Current Nutrition Support Practices in Critical Care

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Nothing to disclose

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Objectives

- Identify various methods used to optimize enteral nutrition support
- Understand clinical situations where early enteral nutrition is safe & beneficial along with therapies that increase nutrition risk/nutrient requirement

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Inova Fairfax Medical Campus

~900 bed academic medical center
- Heart and Vascular Institute
- Women's and Children's Hospital
- Schar Cancer Institute
- Neurosciences Institute

Critical Care Units
- Medical/surgical
- Trauma
- Cardiovascular surgery
- Neuroscience
- Cardiac/coronary
- Neonatal
- Pediatric

Multidisciplinary Team
- Residents, interns, and medical students
- RNs, Advanced Practice Providers, Pharmacists, Respiratory Therapists, Speech/language Pathologist, PT/OT, Case Manager

16 Clinical Registered Dietitians

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High Nutrition Risk: Multiple Comorbidities and Critically ill

- Pulmonary (Chronic obstructive pulmonary disease, respiratory failure, intubated)
- Infectious Disease (Septic Shock, Pneumonia)
- Gastrointestinal tract (GI)
- Renal (Acute Kidney Injury/Chronic Kidney Disease, Hemodialysis/Continuous Renal Replacement Therapy)
- Endocrine (pancreatitis)
- Multi-system organ failure
- Substance abuse (Alcohol abuse, drugs)
- Surgery: General, vascular, GI, hepatobiliary, oncology, transplant

Nutrition needs individualized based on patients medical/surgical history and current clinical condition.

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High Nutrition Risk: Malnutrition

- Use of screening tools?... Malnutrition Screening Tool (MST) and clinical judgement

"Moderate" or "Severe" protein energy malnutrition related to … as evidenced by …

- Malnutrition Criteria (2 out of 6):
  - **Inadequate intake**
  - **Unplanned wt loss**
  - **Loss of muscle mass**
  - **Loss of subcutaneous fat**
  - Fluid accumulation
  - Decreased functional capacity

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High Nutrition Risk: Wounds

- Pressure, traumatic, surgical, diabetic, venous stasis, moisture-associated
- Any critically ill patient is at risk for developing a pressure injury (PI) during their ICU stay
  - Increased risk: elderly, malnourished, altered mobility, poor perfusion
- Role of nutrition - maintaining healthy skin & successful wound healing
  - Calories (individualized based on condition/status)
  - Protein: 1.25-1.5gm/kg body weight, up to 2gm/kg
  - Fluid: 30-35ml/kg or per condition/status
  - Adequate micronutrients
  - Additional amino acid supplementation
  - Oral nutrition supplements or nutrition support if oral intake remains inadequate

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2016 Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.)

B1. We recommend that nutrition support therapy in the form of early enteral nutrition (EN) be initiated within 24-48 hours in the critically ill patient who is unable to maintain volitional intake.

B2. We suggest the use of EN over parenteral nutrition (PN) in critically ill patients who require nutrition support therapy.

Mclave SA, et al. Guidelines for the provision and assessment of nutrition support therapy in the adult critically ill patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (ASPEN). *JPEN.* 2016

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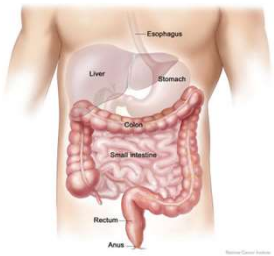
If the gut works,



USE IT!

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Indications for Enteral Nutrition (EN)

- Intubated or ventilator dependent, hemodynamically stable (stable blood pressure)
- Inadequate oral intake
- Dysphagia / esophageal obstruction
- Significant malnutrition / cachexia
- Head and neck surgery / cancer
- Pancreatitis
- Decreased mental status

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Indications for Small Bowel Feedings

- High aspiration risk
- Feeding intolerance (distension, vomiting)
- Reflux esophagitis
- Gastroparesis
- Pancreatitis / Whipple, other complex GI surgeries
- Gastric outlet obstruction

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Contraindications for EN

- Bowel obstruction, paralytic ileus
- Profuse vomiting and/or diarrhea
- Bowel ischemia
- Severe, active GI bleeding
- High-output fistulas (>500 ml/d)
- Severe short bowel syndrome (<100 cm remaining small bowel)

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Consideration for Parenteral Nutrition (PN)

G1. We suggest that, in the patient at low nutrition risk, exclusive parenteral nutrition (PN) be **withheld over the first 7 days** following ICU admission if the patient cannot maintain volitional intake and if early EN is not feasible.

