

Volume - Based Feeding in Patients with Severe Burns

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1

Disclosure

No commercial relationships to disclose.



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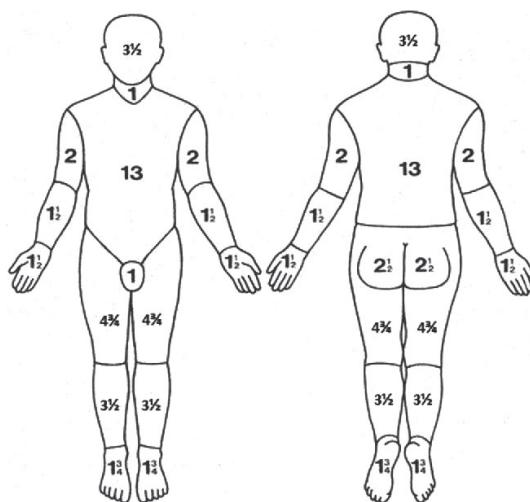
Learning Objectives

Upon completion of this educational activity, the learner will be able to:

- Evaluate the metabolic demands of patients with severe burns.
- Explore the evidence for volume-based versus rate-based tube feeding.
- Implement volume-based feeding protocols in the care of patients with severe burns.

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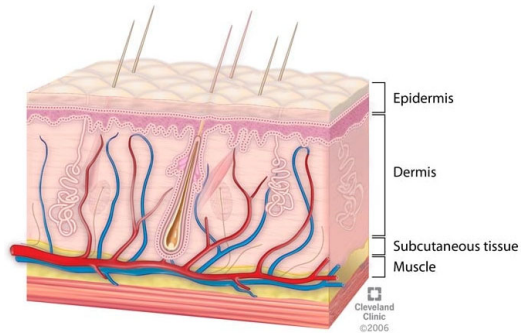
Classification of Burns



*Generally, burns
 $\geq 20\%$ TBSA are
considered severe*

4

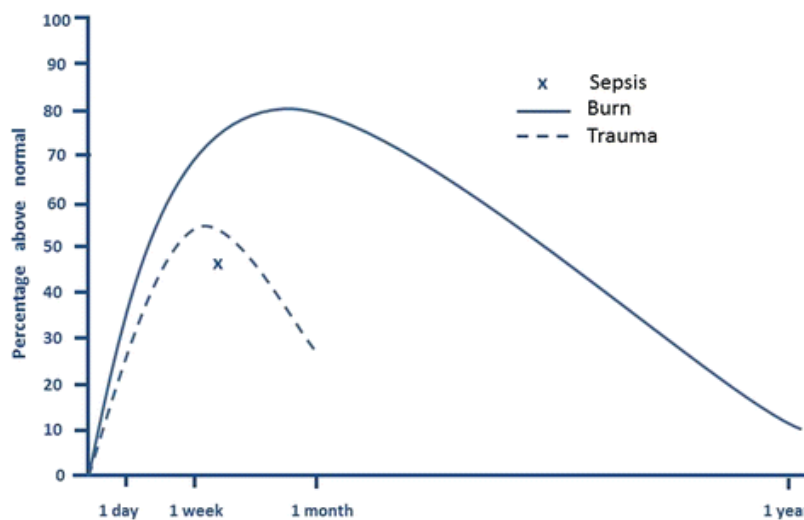
Classification of Burns



- Superficial (first degree burn)
 - Epidermis only
- Partial thickness (second degree burn)
 - Epidermis and part of dermis
- Full thickness (third degree burn)
 - Destroys the epidermis and dermis. May involve subcutaneous tissue
- Fourth degree burns include burns to tendon, muscle, or bones

5

Hypermetabolism in Burn Patients



Clark, A., Imran, J., Madni, T., & Wolf, S. E. (2019). Nutrition and metabolism in burn patients. *Burns & Trauma*, 5(1). <https://doi.org/10.1186/s41038-017-0076-x>

6

Timing of Nutrition Support

ASPEN Guidelines

Initiate enteral nutrition within the first 24-48 hours of ICU admission.
Advance to goal over the first week.

