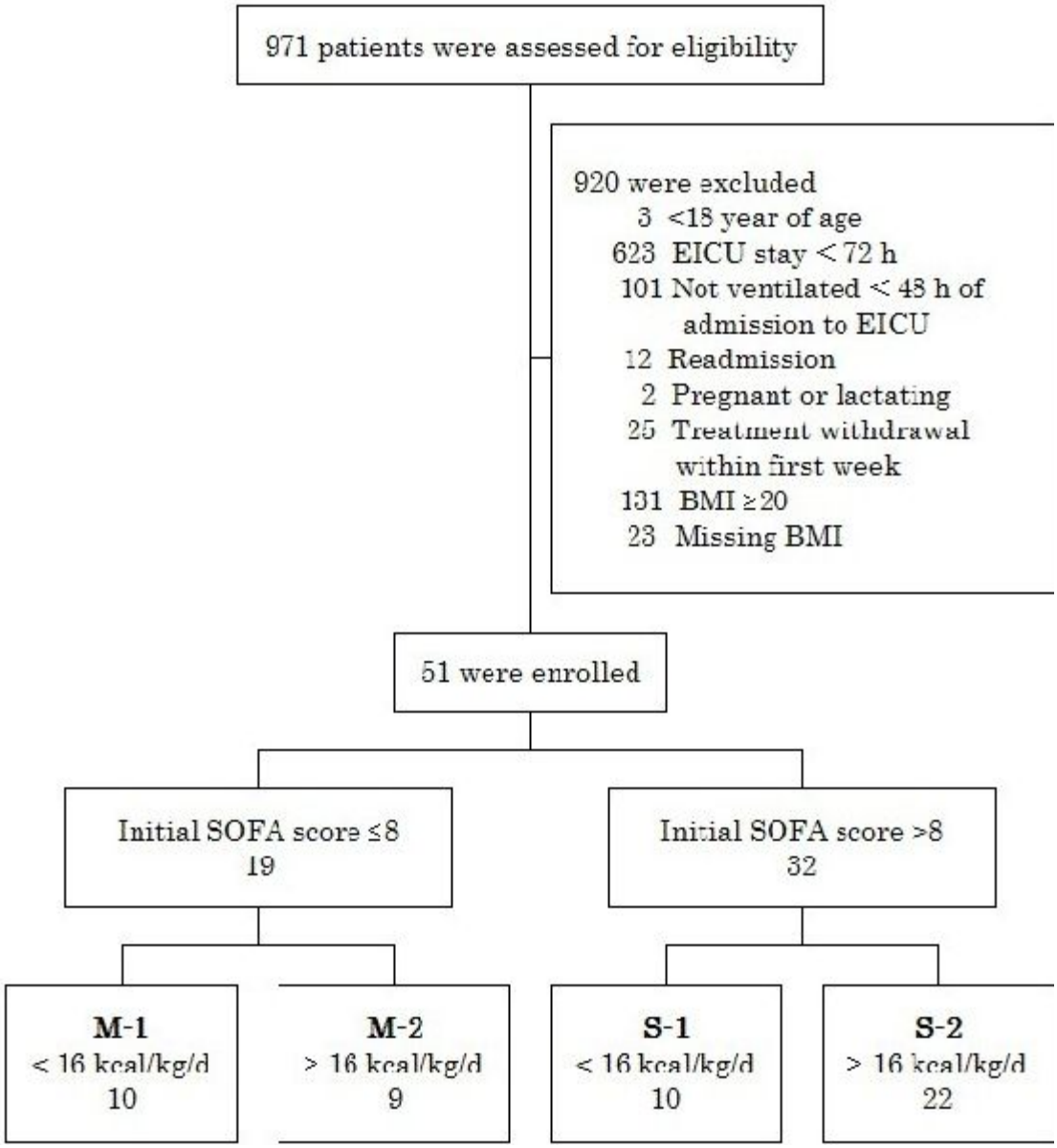

Figure 1. Flow diagram showing patient selection BMI, body mass index; EICU, emergency intensive care unit; SOFA, Sequential Organ Failure Assessment

	Initial SOFA score ≤8			Initial SOFA score >8		
	Group M-1 < 16 kcal/kg/d n=10	**Group M-2** ≥ 16 kcal/kg/d n=9	*P* Value	**Group S-1** < 16 kcal/kg/d n=10	**Group S-2** ≥ 16 kcal/kg/d n=22	*P* Value
Demographics						
Age, years; median (IQR)	65.2 (40.5-75.6)	64.8 (59.1-75.8)	.806	66.9 (35.7-82.4)	71.8 (63.1-81.5)	.360
Sex			.395			.073
Female, n (%)	5 (50)	6 (67)		8 (80)	10 (45)	
Male, n (%)	5 (50)	3 (33)		2 (20)	12 (55)	
Height, cm; median (IQR)	163.2 (152.3-168.1)	158.0 (151.5-165.0)	.566	153.5 (150.0-164.0)	160.1 (151.5-170.0)	.252
Weight, kg; median (IQR)	46.5 (38.8-55.2)	43.1 (41.0-45.0)	.437	44.2 (37.0-50.5)	47.0 (38.0-55.0)	.515
BMI, kg/m^2; median (IQR)	18.4 (15.7-19.6)	17.6 (16.0-18.8)	.414	18.5 (15.8-19.2)	17.8 (16.3-19.2)	1.000
Clinical characteristics						
APACHE II score, median (IQR)	20.0 (15.5-23.0)	20.0 (19.0-21.5)	.680	24.0 (21.0-29.3)	31.5 (19.8-39.3)	.309
Initial SOFA score, median (IQR)	6.0 (5.0-7.0)	7.0 (5.5-8.0)	.292	10.0 (9.0-11.3)	11.5 (9.0-13.0)	.151
Admission category, No. (%)			.630			.051
Medical	3 (30)	3 (33)		3 (30)	15 (68)	
Surgical	7 (70)	6 (67)		7 (70)	7 (32)	
Primary EICU diagnosis, No. (%)			.443			.343
Cardiovascular or vascular disorder	0 (0)	1 (11)		1 (10)	3 (14)	
Respiratory disorder	1 (10)	2 (22)		0 (0)	3 (14)	
Gastrointestinal disorder	0 (0)	0 (0)		2 (20)	1 (5)	
Neurologic disorder	8 (80)	5 (56)		4 (40)	8 (36)	
Sepsis	0 (0)	1 (11)		0 (0)	4 (18)	
Trauma	0 (0)	0 (0)		2 (20)	3 (14)	
Metabolic disorder	1 (10)	0 (0)		1 (10)	0 (0)	
Nutritional characteristics						
Time to initiation of EN or PO, h; median (IQR)	54.6 (29.0-75.4)	26.0 (16.9-39.4)	.018	64.2 (45.1-74.7)	14.6 (3.4-23.1)	.001
Time to initiation of any nutrition support, h; median (IQR)	51.6 (29.0-71.4)	26.0 (16.9-39.4)	.018	61.3 (37.9-70.8)	14.6 (3.4-23.1)	.000
Average energy intake during first week, kcal/kg/day; median (IQR)	10.8 (6.9-12.7)	18.8 (17.7-24.7)	.000	10.9 (7.4-14.8)	21.8 (19.5-27.0)	.000
Average protein intake during first week, g/kg/day; median (IQR)	0.3 (0.2-0.4)	0.9 (0.6-1.0)	.000	0.3 (0.2-0.6)	1.1 (0.8-1.3)	.000

Table 1. Demographics, Clinical Characteristics, and Nutritional Characteristics of Four Groups APACHE II, The Acute Physiology and Chronic Health Evaluation II; BMI, body mass index; EICU, emergency intensive care unit; EN, enteral nutrition; IQR, interquartile range; SOFA, Sequential Organ Failure Assessment, PN, parenteral nutrition; PO, per-oral intake.

	Initial SOFA score ≤8			Initial SOFA score >8		
	Group M-1 < 16 kcal/kg/d n=10	Group M-2 ≥ 16 kcal/kg/d n=9	P Value	Group S-1 < 16 kcal/kg/d n=10	Group S-2 ≥ 16 kcal/kg/d n=22	P Value
All-cause mortality, No. (%)						
In EICU	0 (0)	0 (0)	1.000	0 (0)	0 (0)	1.000
In hospital	0 (0)	0 (0)	1.000	0 (0)	2 (9)	.466
Length of stay, days; median (IQR)						
In EICU	4.6 (3.9-6.9)	7.5 (4.6-10.5)	.121	6.7 (3.8-12.1)	9.6 (6.7-14.6)	.167
In hospital	33.6 (20.6-54.8)	43.3 (26.0-69.4)	.624	60.0 (41.4-73.4)	46.4 (32.1-69.1)	.403
Mechanical ventilation						
Duration of mechanical ventilation, days; median (IQR)	2.7 (1.0-5.7)	9.2 (4.2-17.4)	.040	3.1 (0.7-6.0)	8.8 (6.1-23.1)	.013
Requirement of mechanical ventilation at hospital discharge, No. (%)	0 (0)	2 (22)	.211	1 (10)	6 (27)	.272
Tracheostomy, No. (%)						
In EICU	3 (30)	5 (56)	.255	0 (0)	11 (50)	.005
In hospital	4 (40)	7 (78)	.115	2 (20)	18 (32)	.002
Duration of antibiotics, days; median (IQR)	9.0 (6.0-27.3)	20.0 (9.0-33.5)	.204	27.5 (15.5-50.0)	21.0 (12.5-33.0)	.281
Highest CRP during EICU stay, mg/dL; median (IQR)	12.5 (7.2-27.9)	9.8 (7.6-15.9)	.624	11.4 (3.4-18.8)	16.2 (11.4-23.7)	.104
Liver dysfunction (serum bilirubin >1.2 mg/dl), No. (%)	1 (10)	1 (11)	.737	6 (60)	7 (32)	.133
Renal dysfunction (serum creatinine >1.2 mg/dl) and requirement for RRT, No. (%)	0 (0)	1 (11)	.474	5 (50)	13 (59)	.459
Hypoglycemia (<70 mg/dl) , No. (%)						
First week in EICU	0 (0)	1 (11)	.474	4 (40)	9 (41)	.636
During whole EICU stay	0 (0)	1 (11)	.474	4 (40)	10 (46)	.541
Received insulin administration, No. (%)						
First week in EICU	1 (10)	5 (56)	.050	4 (40)	11 (50)	.445
During whole EICU stay	1 (10)	5 (56)	.050	4 (40)	11 (50)	.445
Average insulin daily dose (units)						
First week in EICU	20.2 (20.2-20.2)	4.3 (1.3-12.1)	.143	3.3 (1.8-4.8)	10.0 (3.3-23.6)	.090
During whole EICU stay	20.2 (20.2-20.2)	3.7 (1.2-11.9)	.143	3.2 (2.5-6.2)	10.0 (1.2-18.7)	.308

Table 2. Clinical Outcomes EICU, emergency intensive care unit; IQR,interquartile range; RRT, renal replacement therapy.