G2. Based on expert consensus, in the patient determined to be at **high nutrition risk or severely malnourished**, when EN is not feasible, we suggest initiating exclusive PN as soon as possible following ICU admission.

G3. We recommend that, in patients at either low of high nutrition risk, use of supplemental PN be considered after **7-10 days if unable to meet >60% of energy and protein requirements by the enteral route alone.** Initiating supplemental PN prior to this 7 to 10 day period in critically ill patients on some EN does not improve outcomes and may be detrimental to the patient.

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Complications: Refeeding Syndrome

Acute intracellular shifts of potassium, magnesium, and phosphorus as part of anabolic process
–results in low serum levels of these electrolytes

Who is at risk?
–Severely malnourished, h/o alcohol abuse, eating disordered patients, etc, who are started on nutrition support

How is it prevented?
–Check electrolytes and correct low levels ***before*** initiation of feeding
–Initiate feeding at a low rate and advance gradually
–Monitor labs and continue to correct low levels as needed

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Ways to Optimize Nutrition Support in the ICU

Enteral Nutrition ICU protocols: evidence based practice

- Volume based tube feedings
- Reduced fasting prior to surgery/procedures
- Small bowel feeding
- Gastric Residual Volume
- Early EN Initiation and Advancement on Vasopressors
- Early EN Initiation and Advancement on Target Temperature Management (TTM)
- Early EN Initiation and Advancement during Prone Positioning

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Ways to Optimize Nutrition Support in the ICU

Volume Based Feeding Protocol:

Tube feeding is ordered as a daily volume goal (e.g., 1200mLs/24hrs) instead of an hourly rate

If feeds are held for any reason (surgery, procedure, imaging, medication administration, breathing trial or other nursing care) the feeds will be restarted at an adjusted rate to provide the remainder of the total daily volume in the remaining hours of the day

Formula:

$$\frac{\text{Total daily volume (specified in TF order)} - \text{volume already given (on pump under history*)}}{\text{Hours left in the 24hrs cycle (hrs until midnight)}}$$

At midnight, the night nurse will either continue the same rate if no adjustments were made during the day or reset to the 24hr rate

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Ways to Optimize Nutrition Support in the ICU

- Reduce fasting time "NPO at midnight" for planned procedures
  - Intubated patients on continuous gastric feeding via an OGT/NGT UNLESS undergoing an airway/GI procedure or proning for surgery
- Small bowel feeding
  - Post-pyloric enteral access system pilot study
- Gastric Residual Volume (GRV)
  - D2a. We suggest that GRVs not be used as part of routine care to monitor ICU patients receiving EN
  - D2b. We suggest that, for those ICUs where GRVs are still utilized, holding EN for GRVs <500mls in the absence of other signs of intolerance should be avoided

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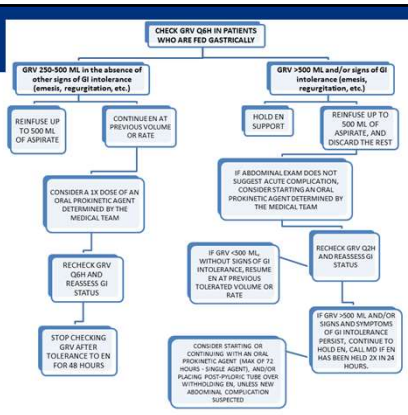

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Ways to Optimize Nutrition Support in the ICU

Early EN Initiation and Advancement on Vasopressors

1. Evidence has shown that it is safe to initiate enteral nutrition support in patients who are receiving Levophed equivalent dose of less than or equal to 12.5 mcg/min.
   - However enteral nutrition support should be based on clinical judgement of team
   - Patients receiving higher Levophed equivalent doses, as the risk of bowel ischemia increases, especially if:
     - Not adequately fluid resuscitated
     - MAP <65 mmHg (Mean Arterial Pressure)
     - Not started on a bowel regimen
     - Signs/symptoms of GI intolerance are present (abdominal distension, unexplained abdominal pain, emesis, regurgitation, lactate >4, etc.)
     - HOB is not maintained at ≥30 degrees