Zagales, R., et al

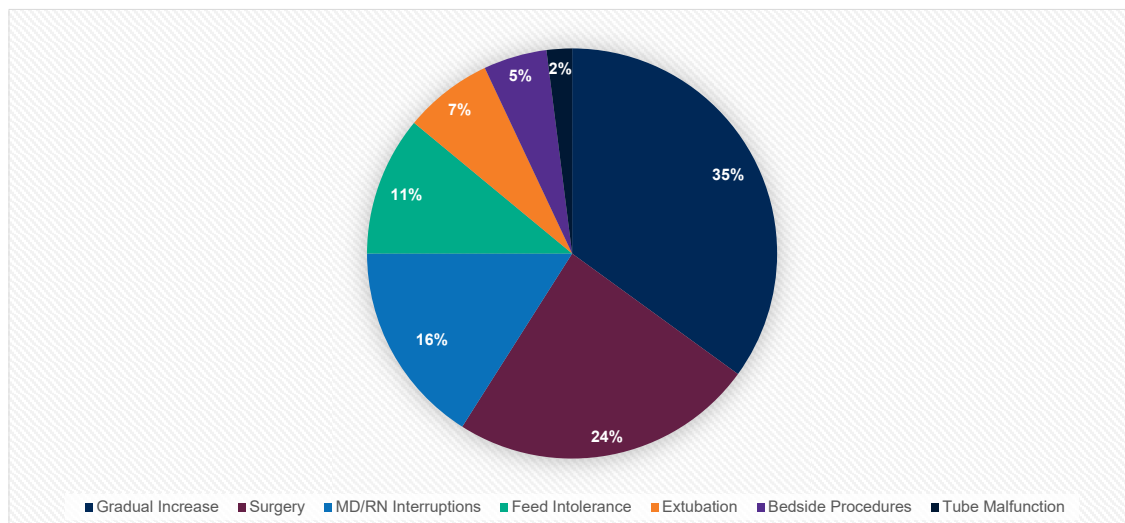
Enteral nutrition should be initiated within the first 24 hours of burn injury.

Zagales R, Watts E, Awan MU, Hernandez N, Haddadi M, Smith HG, Elkbull A. Optimizing Nutritional Needs of Burn Patients: An Evaluation of Nutritional Assessment Tools, Feeding Strategies, and Their Impact on Patient Outcomes. Am Surg. 2025 Mar;91(3):393-406. doi: 10.1177/00031348241259042. Epub 2024 Jun 3. PMID: 38830580.



7

Enteral Nutrition Interruptions



Sudenis T, Hall K, Cartotto R. Enteral nutrition: what the dietitian prescribes is not what the burn patient gets! J Burn Care Res. 2015 Mar-Apr;36(2):297-305. doi: 10.1097/BCR.0000000000000069. PMID: 24722665.



8

Enteral Nutrition Interruptions

01/29 Escharotomy to chest, abdomen, LUE, RUE, LLE.

01/30 Fascial excision, Application of cadaveric allograft skin substitute

01/30 Excision, application of allograft skin

02/01 Excision and allografting to extremities and torso

02/01 Open tracheostomy

02/03 Excision, application of allograft.

Interruptions for surgery account for 24% of total discrepancy time.

Sudenis T, Hall K, Carlotta R. Enteral nutrition: what the dietitian prescribes is not what the burn patient gets! J Burn Care Res. 2015 Mar-Apr;36(2):297-305. doi: 10.1097/BCR.0000000000000069. PMID: 24722665.



9

Strategies to Improve Nutrition Delivery

Feeding Through the OR

Implementation of Continuous Enteral Feeding and Shortened Fasting Periods in the Perioperative Burn Patient

-79 patients with TBSA >20%

-Mean time to feed was hospital day 1

-Jejunal feeds continued through the OR. Gastric feeds continued up until the OR.