I-28 - Preoperative Oral Administration of Cystine and Theanine Improves Survival After Gut Ischemia / Reperfusion in Mice

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Purpose: Oral administration of cystine and theanine(CT) has been demonstrated to increase production of the strong antioxidant glutathione(GSH), to prevent immune suppression after intense exercise loads and to reduce excessive inflammatory responses after some surgical insults. However, the effect of CT on host responses after gut ischemia reperfusion (I/R), a common phenomenon with various surgical insults, remains unclear. The aim of this study was to examine whether preoperative CT administration improves survival after gut I/R.
Methods: Experiment 1) Six-week-old male Institute of Cancer Research(ICR) mice (n=17) were randomly assigned to the Vehicle (n=10) or the CT70 group (n=7). The CT70 group was given cystine and theanine at a dosage of 70 mg/kg (cystine: theanine=5:2) once a day via gavage for 5 days, while the Vehicle mice received only the vehicle (0.5 % methylcellulose solution). During this pretreatment period, both groups had access to normal chow and water ad libitum. The mice then underwent 75-minute occlusion of the superior mesenteric artery (SMA). Survival after reperfusion was observed for 48 hours.
Experiment 2) Because CT70 did not produce marked survival improvement in Experiment 1, higher amounts of CT were tested. Mice (n=35) were randomized into 3 groups (Vehicle: vehicle only, n=11, CT140: CT 140 mg/kg/day, n=14, CT280: CT 280 mg/kg/day, n=10), and fed for 5 days as in experiment 1. Survival after 75-minute gut I/R was observed.
The log-rank test was used to compare survival times.

Results: Pre-experimental body weights and body weight changes after treatment were similar in all groups in both Exp.1 and 2.
Experiment 1
There was no significant difference in survival time between the Vehicle and CT70 groups (P = 0.74).
Experiment 2
The CT280 group showed significantly better survival than the vehicle group. CT140 also improved survival, but the difference did not reach statistical significance (p=0.14).
Conclusions: Preoperative oral administration of CT improves survival after gut I/R dose-dependently. The precise mechanism awaits clarification in future studies.

Group	n	6h	12h	24h	48h
Vehicle	10	6 (60%)	6 (60%)	6 (60%)	4 (40%)
CT70	7	6 (85.7%)	6 (85.7%)	5 (71.4%)	3 (42.9%)

Table.1 Survival rate in Exp. 1

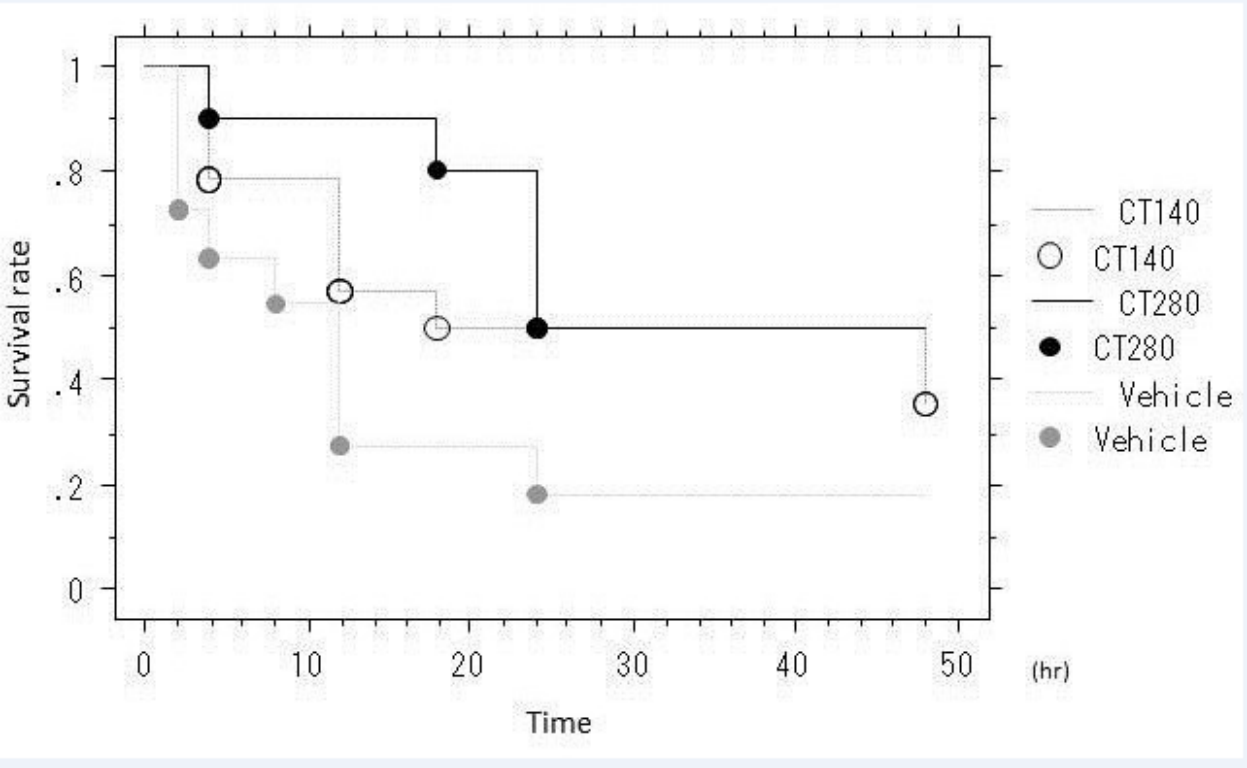

Figure 1. Survival rate in Exp. 2.

I-29 - Impact of Sarcopenia and Perioperative Nutritional Therapy on Survival in Patients Undergoing Living Donor Liver Transplantation

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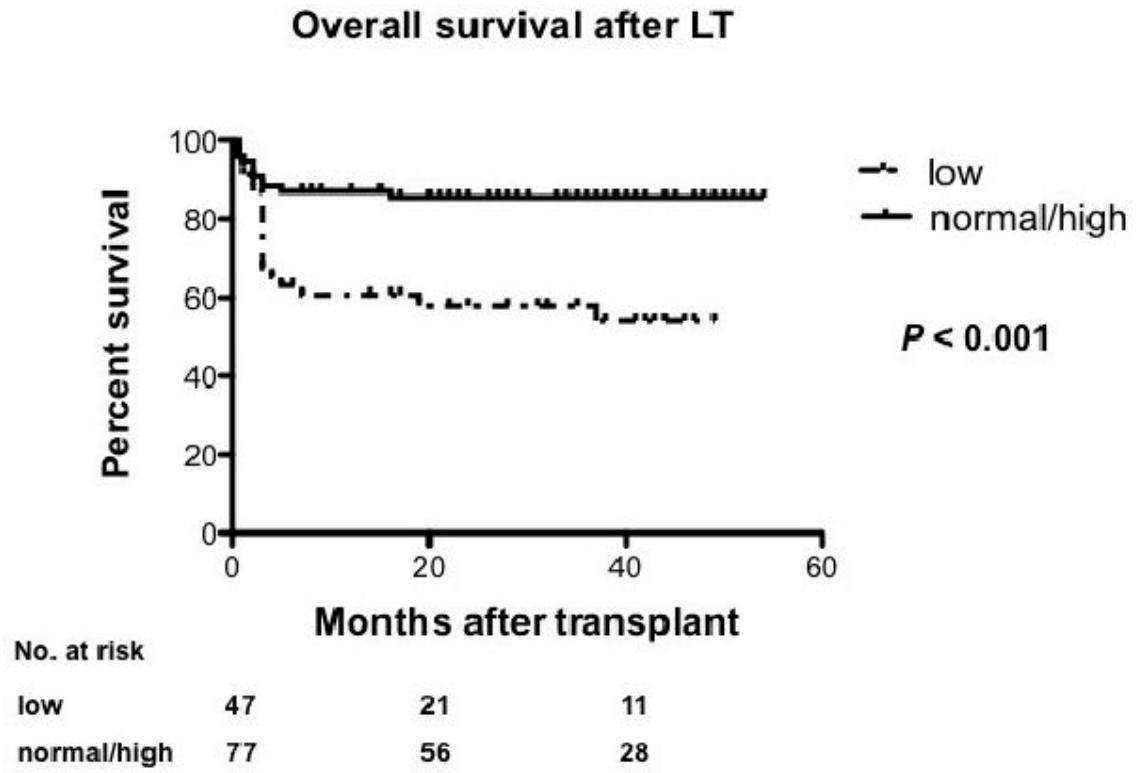
Purpose: Skeletal muscle depletion, referred to as sarcopenia, predicts morbidity and mortality in patients undergoing digestive surgery. However, the impact on liver transplantation is unclear. The present study investigated the impact of sarcopenia on patients undergoing living donor liver transplantation (LDLT).
Methods: Sarcopenia was assessed by a body composition analyzer (InBody 720) in 124 adult patients undergoing LDLT between February 2008 and April 2012. The correlation of sarcopenia with other patient factors (Spearman's rank correlation coefficient), the impact of sarcopenia and perioperative nutritional therapy on survival after LDLT (log-rank test), and perioperative risk factors for poor survival (multivariate analysis using multiple logistic regression models) were analyzed.
Results: The median ratio of preoperative skeletal muscle mass was 92% (range 67%-130%) of the standard mass. Preoperative skeletal muscle mass was significantly correlated with the branched-chain amino acids to tyrosine ratio ($r=-0.254$, $p=0.005$) and body cell mass ($r=0.636$, $p<0.001$). The overall survival rate in patients with low skeletal muscle mass was significantly lower than in patients with normal/high skeletal muscle mass ($p<0.001$). Perioperative nutritional therapy significantly increased overall survival in patients with low skeletal muscle mass ($p=0.009$). Multivariate analysis showed that low skeletal muscle mass, low body cell mass, and lack of perioperative nutritional therapy were found to be risk factors for death after transplantation.
Conclusions: Sarcopenia was closely involved with post-transplant mortality in patients undergoing LDLT. Perioperative nutritional therapy significantly improved overall survival in patients with sarcopenia.