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Ways to Optimize Nutrition Support in the ICU

Early EN Initiation and Advancement on Target Temperature Management (TTM):

1. No need to withhold enteral nutrition support in patients undergoing TTM/Arctic Sun. Start enteral nutrition support within 24-48 hours in critically ill ICU patients if:
   - Adequately fluid resuscitated
   - MAP >65 mmHg
   - Started on a bowel regimen
   - No signs/symptoms of GI intolerance (abdominal distension, unexplained abdominal pain, emesis, regurgitation, lactate >4, etc.)
   - Head of bed maintained ≥30 degrees
2. During the cooling phase (32-34 degrees C):
   - Initial calorie goal: ~19 kcal/kg or 75-80% goal calories, accounting for calories from other sources.
3. During rewarming (36.4 degrees C): Increase TF rate by 10-20 ml q4h as tolerated
4. Monitor for signs/symptoms of GI intolerance.

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ARCTIC SUN® temperature management system used to reach and maintain a specific body temperature for therapeutic hypothermia or normothermia

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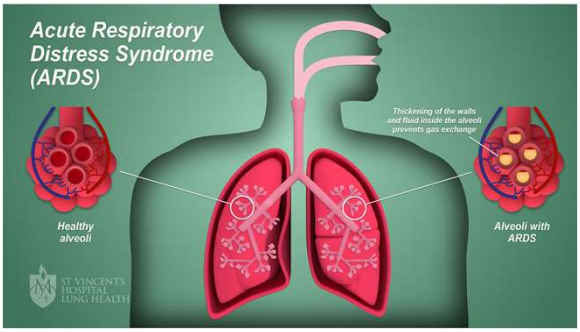

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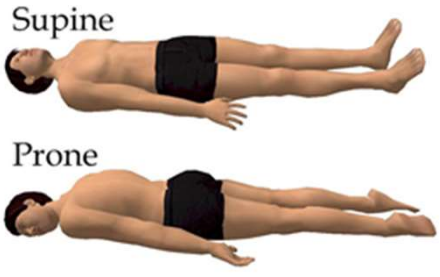
Acute Respiratory Distress Syndrome: Proning



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COVID-19

- Coronavirus disease 2019 (COVID-19), patients are presenting with acute respiratory distress syndrome (ARDS) requiring urgent respiratory and hemodynamic support in the intensive care unit (ICU).

Challenges in Management of COVID 19 Patients

- Obesity
- T2DM/Hyperglycemia
- Gastroparesis
- Fluid/Electrolytes
- Hypertriglyceridemia
- Increased LFTs
- Prone Positioning
- ECMO
- Sedation

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Ways to Optimize Nutrition Support in the ICU

Early EN Initiation and Advancement during prone positioning:

1. Start enteral nutrition support within 24-48 hours in critically ill ICU patients if:
   - Adequately fluid resuscitated
   - Head of bed maintained at or above 25 degrees (ideally 30-45 degrees if patients medical condition allows) while in prone position.
   - MAP >65 mmHg
   - Started on a bowel regimen
   - No signs/symptoms of GI intolerance (abdominal distension, unexplained abdominal pain, emesis, regurgitation, lactate >4, etc.)
1. Initiate with an enteral formula at trickle rate.
2. Advance rate of enteral formula to goal as tolerated per unit RD recommendations
3. Continue to monitor for signs/symptoms of GI intolerance.

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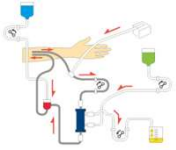
Complex Clinical Situations

Continuous Renal Replacement Therapy (CRRT)

- Continuous extracorporeal fluid and/or solute removal
  - Eases the metabolic consequences until renal recovery occurs
  - Able to more safely dialyze a hemodynamically unstable patient
- Multiple different modes that utilize the principles of ultra-filtration, convection, diffusion, or a combination



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Complex Clinical Situations - CRRT