-EN group:

-Average 2 less vent days

-Decreased wound infection and graft loss

-No difference in aspiration events

Post-Pyloric Access

Gastric-tube versus post-pyloric feeding in critical patients: a systematic review and meta-analysis of pulmonary aspiration- and nutrition-related outcomes

-Included 41 studies involving 3248 patients

-Post pyloric feeding:

-Lower incidence of pulmonary aspiration, gastric reflux, and pneumonia

-Fewer GI complications (vomiting, diarrhea, nausea, abdominal distention, constipation, high residuals)

-Improved nutrition intake, time to tolerate EN, time required to start feeding, and time required to reach nutrition targets

-Shorter length of mechanical ventilation, ICU stay, and hospital stay

Maarouf R, Feldman MJ. Implementation of continuous enteral feeding and shortened fasting periods in the perioperative burn period. J Burn Care Res 2018;39:70.
Liu, Y., Wang, Y., Zhang, B. et al. Gastric-tube versus post-pyloric feeding in critical patients: a systematic review and meta-analysis of pulmonary aspiration- and nutrition-related outcomes. Eur J Clin Nutr 75, 1337–1348 (2021). <https://doi.org/10.1038/s41430-021-00860-2>



10

Volume-Based Feeding

Volume-Based Feeding i

A Volume-Based Feeding Protocol Improves Nutrient Delivery and Glycemic Control in a Surgical Trauma Intensive Care Unit

Stephen A. McClave, MD¹; Mohar Mary Anderson, RD²; Alice E. Jot Daren K. Heyland, MD³; and Ryan

Abstract
Introduction: Cr designed to adjust fixed hourly rate critically ill patients strategy was imp physicians deter a mean age of 52 (37) received 92.5 received 80.9% c EN days in VBF a mean 77.6% of intolerance occur standard more co

A Quality Im and Rate-Bas in Critically I

Travis Swiatlo, MS Kasuen Mauldin, P

Abstract
Background: Adequa malnutrition and im infusion rate. Per vol feeding protocols like F feeding deficits, ensu limiting hyperglycemic on VBTF vs RBTF. 888) included patients ≥ 18 years of age who were ad Results: More patients on VBTF (n = 77; 55.8% adequate nutrition (VBTF: 88.3%, 93.1 ± 11.3 females, age 61 ± 15 years, BMI 28.3 ± 6.5 kg percentage of total goal protein received, incidence of moderate hyperglycemia P = 0.052 adverse outcomes (hyperglycemia P = 0.052 output P = 0.096) were found between the gro evidence for clinicians to be more proactive an deemed appropriate for VBTF. (Nutr Clin Prac

Volume-Based Feeding Enhances Enteral Delivery by Maximizing the Optimal Rate of Enteral Feeding (FEED MORE)

Phillip J. Prest, DO, Nathanial Bell, PhD^{1,2}

Abstract
Background: Inadequat intensive care unit prov Energy Provision via th data are sparse on its s initiated at our Americ (pre-PEP uP) were con energy goals (defined a (OR) of 4.98 (95% CI : an adjusted OR of 11.8 in the post-PEP uP arm

Amanda Holyk, PharmD, BCCCP; Valerie Belden, PharmD, BCPS; Michael Sirlimatos, PharmD, FCCM; Kathryn Chiles, RD, CNSC; Nicole Fontenot, DNP, ACNP-BC; Annette Lista, PharmD, BCCCP; Mary K. Broadway, MSN, CNRN; and Raul Sanchez Leon, MD

Abstract
Background: The importance of enteral nutrition (EN) in critically ill patients is well documented. However, actual administration of EN frequently does not amount to prescribed nutrition goals. Persistent underfeeding may lead to impaired immune response, increased mortality, and higher costs. Traditionally, EN uses a rate-based approach, utilizing slow titration to goal and a final fixed hourly rate, regardless of interruptions in feeding. Volume-based feeding (VBF) establishes a 24-hour EN goal volume, and the rate varies to achieve this daily goal when interruptions occur. Materials and Methods: This was a retrospective, single-center, quasi-experimental study comparing traditional rate-based feeding (RBF) to VBF in adult patients admitted to the medical and neurosurgical intensive care units (ICUs). The primary outcome was mean percentage of total goal energy received after EN initiation until 7 days, transfer from ICU, removal of feeding tube, or oral diet order placed. Secondary outcomes included mean percentage of total goal protein received, percentage of patients meeting 80% of nutrition goals, incidence of gastric residual volumes >400 mL, and incidence of moderate hyperglycemia (>250 mg/dL). Results: The study enrolled 189 patients. Mean percentage of goal energy delivered (75% RBF, 102% VBF; P < .001) and goal protein delivered (68% RBF, 87% VBF; P < .001) was significantly higher with VBF compared with RBF. Conclusion: VBF demonstrated a significant increase in energy and protein delivery with no major safety or tolerability issues. VBF should be considered for use in ICU patients to optimize nutrition delivery. (JPEN J Parenter Enteral Nutr. 2020;44:1038-1046)