I-30 - The Characteristics of Hypozincemia in Breast Cancer Patients
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Purpose: It is well-known that the levels of serum zinc are low in patients with gastrointestinal malignancies. As these patients can not fully have a meal, malnutrition is thought to cause this hypozincemia. On the other hand, malnutrition is very rare in breast cancer patients. To investigate the serum zinc levels in breast cancer patients leads to find the characterristics of hypozincemia without the influence of malnutrition.
Methods: Between Jan 2010 to Jul 2013, 72 preoperative patients with breast cancer were enrolled and levels of

serum zinc were measured. Serum albumin levels and BMI were also measured. Patients were devided into two groups by the level of serum zinc. If levels of serum zinc were below 65, they were classified into group(ZnL). Other patients whose levels of them were more than 65 were classified into group(ZnN). Serum zinc levels were also measured after surgery only in patients with hypozincemia .
Results: The mean age was 64 years (range, 33 to 91 years). The mean values of serum albumin was 4.3g/dl. In only one patients, the level of serum albumin was below 3.5 g/dl. The average value of BMI was 23.4kg/m2. Serum zinc levels decreased in twenty-two patiens(30.5%). The values of serum albumin of group(ZnN) and group(ZnL) were 4.4±0.2 and 4.2±0.3 g/dl (M±SD). BMI levels were 23.9±3.9 and 22.2±3.4 kg/m2, respectively. BMI levels were below 18.5 in six patients. The value of serum zinc was within normal range in four of these six patiens. If patients were devided by cancer stage (stageI vs IIB to IV), the levels of serum zinc were 73.3±11.0 and 66.5±11.9 ($p<0.05$). The values of serum albumin did not differ between those two groups. The levels of serum zinc were measured after surgery in eight patients with hypozincemia. In six of eight patients(75%), the value of serum zinc increased after operation. These values of serum zinc before and after surgery were 58.3±6.0 and 60.0±6.0(N=8).
Conclusions: In breast cancer patients, malnutrition was very rare. But hypozincemia was observed in twenty-two out of seventy-two patiens (30.5%). This finding leads to the existence of hypozincemia without malnutrition. The levels of serum zinc were low in patients with advanced cancer stage.This implies the consumption of zinc by cancer cells. Moreover the increase of zinc level after surgery supports those consumption by cancer cells. As cancer cells may utilize serum zinc for their growth, it is not rational to fill up zinc to these patients.

I-31 - A Successful Modified Exchange Procedure of Tunneled Central Venous Catheters Using a Subcutaneous Fibrous Sheath

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Purpose: The reserve of the venous route to the central veins is important for patients receiving long-term parenteral nutrition (PN). However, central venous catheters often become either damaged or inadvertently displaced, and replacement is therefore required. Moreover, the occurrence of catheter-related bloodstream infection (CRBSI) can become a life-threating event. Therefore, a modified catheter-exchange procedure was developed using a subcutaneous fibrous sheath in the same cervical scar, and this method is considered to be advantageous for patients who require long-term central venous access.
Methods: Eight patients who required long-term PN underwent the modified exchange procedure using a tunneled CVC with a fibrous sheath and the outcome of the exchanged CVC was thereafter retrospectively reviewed.
Results: The procedure was performed 14 times on eight patients. The venous routes were either the internal or external jugular vein in all patients. The reasons for exchanging the catheter were CRBSI, catheter damage (repair), a suspected cuff-infection or the appearance of infected granulation tissue. The duration of use for the new catheter ranged from 60-1830 days following the exchange. Four patients underwent repeated catheter-exchange (3 times: 1 case, 2 times: 2 cases) using this method without any complications.
Conclusions: We developed a new modified catheter exchange method using a fibrous sheath at the same site. This procedure appears to effectively reserve the venous route to the central veins in patients requiring long-term PN.

Singapore

I-32 - Nutrition Adequacy of Patients in the Pediatric Intensive Care Unit Prior To Feeding Protocol Initiation

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Purpose: Despite the known benefits of early initiation of enteral nutrition (EN), malnutrition remains common in the pediatric intensive care unit (PICU). The delivery of EN may be impeded by a variety of factors and barriers, that directly leads to failure or delay in feed optimization. By providing a detailed guideline to early EN initiation and standardization of practice, a protocol approach to feeding was proposed in our PICU. To determine the effectiveness of the protocol, we first evaluated the nutrition adequacy of critically ill children prior to protocol initiation.

Methods: We conducted an observational, descriptive study of patients in the PICU who were started on EN. Data was collected from patients' charts from October 2012 to January 2013 prior to feeding protocol initiation. Patients admitted to PICU for at least 3 consecutive days were included. Patients with contraindications to early feeding such as post cardiac surgery, septic shock and gastrointestinal complications as well as those achieving full oral diet prior to three days in the PICU were excluded. We collected data on baseline characteristics, EN type and volume per day. Energy and protein intake was calculated from admission till discharge from PICU or up to a maximum of 7 days. Energy requirement was calculated using Schofield equation and protein intake was determined using the dietary reference intake appropriate for age. Both energy and protein requirements were adjusted for stress where applicable. To determine nutrition adequacy, actual energy and protein intakes were compared with calculated requirements, expressed as percentages. We recorded reasons for and duration for which feeds were stopped. Causes of EN interruption were categorized a priori into the following broad groups: patient being too sick; high gastric residual volume; bloody or coloured aspirates; abdominal distension; endotracheal intubation or extubation; radiological procedure; and other reasons not already specified.
Results: Patients' characteristics are summarized in Table 1. Nine of the 20 patients (45%) did not have EN initiated within 24 hours of admission. Nutritional goals were not met by any patients on the first two days of EN initiation. By Day 3, the mean energy and protein intake were 55% and 54% of the calculated requirements respectively. The mean energy and protein intake did not meet at least 90% of requirements over the seven days. Of the 15 patients who stayed in PICU for at least 7days, overfeeding as defined by intake exceeding 110% of requirement was evident in 2 patients. Feeds were withheld for a total of 38 episodes. Fasting for procedure either for radiological purpose (34%) or for endotracheal intubation or extubation (25%) were the two most common reasons for feed interruptions. The median duration for which feeds was held for radiological procedure and for endotracheal intubation or extubation was 11 hours (range 5-18) and 9 hours (range 6-14) respectively.
Conclusions: A delay in the provision of optimal nutrition and the inconsistency in duration for which feeds were held for common procedures were demonstrated. A follow-up evaluation after the introduction of the feeding protocol in PICU would demonstrate if a feeding protocol would improve the delivery of EN in our PICU.

Table 1. Demographics.

Variables	Patient (N=20)
Age (months)	63.5 (0-150)
Male, N (%)	13 (65)
Race, N (%) Chinese Malay Indian Others	14 (70) 2 (10) 1 (5) 3 (15)
Reason for admission, N (%) Respiratory Post-trauma Cardiac Neurological Others	8 (40) 5 (25) 3 (15) 3 (15) 1 (5)
Length of stay in PICU (days)	10 (4-48)
Length of stay in hospital (days)	23 (4-91)
Patients on ventilator support, N (%)	16 (80)
Mortality, N (%)	1 (5)

Continuous variables described in median and ranges.

I-33 - Incidence, Risk Factors, and Management of Hyperglycemia in Patients Receiving Parenteral Nutrition
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Purpose: Parenteral Nutrition (PN), a type of specialized nutrition support is beneficial for patients who cannot, should not, or will not eat adequately and in whom the benefits of improved nutrition outweigh the risks. However, PN, a complex mixture, is associated with significant, serious, and potentially fatal complications. One of the most common complications in patients receiving PN is hyperglycemia. Hyperglycemia has serious negative impact on morbidity and mortality in hospitalized patients, as demonstrated by several studies. The primary objective of the study was to determine the incidence of hyperglycemia in patients receiving compounded parenteral nutrition, as defined by number of blood glucose levels above 10mmol/L out of the total number of levels taken for all patients studied. The secondary objectives were to identify the risk factors related to the development of hyperglycemia and

to assess the current management of hyperglycemia in PN patients.
Methods: This was a retrospective study carried out in Singapore General Hospital. The medical records of all adult patients prescribed with compounded PN from June to December 2012 were reviewed. Data collected included patient's demographics, length of hospital stay (LOS), underlying diagnosis and other co-morbidities, PN indication, recent surgery, PN regimen (total calories intake and amount of dextrose per day), concurrent medications which could affect blood glucose levels, namely corticosteroids and somatostatin / octreotide, and blood glucose levels. Patients were deemed to be hyperglycemic if any blood glucose levels were above 10mmol/L and hypoglycemia if blood glucose levels were below 3.9mmol/L. The management of hyperglycemia with the use of insulin was also captured.
Results: A total of 128 patients were reviewed. The mean duration of PN was 13.2 ±10.9 days. Average PN calories prescribed was 22.3kcal/kg and average dextrose infusion rate was 2.45mg/kg/min. The incidence of hyperglycemia was 13.8%. Fifty-nine (46.1%) patients experienced at least one episode of hyperglycemia during PN administration but only 28 of them (47.5%) had insulin prescribed. Ten out of the 28 patients had insulin prescribed only after at least one hyperglycemic episode during PN. There was an average delay of 2.7days before initiation of insulin after the first episode of hyperglycemia. Even with insulin, 96.4% (27) of them had persistent hyperglycemia during PN. A total of 12.5% of all studied patients had at least one episode of hypoglycemia. Significant association existed between hyperglycemia during PN and older age ($p<0.001$), female gender ($p=0.017$), PN duration ($p=0.001$), pre-existing diabetes mellitus ($p<0.001$), concurrent use of corticosteroids ($p=0.001$) and somatostatin / octreotide ($p=0.003$). After adjusting for potential confounders, age (OR 1.11; 95% CI 1.05-1.18, $p=0.001$) and concurrent use of corticosteroids (OR 117.44; 95% CI 9.76-1413.57, $p<0.001$) were identified as predictors for hyperglycemia during PN. The PN regimen was not significantly different for patients with or without hyperglycemia.
Conclusions: Patients on PN should be closely monitored for hyperglycemia, especially the elderly and patients on concurrent corticosteroids. Current management of hyperglycemia in PN patients was inadequate. A high percentage of patients had persistent hyperglycemia even with the use of insulin. A standardized insulin protocol initiated at PN commencement may be beneficial in reducing the incidence of hyperglycemia.