- Nutrition Implications
  - Significant protein loss
    - Estimated loss of 10-15gm/day, provide a max of 2.5gm/kg
  - Potential energy gain or loss from the dialysate, replacement fluid, and/or type of anticoagulation being used
  - Micronutrient loss
    - Water-soluble vitamins (thiamine, folic acid, pyridoxine)
    - Trace elements (selenium, possibly chromium and zinc)
- Nutrition Support
  - Enteral is the preferred route of feeding
  - Electrolyte and volume-restricted formula is not indicated, high protein formula is ideal
  - PN requires collaboration with Nephrology on volume and electrolytes

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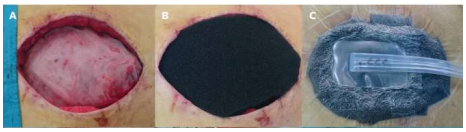
Complex Clinical Situations

Open Abdomen

- Management technique used in trauma/emergency surgery, vascular surgery, intra-abdominal sepsis, and abdominal compartment syndrome
- Temporary closure is required (negative pressure wound therapy is recommended, skin approximation techniques or grafting may be used)



Wounds 2018;30(10):310–316

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Complex Clinical Situations - Open Abdomen

ASPEN/SCCM (2016)

- M3a. Based on expert consensus, we suggest early EN (24-48 hours post injury) in patients treated with an open abdomen in the absence of a bowel injury
- M3b. Based on expert consensus, we suggest providing an **additional 15-30g of protein per liter of exudate** lost for patients with open abdomen. Energy needs should be determined as for other ICU patients.
- O4. We suggest enteral feeding for many patients in difficult postoperative situations such as prolonged ileus, intestinal anastamosis, OA, and need of vasopressors for hemodynamic support. Each case should be individualized based on perceived safety and clinical judgment. [Low to very low evidence]

ESPEN (2019)

- 3.17 Clinical question 17: Nutrition therapy in special conditions
  - Recommendation 40 - Early EN (within 48hrs of ICU admission) should be performed in patients with open abdomen

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Ways to Optimize Nutrition Support in the ICU; Case Study

46 y.o. male with PMH significant for obesity, DM, and HLD, presenting 1/8/21 after 5 days of dry cough and fatigue, positive for COVID 19. Admitted to intermediate care unit (IMC) on high flow nasal cannula (HFNC). Patient hospital course complicated by ongoing acute hypoxic respiratory failure. Initially able to self prone and tolerate HFNC, but became hypoxic w/ increased work of breathing on 1/20/21 requiring intubation.

Day 2 of ICU stay: Despite ventilator support, he has worsening hypoxia, subsequently pt was proned.

Night of Day 2: Overnight the team started trickle feeds of high protein formula

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Ways to Optimize Nutrition Support in the ICU; Case Study

Pertinent Labs: POCT glucose 165, Glucose 192, Na 134, TG 413

Pertinent Meds: Decadron, Pepcid, Lantus, Humalog, Pericolace, Nimbex, Fentanyl, Ketamine, Levophed @ 8 mcg/min, Propofol @ 29.2 ml/hr (770 kcals)

Anthropometrics: 175.3 cm (5' 9"), Weight: 108.5 kg (239 lb 3.2 oz), Body mass index is 35.32 kg/m².

Nutrition Goals: 1200-1530 kcals (11-14 kcals/kg), 145-183 g of protein (2.0-2.5 g/kg IBW), fluids per team

Recommendations: high protein formula 1.0 formula @ trickle rate

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Ways to Optimize Nutrition Support in the ICU; Case Study

Day 3: Pt back to supine. Tube feedings were held due to high gastric residuals (~500-600 mLs). Reglan started. Had BM x2. Tube feedings restarted @ trickle rate

Day 4-5: Pt remains intubated/sedated/paralyzed back in proning position. Residuals now <500 mLs during trickle feeds.

Day 6-7: Patient was proned a total of three times. On strict I/O, diuresing. EN at volume goal, tolerating well.

Labs: POCT glucose 190, Glucose 154, TG 262

Meds: Pepcid, Lantus, Humalog, Miralax, Pericolace, Vancomycin, Nimbex, Veletri, Fentanyl, Lasix gtt, Ketamine, Levophed @13 mcg/min, Propofol @ 26 ml/hr (686 kcals)

*EN Goal: High protein formula 480 mls daily with 3 packets of additional protein modular given TID (9) while on Propofol

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Ways to Optimize Nutrition Support in the ICU; Case Study

Day 8-13: Remains intubated and sedated on Propofol. Paralytic stopped day 12

Day 14: Attempting to wean off Propofol as triglycerides trend up, added Precedex gtt.