Volume based feeding versus rate based feeding in the critically ill: A UK study

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q Husain¹, Katerina Hilari², an³, Paul Bassett¹ and

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on Thomas, MD¹;

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Journal of Parenteral and Enteral Nutrition
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receive goal nutrition support. Factors impeding delivery gastric residuals. A volume-based feeding protocol (VP) is hypothesize that implementation of a VP would increase de. This study compared patients on CM to those on VP. During the entire intensive care unit (ICU) stay. Inclusion schanism of injury and admission to the ICU >72 hours, etic, and EN via nasogastric or post-pyloric feeding tube. patients in the VP group were compared with the control percentage of goal EN than those on CM (73.3% vs 65%, 4.16% vs VP 5.19%; P = .29) or tube dislodgment (CM ficantly increased delivery of EN by 8.3% over that given g-related complications. (JPEN J Parenter Enteral Nutr.

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11

Volume-Based Feeding in Critical Care

PEP uP Protocol (2014)

P: 24 ICUs across Canada

I: 8 ICUs implemented the PEP uP protocol. The protocol included several interventions including a volume-based feeding schedule

C: 16 ICUs served as control sites

O: Intervention sites received more energy from EN (60.1% vs 49.9%) and protein from EN (61.0% vs 49.7%)

Wang L, et al (2023)

P: 16 studies involving 2896 ICU patients

I: Volume-based feeding protocol

C: Rate-based feeding protocol

O: VBF significantly improved EN delivery and resulted in shorter ICU stay. No change in mortality or ventilation days. No significant change in EN complications (diarrhea, emesis, feeding intolerance, and gastric retention)

Wang L, Wang Y, Li HX, Zhang RP, Chang L, Zeng J, Jiang H. Optimizing enteral nutrition delivery by implementing volume-based feeding protocol for critically ill patients: an updated meta-analysis and systematic review. Crit Care. 2023 May 5;27(1):173. doi: 10.1186/s13054-023-04439-0. PMID: 37147701; PMCID: PMC10161662.
Yeh DD, Ortiz LA, Lee JM, Chan J, McKenzie K, Young B, Chetelat L, Collier B, Benson A, Heyland DK. PEP uP (Enhanced Protein-Energy Provision via the Enteral Route Feeding Protocol) in Surgical Patients-A Multicenter Pilot Randomized Controlled Trial. JPEN J Parenter Enteral Nutr. 2020 Feb;44(2):197-204. doi: 10.1002/jpen.1521. Epub 2019 Feb 11. PMID: 30741439.

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12

Volume-Based Feeding in the Trauma ICU

Sachdev G, et al (2020)

P: 227 adult trauma patients in the ICU for >72 hours

I: 79 patients included in a volume-based feeding protocol

C: 148 patients in the rate-based feeding protocol

O: VBF received higher percentage of goal EN intake (73.3% vs 65%) with no difference in the incidence of diarrhea or tube dislodgement.

Prest PJ, et al (2020)

P: 492 patients in the ICU of a Level 1 trauma center compared before and after implementation of the PEP uP protocol

I: 295 patients post-protocol

C: 197 patients pre-protocol

O: The post-protocol patients more often met/exceeded both energy and protein targets with no significant difference in emesis and less incidence of hyperglycemia.