Thailand

I-34 - Effects of a Low Glycemic Index Diet on Body Composition, Insulin Resistance, and Plasma Adiponectin in Obese Thai Children: A Randomized Controlled Trial

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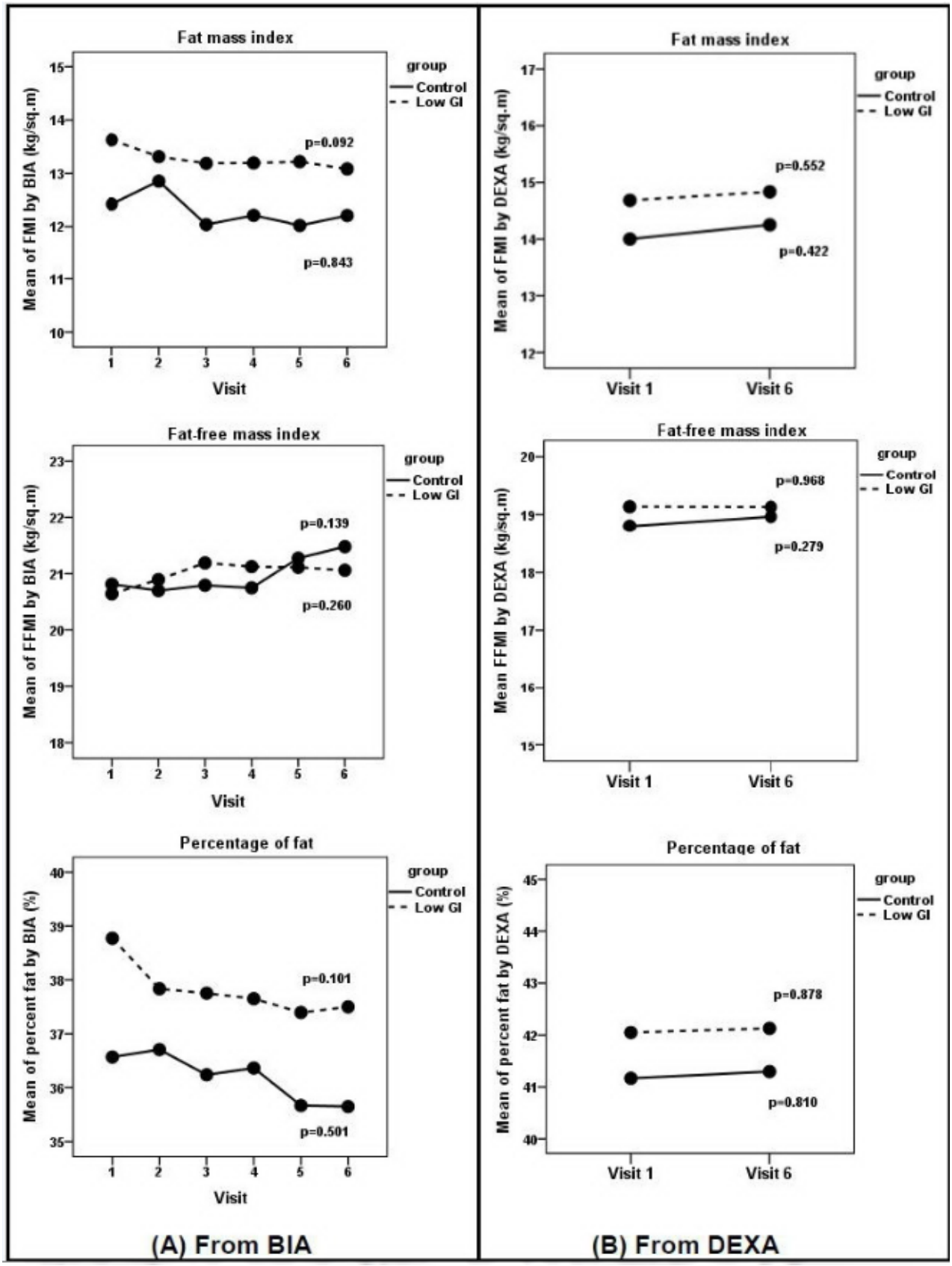
[1]Pediatrics, King Chulalongkorn Memorial Hospital, Bangkok, Thailand; [2]Pediatrics, Pattani Hospital, Pattani, Thailand; [3]Dietetics and Diet Therapy, King Chulalongkorn Memorial Hospital, Bangkok, Thailand; [4]Pediatrics, Chulalongkorn University, Bangkok, Thailand.
Purpose: Low glycemic index (GI) diet may be beneficial for weight management programs due to its effect on insulin metabolism and satiety. We aimed to compare the effectiveness of a low GI diet and conventional management of childhood obesity.
Methods: Obese children aged 9-16 years from King Chulalongkorn Memorial Hospital were randomized to receive either the instruction for a low GI diet (intervention group) or a low calorie-low fat diet (control group). Both groups were followed-up every month for six months. The primary outcomes were body composition changes during the six-month period, measured by dual X-ray absorptiometry (DEXA) and bioelectrical impedance analysis (BIA). Secondary outcomes were metabolic syndrome risks measured by fasting plasma glucose, fasting insulin, adiponectin and lipid profiles.
Results: A total of seventy obese children participated in the study (mean age 12.2±1.9 years, 47 boys). Seventy-four percent completed the 6-month follow-up period (25 and 27 in the intervention and control groups, respectively). Both groups were equal in baseline body composition and metabolic parameters except higher fasting insulin in the low GI group (22.2±14.3 mU/L vs 15.0±8.2 mU/L, $p=0.035$). Body mass index (BMI) z-score significantly decreased from 3.7±0.9 to 3.4±1.0 ($p<0.0001$) in the intervention group and from 3.6±1.6 to 3.4±1.3 ($p=0.015$) in the control group during the 6-month period. The changes in BMI, fat mass index (FMI=fat mass (kg)/height (square metre)) and fat-free mass index (FFMI=fat-free mass (kg)/height (square metre)) were similar in both groups (Figure 1). After 6 months, there were no significant differences in the changes of fasting plasma glucose and lipid profiles between the two groups. However, the low GI group showed a significant decrease in fasting insulin (-8.5±13.5 mU/L vs -0.8±11.3 mU/L, $p=0.032$) and HOMA-IR (-1.9±3.2 vs 0.1±2.8, $p=0.019$)

compared with the control group (Figure 2). Obese children who followed the low GI diet program had a decrease in BMI z-score, fasting insulin and HOMA-IR, showing improved insulin sensitivity, before any change in body composition. Changes in plasma adiponectin followed the same trend which might have reflected better insulin sensitivity in the low GI group.
Conclusions: Despite subtle effect on body composition, the low GI diet might improve insulin sensitivity in obese children who had high baseline insulin.

Figure 1. The body composition measured by bioelectrical impedance analysis (BIA) (A) and dual X-ray absorptiometry (DEXA) (B). The control group was represented in the solid line, the low glycemic index (GI) diet group was represented in the dotted line. FMI: fat mass index = fat mass (kg)/height (square metre), FFMI: fat-free mass index = fat-free mass (kg)/height (square metre), percentage of fat = fat mass (kg) x 100/body weight (kg).


Fat mass index
Mean of FMI by BIA (kg/sq.m)
group
Control
Low GI
p=0.092
p=0.843
Visit
Fat-free mass index
Mean of FFMI by BIA (kg/sq.m)
p=0.139
p=0.260
Visit
Percentage of fat
Mean of percent fat by BIA (%)
p=0.101
p=0.501
Visit
(A) From BIA
Fat mass index
Mean of FMI by DEXA (kg/sq.m)
p=0.552
p=0.422
Visit 1
Visit 6
Fat-free mass index
Mean FFMI by DEXA (kg/sq.m)
p=0.968
p=0.279
Visit 1
Visit 6
Percentage of fat
Mean of percent fat by DEXA (%)
p=0.878
p=0.810
Visit 1
Visit 6
(B) From DEXA

Changes in outcomes (Visit6-Visit1)	Control (n=27)	Low GI (n=25)	p-value
Fasting plasma glucose (mg/dl)	1.0 ± 7.8	-1.5 ± 8.1	0.269
Total cholesterol (mg/dl)	-3.1 ± 23.6	-2.9 ± 27.8	0.978
Triglyceride (mg/dl)	2.9 ± 35.1	-8.5 ± 35.9	0.259
HDL (mg/dl)	1.7 ± 8.9	0 ± 10.6	0.549
LDL (mg/dl)	0.5 ± 19.9	-4.2 ± 17.6	0.379
Fasting insulin (mU/L)	-0.8 ± 11.3	-8.5 ± 13.5	0.032
HOMA-IR	0.1 ± 2.8	-1.9 ± 3.2	0.019
Adiponectin (ng/ml)	221.0 ± 1,120.1	384.5 ± 1,164.9	0.626

Figure 2 Comparison of changes in fasting plasma glucose, lipid profiles, fasting insulin, HOMA-IR and adiponectin between the control and intervention groups. HOMA-IR: homeostasis model assessment-estimated insulin resistance = (fasting plasma glucose (mmol/L) x fasting insulin (mU/L))/22.5 GI: glycemic index