Day 15-20: Remains in ICU; Propofol discontinued, as triglycerides trending high. Still tolerating EN at volume goal.

Goal EN: High Protein Formula 1320 mls daily with additional protein modular TID

Remains in ICU. Poor Prognosis, ongoing goals of care discussion with family

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Ways to Optimize Nutrition Support in the ICU; Case Study

- 22 year old healthy male involved in a motor vehicle collision
- Exploratory laparotomy: control of mesenteric hemorrhage, nonviable segment of small bowel resected with the bowel left in discontinuity and the abdomen left open
- Returned to the OR day 2 for small bowel anastamosis but still with bowel edema, abdomen again left open to facilitate another look
  - Patient returns to the ICU intubated and on high-dose vasopressors but able to be weaned overnight

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Ways to Optimize Nutrition Support in the ICU; Case Study

Ht: 177.8cm (5'10") Wt: 70kg (154lbs) BMI: 22.1kg/m^2

Labs: BG 112, BUN 16, creat 0.7, Na+138, K+4.2, Mg++2.0
Meds: pepcid, LR @100ml/hr, fentanyl, precedex, levophed @ 25mcg/min
Skin: complex scalp laceration repaired, abdominal Abthera wound vac
GI: OGT to low continuous suction

Estimating Needs
- Calories
  - 20-35 kcal/kg/day
    - 1750-1900 kcals (25-27 kcal/kg)
- Protein
  - 1.5-2 gm/kg general trauma range
    - 105-140gm protein
  - Additional protein depending on negative pressure wound therapy (NPWT) output

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		0701 - 1900	1901 - 0700	Daily Total	0701 - 1900	1901 - 0700	Daily Total	0701 - 1900	1901 - 0700	Daily Total
In	I.V (mL/kg)	180.08 (2.9)	242.98 (3.91)	423.06 (6.81)	108.19 (1.74)	142.88 (2.3)	251.07 (4.04)			
	NG/GT	38		38		270	270	380	358	738
	IV Piggyback	200	100	300	200	600	800	200	100	300
	Total Intake (mL/kg)	**418.08** (6.73)	**342.98** (5.52)	**761.06** (12.26)	**308.19** (4.96)	**1,012.88** (16.31)	**1,321.07** (21.27)	**580** (9.34)	**458** (7.22)	**1,038** (16.37)
Out	Urine (mL/kg/hr)	530 (0.71)	664 (0.89)	1,194 (0.8)	671 (0.9)	395 (0.53)	1,066 (0.72)	535 (0.72)	1,005 (1.32)	1,540 (1.01)
	Other	1,500	600	2,100	300	450	750	500	1,000	1,500
	Output (mL): NPWT Drainage a...	1,500	600	2,100	300	450	750	500	1,000	1,500
	Stool									
	Chest Tube	0		0						
	Total Output (mL/kg)	**2,030** (32.69)	**1,264** (20.35)	**3,294** (53.04)	**971** (15.64)	**845** (13.61)	**1,816** (29.24)	**1,035** (16.67)	**2,005** (31.62)	**3,040** (47.99)
Net	**I/O**	**-1,611.92**	**-921.02**	**-2,532.94**	**-662.81**	**+167.88**	**-494.93**	**-455**	**-1,547**	**-2,002**

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Ways to Optimize Nutrition Support in the ICU; Case Study

Goal EN: 1200ml daily volume of a 1.5kcal/ml high protein formula with additional protein modular to provide 1960 kcals and 156gm protein

Day 3: trickle tube feeds started at 20ml/hr
- Gastric residuals are 200-400mls

Day 4: a bedside washout is done with wound vac replacement
- Tube feeds restarted at 20ml/hr afterwards, tolerance improves

Day 5: tube feeds increased to goal and patient tolerates

Day 7: delayed abdominal fascia closure, superficial wound vac is placed over the incision, output is <200ml/day. Still tolerating EN goal daily volume, additional protein modulars adjusted to provide 134gm (105-140gm protein)

Day 12: unable to wean off mechanical ventilation, surgery performs a tracheostomy/PEG-tube placement

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Our Implementation Experience!

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