Korea

I-35 - A Study on Enteral Formula Proper for Critically Ill Patients in Korea through an Analysis of Commercial Enteral Formula: Product Monitoring

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Purpose: The mortality of critically ill patients including cancer, injury, burn, and post-surgery patients in ICUs resulting from hospital infection has been increasing, emphasizing the importance of a healthy immune system. Therefore, this study has been conducted to identify enteral formula proper for critically ill patients in Korea who need to improve their immune systems by analyzing and comparing commercial enteral formula available in Korea, and American health enhancement products.
Methods: Data on commercial enteral formula available in Korea(Greenbia, Newcare, MDwell, Carewell), such as nutrient, usage, and nutrients related to improve immunity were collected, analyzed and compared with collected information on immunity enhancement component-containing enteral formula available in the US(Nestle Co., Ltd.; Abbott Co., Ltd.).
Results: No major enteral formula available in Korea is produced for critically ill patients only and do not include the functional elements necessary for immunity enhancement, even though a high protein diet is recommended for burn and post-surgery patients. In the US, a wide range of products for burn and post-surgery patients are available and it is found that they contain many functional elements for immunity enhancement such as arginine, omega 3, glutamine, etc. However, most ICU patients in Korea have septicemia and it is known that an overdose of arginine may cause serious side effects to death. Thus, foreign products do not seem suitable for critically ill patients in Korea and it is necessary to find and develop immunity enhancement elements and enteral formula proper for people in Korea.
Conclusions: As a result of analysis of enteral formula available in Korea, they are divided into products for diabetic, renal disease, and thyroid patients by disease or into products containing high protein and high dietary fiber by nutritive component. However, none of them are produced for critically ill patients only and do not include immunity enhancing components. Therefore, it is necessary to find and develop immunity enhancement components and enteral formula proper for critically ill patients in Korea.

Table 1. Nutrient of commercial enteral formula available in Korea.

	Only tube feeding	High protein	High fiber	For diabetic	For renal disease	For thyroid patients
Kcal/200mL	200	200	200	200	400	200
Protein(g)	8	13	8~9	8.5~10	6~15	6
Fat(g)	4.5~6	4.5~6	6~7	8~9.7	13~16.89	6
Carbohydrate(g) [Fiber(g)]	29~34 [0.8~3]	24~28 [0.8~2]	28~32 [3.0~4.6]	22~25.4 [2.4~5]	47~63 [2~4]	32 [0]
Vit*. A(ugRE)	150~169	150	150~200	150~300	70~150	150
Vit. B**(mg)	5.1~6.3	5.1~5.2	5.1~6.3	5.1~6.0	5.8~6.4	10.2
Vit. C(mg)	20~35	20~28	20~35	20~75	35~50	40
Vit. D3(ug)	1	1	1~1.4	1~1.4	0.8~1	1
Vit. E(mgα-TE)	2~5	2	2~5	2~21.5	2~2.48	2
Vit. H(ug)	6~34	6	6~34	6~45.4	11~20	12
Vit. K1(ug)	15~27.5	15	15~27.5	9.75~16	0~18.6	15
Choline(mg)	73	73~180	110	68~241	-	73
Ca(mg)	140~154	140~154	140~162	140~160	240~340	210
P(mg)	140~142	140	140~147	140	70~140	105
Mg(mg)	41~68	44~68	44~60	44~68	40	44
Zn(mg)	2~2.4	2~2.4	2~2.4	2~2.4	2~5	2
Fe(mg)	2~2.45	2~2.4	2~2.4	2~2.4	2~3	2
Na(mg)	120~160	185~190	135~150	150~200	120~145	110
Cl(mg)	120~228	200~217	125~230	170~224	80~150	155
K(mg)	200~230	240~310	220~308.5	250~280	150~160	175
Mn(mg)	0.4~0.5	0.7~68	0.4~0.7	0.4~0.7	0~0.4	0.5
I(ug)	19.5~30	30	17~30	12.5~30	-	-
Cu(mg)	0.1~0.16	0.16	0.16~0.22	0.1~0.16	0~160	0.1
Se(ug)	5.5	-	5.5	-	-	5.5
Cr(ug)	5	-	5	-	-	5
Taurine(mg)	22	20~80	40	22~80	0~20	40
L-Carnitine(mg)	22	20~30	40	22~50	0~20	40
L-Arginine(mg)	-	-	-	1000	-	-

*Vit. is an abbreviation for Vitamin. **Vit. B is composed of Vitamin B1, B2, B3, B5, B6, B9, B12.

Table 2. Immunity enhancement component of enteral formula in the US.

	A	B	C	D	E	F	G	H	I
Arginine(mg)	-	2,500	3,540	3,260	3,740	2,500	-	-	2,600
Glutamine(mg)	-	-	-	3,000	-	-	-	1,300	-
Taurine(mg)	16	-	-	28	56	-	-	64	30
L-Carnitine(mg)	16	-	-	28	28	-	-	37	30
Zn(mg)	2.8	3	4.2	4	3.6	3	21	4.8	5

Nucleotide(mg)	-	240	354	320	320	240	-	-	-
ω-3 fatty acid (mg)	-	340	928	540	520	340	270	1,880	780

UNITED KINGDOM

England

I-36 - Design of a New Range of Dual Purpose Gastric Decompression and Enteral Feeding Tubes

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Purpose: The importance of early post-operative enteral nutrition in surgical patients and early institution of enteral nutrition in ICU patients have recently been highlighted. Unfortunately institution of enteral feeding in both groups of patients often has to be postponed due to delayed gastric emptying and the need for gastric decompression. The design of current polyvinyl chloride (PVC) gastric decompression tubes (Salem sump, USA; Ryles, UK and Europe) make them unsuitable for their subsequent use as either nasogastric enteral feeding tubes or for continued gastric decompression during post pyloric enteral feeding.
Methods: To overcome these problems, we have designed a range of polyurethane (PU) dual purpose gastric decompression and enteral feeding tubes that include two nasogastric tubes (double-lumen to replace Salem Sump; single lumen to replace Ryles).Two novel multi-lumen nasogastro-jejunal tubes (triple lumen for US ;double lumen for UK and Europe)complete the range. By using PU a given internal diameter (ID) and flow area can be incorporated into a lower outside diameter(OD) than can be achieved with PVC.(The ID and lumen and flow area of an 18Fr (OD 6.7mm) PVC Salem Sump can be incorporated into a 14Fr (OD 4.7mm) PU tube).
Results: The design of aspiration/infusion ports of current PVC and PU tubes invite occlusion by gastrointestinal mucosa and clogging by mucus and enteral feed. To overcome this we have designed long, single, widened, smooth and curved edge ports with no ‘dead space' to trap mucus or curdled diet. Involving 214° of the circumference these ports have up to 11 times the flow areas of the aspiration ports of current PVC tubes.
Conclusions: The proposed designs will lead to the development of dual purpose nasogastric and nasojejunal tubes that will significantly improve the clinical and nutritional care of post-operative and ICU patients.

EUROPE

Netherlands

I-37 - Cross-Cultural Adaptation of the Dutch Version of the Scored Patient-Generated Subjective Global Assessment

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Purpose: Nutritional assessment is considered to be an important element in the nutrition care process of cancer patients, since nutritional status is positively associated with health outcome. The Scored Patient-Generated Subjective Global Assessment (PG-SGA) is a multidimensional nutritional assessment tool, developed for the oncology setting. The PG-SGA consists of four boxes with patient reported items and four worksheets containing health care professional reported items. The PG-SGA was originally developed in English and until now an official Dutch translation was not available. We primarily aimed to develop a cross-cultural adaptation of the PG-SGA for the Dutch setting. Second, we aimed to explore its face and content validity among a sample of Dutch cancer patients and health care professionals.
Methods: The study design was developed conform the "Principles of Good Practice for the Translation and Cultural Adaptation Process for Patient Reported Outcomes" by the International Society for Pharmacoeconomics and Outcomes Research (ISPOR). The consecutive phases of the cross-cultural adaptation process are shown in

Figure 1. The pilot test consisted of a sample of six Dutch cancer patients who completed the patient reported items of the PG-SGA, and eight Dutch health care professionals (dietitian (n=6), nurse practitioner (n=1), medical intern (n=1)) from four hospitals, who completed the professional reported items. Subsequently, patients and professionals scored respectively patient and professional reported items for "comprehensibility" and "difficulty". Professionals additionally scored each PG-SGA item for "relevance" using 4-point scales. Item content validity indices (I-CVI) and average scale content validity indices (S-CVI/Ave) were calculated to assess content validity. To evaluate face validity, first each professional was asked to scan the tool and give their overall impression of the adequacy of the Dutch PG-SGA as a nutrition assessment tool for cancer patients. Open ended questions were posed to gather more insight in barriers concerning item comprehensibility, difficulty and relevance.
Results: The patients reported excellent understanding of the Dutch translated PG-SGA (S-CVI/Ave: 0.94) and perceived the items as easy to fill in (S-CVI/Ave: 0.89) (Table 1). Comprehensibility of the items completed by the professionals was experienced as 'acceptable' (S-CVI/Ave: 0.81), but they also experienced the items as very difficult to complete (S-CVI/Ave: 0.46) (Table 2). Professionals deemed the overall PG-SGA to be relevant and appropriate in the assessment of malnutrition in oncology patients (S-CVI/Ave: 0.86). Overall, the professionals considered layout and time-consuming nature as barriers for applying the Dutch PG-SGA in daily practice. On the dimensional level, they perceived the worksheet on physical examination as a barrier for application.
Conclusions: The Dutch cross-cultural adaptation of the PG-SGA was considered easy and was well understood by patients. Professionals evaluated the PG-SGA as relevant, but had some issues with lay out, elaborateness and difficulty of items regarding physical examination. To increase the accessibility and applicability of the PG-SGA for clinicians, training of these professionals is needed.

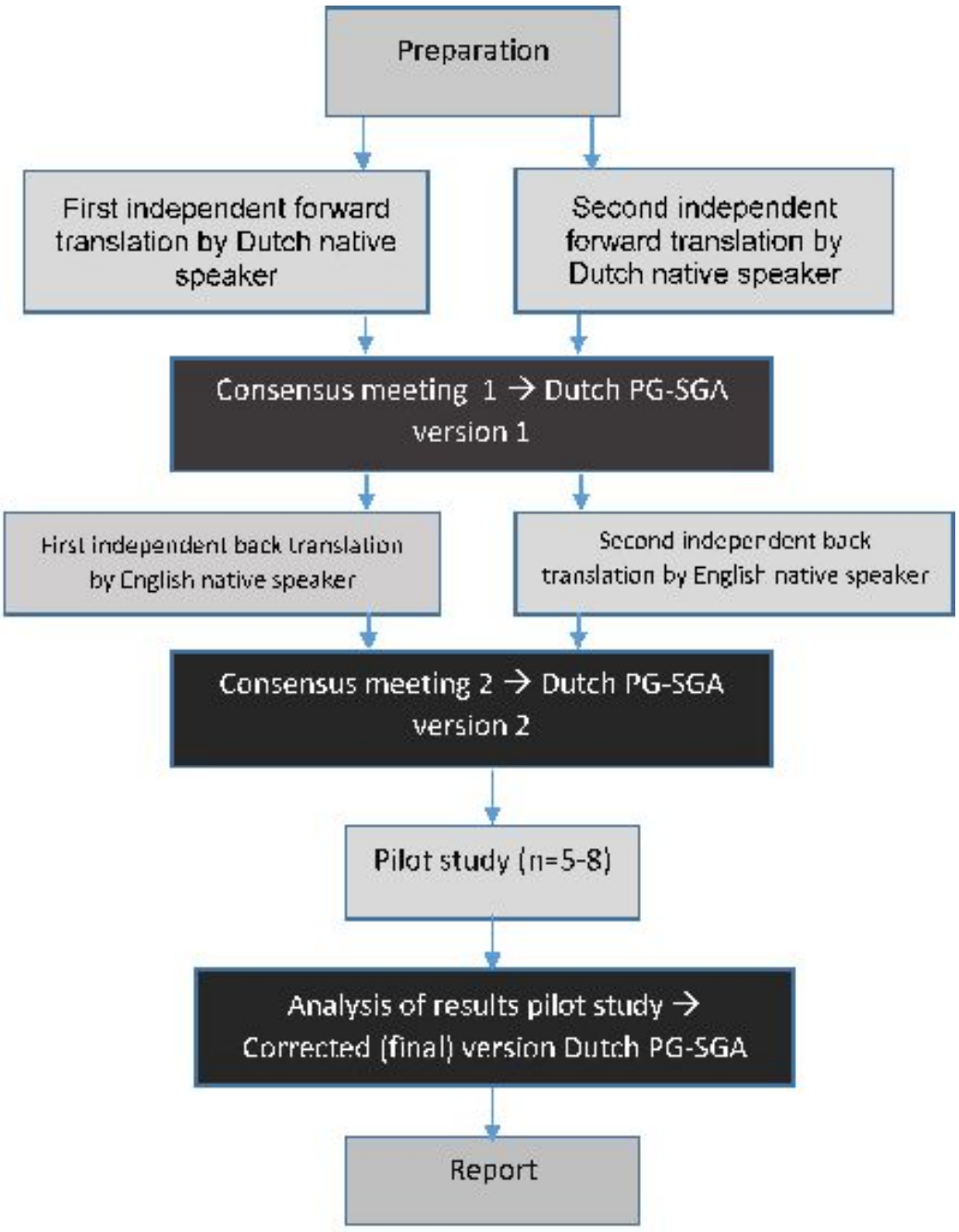

Figure 1. Flowchart of cross-cultural adaptation process

Table 1. Item difficulty and comprehensibility regarding Box 1-4 of the Dutch PG-SGA as reported by patients

Item	I-CVI[a] Difficulty N=6	I-CVI[a] Comprehensibility N=6
Box 1. Weight		
1a. Current weight	1.0[b]	1.0[b]
1b. Length	1.0[b]	1.0[b]
1c. Weight 1 month ago	1.0[b]	1.0[b]
1d. Weight 6 months ago	0.83[b]	1.0[b]
1e. Weight change in past 2 weeks	1.0[b]	1.0[b]
Box 2. Food intake		
2a. Intake compared to normal intake	0.67[b]	0.83[b]
2b. If less, what does the intake consist of now	0.83[b]	0.83[b]
Box 3. Symptoms		
3. Problems that kept patient from eating enough	0.83[b]	1.0[b]
Box 4. Activities and function		
4. General activity over the past month	0.83[b]	0.83[b]
	S-CVI/Ave[c] Difficulty	**S-CVI/Ave[c] Comprehensibility**
	0.89[c]	0.94[d]
	Item response[e] Difficulty	**Item response[e] Comprehensibility**
	0.93	0.94

a. Item Content Validity Index
b. Cut off points I-CVI: excellent ≥ 0.78, adequate 0.89-0.77, acceptable/equivocal 0.55-0.68, insufficient ≤ 0.54
c. Average Scale Content Validity Index
d. Cut-off points S-CVI/Ave: excellent ≥ 0.90, acceptable ≥ 0.80–0.89
e. Proportion of completed items

Table 2. Item difficulty and comprehensibility regarding Worksheet 1-4 of the Dutch PG-SGA as reported by professionals

Item	I-CVI Difficulty[a] N=7	I-CVI Comprehensibility[a] N=8
Relevant diagnoses	0.71[b]	0.75[b]
Stage primary illness	0.71[b]	0.75[b]
Age	1.0[b]	1.0[b]
Worksheet 1: weight		
Scoring of weight loss	0.71[b]	1.0[b]
Worksheet 2: disease		
Disease characteristics	0.71[b]	0.88[b]
Worksheet 3: metabolic demands		
Fever	0.71[b]	0.88[b]
Fever duration	0.71[b]	0.88[b]
Corticosteroids	0.86[b]	0.88[b]
Worksheet 4: physical assessment		
Fat mass status (average of 4 items)	0.25[b,c]	0.68[b,c]
Muscle mass status (average of 8 items)	0.30[b,c]	0.79[b,d]
Fluid status (average of 4 items)	0.32[b,c]	0.85[b,c]
Global Assessment categories	0.43[b]	0.85[b]
PG-SGA numerical score	0.71[b]	0.75[b]
	S-CVI/Ave[e] difficulty	S-CVI/Ave[e] comprehensibility
	0.46	0.81
	Item response[g] difficulty	Item response[g] comprehensibility
	0.82	1.0

a. Item Content Validity Index
b. Cut off points I-CVI: excellent ≥ 0.78, adequate 0.69-0.77, acceptable/equivocal 0.55-0.68, insufficient ≤ 0.54
c. Average of 4 I-CVI scores
d. Average of 8 I-CVI scores
e. Average Scale Content Validity Index
f. Cut-off points S-CVI/Ave: excellent ≥ 0.90, acceptable ≥ 0.80–0.89
g. Proportion of completed items

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Spain

I-38 - Harris-Benedict Equation Underestimates Resting Energy Expenditure in a Cohort of Malnourished Anorexia Nervosa Females

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Purpose: Harris-Benedict (HB) equation is widespread used in daily practice to predict resting energy expenditure (REE). It is known to overrate REE in lean individuals due to their lower lean body mass (LBM). We now wanted to evaluate the accuracy of HB in a cohort of malnourished Anorexia Nervosa (AN) females, matched with normal weight controls, when comparing its REE measurement with Indirect Calorimetry (IC).

Methods: Prospective cohort study of malnourished AN females (n=36; 30.3y ±10, 8; XLOS 40d) admitted to a Referral Unit for treatment, including refeeding. A matched control group (n=63) was generated. REE was measured by IC (Fitmate Wellness Technology Cosmed) and predicted by HB at admission and discharge. Simultaneously, LBM and fat free mass (FFM) were calculated with vectorial BIA (BIVA). Data (mean ±SD) were stat. analyzed by t-test for Mean Differences (X dif). Correlation between methods was calculated by Intraclass Correlation Coefficient (ICC) and Bland-Altman (BA). Significance was reached at p <.05.

Results: See Tables 1, 2 and Figures 1, 2.

Conclusions: 1. HB, despite being adequate in controls, does not accurately calculate REE in our cohort of patients.
2. In this setting HB, compared with IC, significantly underestimates REE in patients at admission and discharge [105 (45-165)]; [171 (73-278) Kcal /day] respectively.
3. The underestimation of REE by HB is more pronounced after adjusting REE by weight, FFM and LBM.
4. Correlation (ICC, BA) between IC and HB has been shown to be very poor.
5. We suggest ruling out hypermetabolism when measuring REE in undernourished AN patients.

		CONTROL (N=63)	AN ADMISSION (N=36)	AN DISCHARGE (N=36)
WEIGHT (Kg)		59.8	41.2	46.2
IMC (Kg/m^2)		22.7	15.7	17.6
Kcal/day	IC HB	1140,1 1091,4	1016,8 911,8	1130,4 959,8
	X̄ dif. (95% CI) p	48.7 (-17.2 ; 114.5) .14	105.0 (45.1 ; 164.9) .00	170.6 (73.4 ; 267.8) .00
Kcal/kg	IC HB	19.,2 18.4	24.9 22.3	24.5 20.8
	X̄ dif. (95% CI) p	0.8 (-0.4 ; 1.9) .18	2.6 (1.0 ; 4.2) .00	3.6 (1.5 ; 5.7) .00
Kcal /FFM (kg) BIVA	IC HB	27.6 26.4	27.5 25.0	29.0 24.7
	X̄ dif. (95% CI) p	1.1 (-0.5 ; 2.7) .17	2.7(1.1 ; 4.4) .00	4.3 (1.8 ; 6.8) .00
Kcal /LBM(kg) BIVA	IC HB	41.8 40.2	43.6 39.1	48.1 40.7
	X̄ dif. (95% CI) p	1.6 (-0.8 ; 4.0) .18	4.5 (1.8 ; 7.2) .00	7.3 (3.2 ; 11.5) .00

Table 1. Mean differences between IC and HB.

FFM, Fat Free Mass; HB, Harris-Benedict; IC, Indirect Calorimetry; LMB, Lean Body Mass.

		ADMISSION			DISCHARGE		
		REE-HB equation	REE/Kg weight -HB/Kg weight	REE/Kg FFM - HB /Kg FFM	REE - HB equation	REE/Kg weight -HB/Kg weight	REE/Kg FFM - HB Kg /FFM
ICC	Single measure	0.245	0.189	0.240	0.053	-0.79	0.088
	Average measures	0.394	0.318	0.388	0.101	-1.70	0.161

Table 2. ICC between IC and HB at admission and discharge. ICC= Intraclass Correlation Coefficient; REE= Resting Energy Espenditure; HB=Harris-Benedict; FFM=Fat Free Mass; LMB=Lean Body Mass.

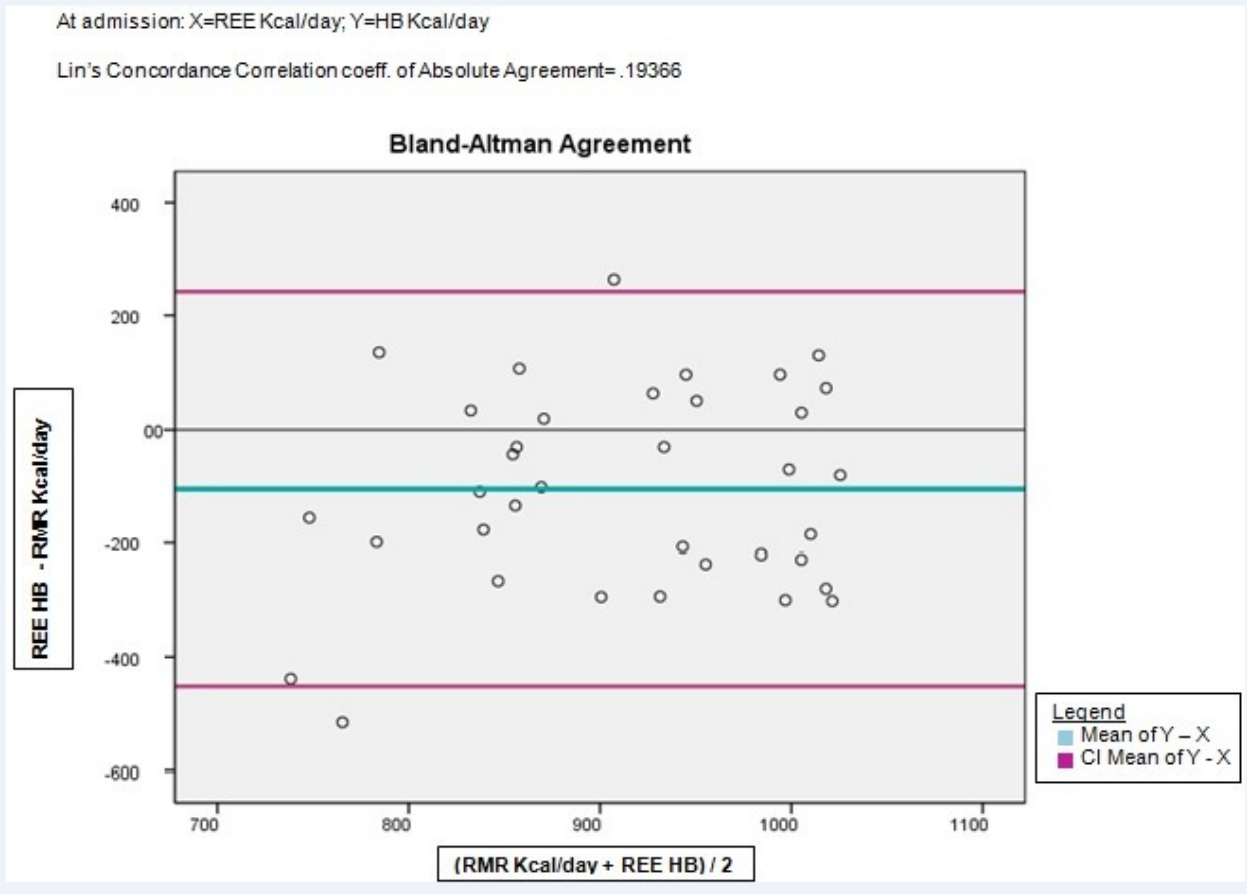

Figure 1. Bland-Altman at admission.

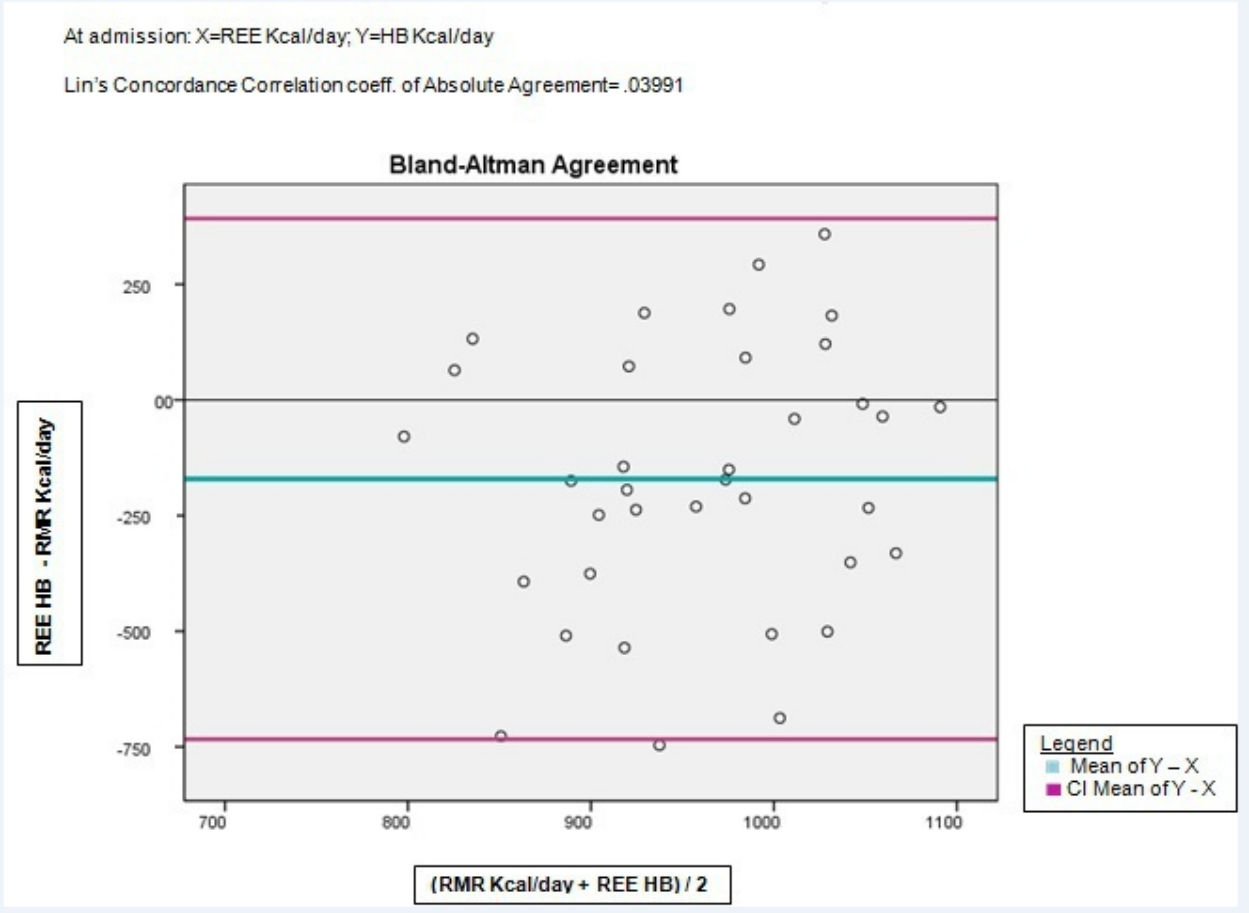

Figure 2. Bland-Altman at discharge.

I-39 - Supplementation Result in Improved Nutritional and Functional Status in Moderate Dependency Diabetic and Non-Diabetic Patients

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Purpose: Nutritional support improves nutritional status in most studies in elderly patients with malnutrition and diabetic patients might follow in the same direction. Furthermore, only a few studies have been performed to evaluate the effect of oral nutritional support on functional parameters. The aim of this study was to study the effects of oral supplementation on nutritional, cognitive and functional status in a 6 month follow-up period in undernourished geriatric patients.

Methods: 43 patients with type 2 diabetes treated with sulfonilurea who need nutritional supplementation due to malnutrition (MNA score <17 and serum albumin < 3g/dl). They were matched one to one with non-diabetic individuals on age, sex and MNA score. Patients received two 200 cc tetra packs of liquid nutrition supplementation per day in addition to their regular dietary intake for a study period of 6 months. Formula Composition (grams of proteins/carbohydrates/fats/fiber in 100ml): For diabetic patients: a specific and hypercaloric diabetes enteral formula: 7.5/12.95/7.5/1.7 and for non-diabetic: a hypercaloric enteral formula: 7.9/15.88/3.3/1.

We assessed their nutritional status and cognitive and functional ability at the beginning (day 0) and at the end of the study (6 months). Informed consent was obtained.

We studied the differences between diabetic and non-diabetic patients. Furthermore, we studied the differences between patients with Barthel index < 45 and > 45 in both groups to study if functional status determines the response to the nutritional supplementation. Changes in parameters from the beginning up to the 6 months of intervention were calculated. STATISTICS: Repeated measures analysis for variance with Wilcoxon test and Chi

square.
Results: There were increases in body weight (p=0.003) and serum albumin (p=0.02) in diabetic and non-diabetic groups, with no differences between these groups. Patients with basal Barthel score > 45 showed better response to enteral supplementation in body weight (p=0.01), plasma albumin (p=0.03) and even Barthel index (p=0.04). But mental status determined by the Pfeiffer index did not improve. In the diabetic group, mean blood glucose increased, but blood sugar and HbA1c remained within the optimal range in all patients.
Conclusions: Oral supplementation may result in improved nutritional status and thus contribute to improvements in functional status in patients with moderate dependency (Barthel <45). In the diabetic group, the use of a specific formula with modified carbohydrates achieves the same objectives, having no deleterious effects on glucose control.

	DM Barthel >45	DM Barthel <45	nonDM Barthel >45	nonDM Barthel <45
N (completed)	20 (17)	23 (18)	20 (19)	23 (23)
Weight increment	1.4+0.20.	5+0.5*	1.5+0.4	0.2+0.6*
Albumin increment	0.8+0.5	0.3+0.2*	0.7+0.4	0.2+0.4
Barthel increment	11+8	2+7*	12+9	3+7*

Poland

I-40 - The Critical Evaluation of Long-Term Enteral Nutrition: Results of Prospective, Multicenter Study
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Purpose: Enteral nutrition (EN) has been recognized as the best therapeutic option for patients unable to eat, but with functioning gastrointestinal tract, particularly at long-term basis. However, due to growing health care costs, some authors have recently questioned its real value. The unique reimbursement situation for home EN (HEN) in Poland, allowed the critical evaluation of clinical value of EN.
Methods: The prospective observational study of 456 HEN patients (206 women, 250 men, mean age 46.0 years). All patients were fed with a home-made diet before the enrollment to HEN due to the lack of reimbursement in Poland before 2007, and received enteral nutrition with a complex care afterwards. Twelve months from both periods were analyzed as far as the incidence of hospital admissions, length of hospital stay (LOS), complications, laboratory tests and costs of treatment were concerned.
Results: Implementation of HEN significantly reduced the number of hospital admissions, (1.98 vs 1.26/patient/year, p<0.001) and LOS (39.7 vs 11.9 days/patient/year, p<0.001). HEN was associated with a significant decrease in the prevalence of pneumonia (31.7% vs 11.2%, p<0.001), urinary tract infection (14.2% vs 5.7%, p<0.001), and undernutrition (13.9% vs 7.0%, p<0.001), but not respiratory failure (5.3 vs 7.0%). HEN resulted also in decrease of costs (6,215.52 to 2,009.77 USD/year/patient, p<0.001). The improvement was, however, observed only in few laboratory parameters.
Conclusions: Enteral nutrition represent a remarkably effective therapeutic option for long-term nutritional intervention.

Turkey

I-41 – Protective Effect of Nutritional Follow-Up on Mussle Mass in Radiotherapy Patients with Head and Neck Cancer

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Purpose: Radiotherapy, especially to the head and neck, may produce serious nutritional problems for cancer patients. The aim of this study is to examine the effect of nutritional counselling, support and follow-up on muscle mass and other antropometric parameters in patients with head and neck cancer receiving radiotherapy (RT) or RT plus chemotherapy.
Methods: The study included patients who admitted to Ege University Hospital , Department of Radiation Oncology between January-July 2013. All patients received dietary counseling before, in the middle and at the end of RT. The dietary advices consisted of therapeutic diet using regular food and oral nutritional supplements if needed according to individual requirements. Patients' compliance to nutritional advices were evaluated by 3-day food diary. All patients' weight, BMI, muscle mass, fat-free mass and handgrip tests were evaluated before, in the middle and at the end of RT. Compliant and non-compliant patients comparatively evaluated at the end of the study.
Results: Sixty-nine patients (53 men and 16 women; mean age:61,6 (min:26, max: 88 years) with head and neck cancer who were referred for RT were evaluated. Thirty-eight of patients (55%) was receiving or had just already received chemotherapy at the time of this study. Twenty-six had stage I/II disease, and 43 had stage III/IV disease. Thirty-two patients (46%) underwent an operation, 20 of these had neck dissection.
When compared between the first and the thirth nutritional evaluations, we observed significant decreases in muscle mass in semi-compliant and non-compliant groups while no significant difference was detected in patients who were compliant to nutritional advices.
Conclusions: This study shows that patients' compliance is very important and have beneficial effects on nutritional status during radiotherapy for head and neck cancer. Weaknes of mussle mass can be prevented by individualized dietary counseling and close follow-up.

Antropometric evaluations of patients according to groups

	Compliant patients	Semi-compliant patients	Non-compliant patients
	n=29	n=16	n=10
Weight (kg)	70,2±15,6 69, 3±14,4	71,8±14,3 65,3±11,9**	72,8±15,4 63,4±14,8**
BMI (kg/m2)	25,9± 4,3 25,4± 4,3	26±4,1 23,9±3,6**	26,6±5,8 23 ±5,7**
Fat-free mass (kg)	52,2± 9,6 52,1± 9,6	53,3± 10,6 49,1±9,5**	54±9,1 49,2±9,2**
Muscle mass (kg)	49,6 ±9,1 49,5± 9,1	50,6±10,1 46,6±9,1**	51,3±8,7 46,7±8,7**
Handgrip test	25,1 ±8,6 27± 10,3*	27,3±9,6 28,3±9,9	30,5±10,6 27,2±10,8*

*P<0,05 and **P<0,01 when compared between first and last evaluation.

Bulgaria

I-42 - L-Citrulline Supplementation Prevents the Decline of Arg/ADMA Ratio in Liver and Kidney of Septic Rats

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Purpose: Nitric Oxide (NO) homeostasis and bioavailability is crucial to proper hemodynamics and immune defense. Studies have demonstrated that endothelial NO (eNO) levels are significantly impaired in the setting of sepsis. NO production is dependent on its precursor L-Arg and the L- Arg inhibitor, ADMA. In addition, the L-Arg/ADMA ratio has proven to be a reliable measurement of NO bioavailability. This is a preclinical study that provides the first data assessing the impact of enteral supplementation of L-Citrulline (L-CIt) on preventing liver

and kidney reduction of the Arg/ADMA ratio in a rat model of sepsis. The objective was to study the effect of enteral L-Cit supplementation on modulating the levels of L-Arginine (L-Arg), Asymmetric Dimethylarginine (ADMA) and in preventing the decline of L-Arg/ADMA ratio in liver and kidney of septic rats.
Methods: Sepsis was induced by cecal ligation and puncture model as previous described and under an animal use committee approved protocol. Amino acid levels were measure by high-performance liquid chromatography tandem mass spectrometry (LC/MS/MS) in liver and kidney. Macrophage quantification was analyzed in spleen. Statistical analysis was performed utilizing the student t-test and ANOVA. P-values of less than 0.05 ($p<0.05$) were considered statistically significant.
Results: L-Cit supplementation leads to an increase in L- Arg, decrease of AMDA and an increase in the Arg/ADMA ratio, suggesting a potential for increasing NO bioavailability in sepsis. In addition L-Cit supplementation may have broader immunologic impact as evidenced by decreased macrophage recruitment in the spleen.
Conclusions: Our data suggests that oral L-Cit supplementation has beneficial effects in end organs primarily associated with multisystem organ dysfunction in sepsis, especially the hepatorenal axis. The data also suggests that L- Cit supplementation may blunt the septic response in macrophages. Thus, L-Cit may be an important neutraceutical for the septic patient.

ASIA / Viet Nam

I-43 - Nutrition in Wilson's Disease: A Case Report
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Purpose: Our intent is to report a case of Wilson's disease (WD), Stage III in which the patient had prehistory of contact with pesticide containing copper before the diagnosis of WD. He had maintenance treatment with chelating drug and oral zinc, but he consumed lot of mushroom soup every day during the last 4 months of procedure of treatment. This factor caused development of severe cirrhosis, low diet, edema, and severe malnutrition. As a result, the patient passed away.
Description: 31 year old male farmer with severe malnutrition.
Exposure to pesticide containing 85% copper (COC 85 - CuCl2.3CuO.4H2O) 2 years before diagnosis of WD.
Diagnosed and treated for WD with Penicilamine 500mg/day and Zinc Gluconate 420 mg/day for 9 months.
Was consuming 200 grams of mushrooms per day in the last 4 months. Energy decreased from 1000 kcal/day to < 500 kcal/day in the last month.
BMI 13.1 kg/m2, 16 kg weight loss in 8 months.
Admitted to hospital for more severe ascites, seizure, edema, dystonia, Kayser-Fleischer rings, nausea, muscle strength 3/5.
Results: The serum ceruloplasmin was followed up 3 times during 8 months of treatment, it varied in range from 6 mg/dl to 11.4 mg/dl, Cu/urine was 752 μg/24 hours and 20.9 μmol/24 hours respectively. The last result of serum ceruloplasmin was 1.1 mg/dl when he was admitted to hospital in critical condition. He was continued to be treated with zinc oral and nutritional support was provided by nasogastric tube feeding and parenteral nutrition. Since his condition turned more critical, he passed away.
Discussion: This patient suffered WD which was asymptomatic in nature. But he had been consistently exposed to pesticide containing copper for a period of 2 years which enhanced the risk of WD. Another critical factor was that the patient was consuming mushroom soups every day during the last 4 months of maintenance treatment because his relatives suggested that mushroom soup would be good for his health. But the fact is that mushroom is a food item with high copper content of 0.3 mg/100 grams. Hence, the daily consumption of mushrooms made WD too difficult to control in spite of treatment with chelating drug and zinc oral.
In addition, cirrhosis causes 1.3 times increase in energy expenditure which increases the energy need of the patient. This patient was affected by energy deficiency for a prolonged duration which depleted the glycogen stored in liver. It depleted glucose and lipid intake as well. As a result, the energy released by catabolic reactions caused weight loss and severe malnutrition.
Severe malnutrition, end-stage cirrhosis and wrong diet made control and treatment of WD too difficult and the disease increased in severity.
Conclusions: Wilson's disease is a rare autosomal recessive inherited disorder of copper metabolism. Early diagnosis and life-long low dose chelating therapy can cure WD. But the physician has to prescribe a diet consisting

of foods with low copper content and avoidance of exposure to chemical substances containing copper. This course of action would certainly help the patient by preventing complications.