Prest PJ, Justice J, Bell N, McCarroll R, Watson CM. A Volume-Based Feeding Protocol Improves Nutrient Delivery and Glycemic Control in a Surgical Trauma Intensive Care Unit. JPEN J Parenter Enteral Nutr. 2020 Jul;44(5):880-888. doi: 10.1002/jpen.1712. Epub 2019 Sep 16. PMID: 31529520.

Sachdev G, Backes K, Thomas BW, Sing RF, Huynh T. Volume-Based Protocol Improves Delivery of Enteral Nutrition in Critically Ill Trauma Patients. JPEN J Parenter Enteral Nutr. 2020 Jul;44(5):874-879. doi: 10.1002/jpen.1711. Epub 2019 Sep 16. PMID: 31532004.



13

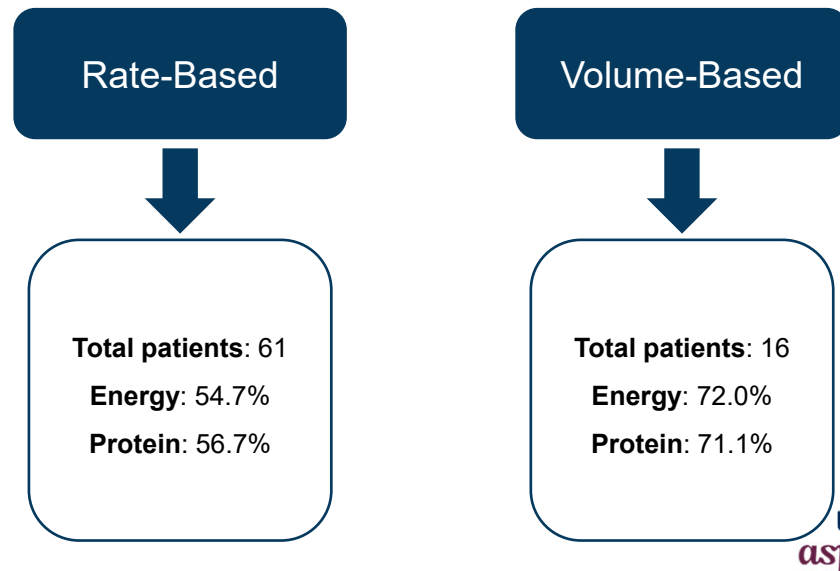
Volume-Based Feeding in Severe Burns

- Retrospective data collection
- Included
 - ≥ 18 years old
 - $\geq 20\%$ TBSA burns
 - Ordered enteral nutrition for ≥ 7 days
- Excluded
 - Patients that did not receive EN for 7 days
 - Patients admitted for <7 days
 - Patients that expired within the first 7 days of admission
- Compared nutrition intake (% of estimated needs) between rate-based and volume-based feeding.



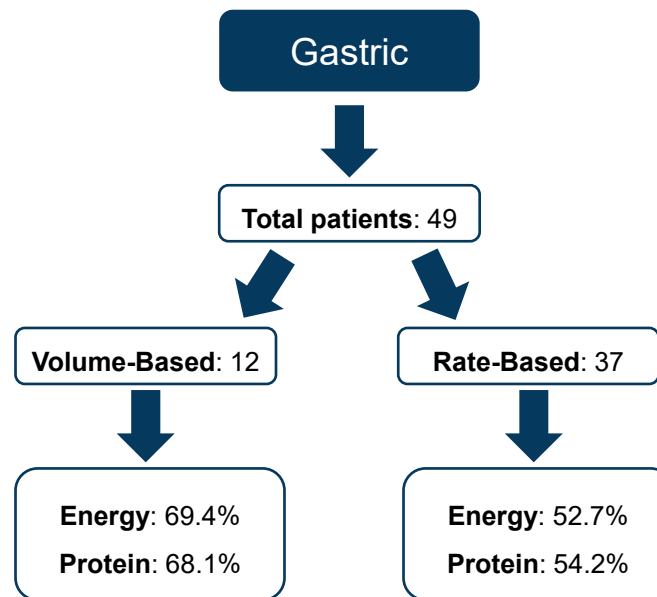
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Study Interpretations – Feeding Method



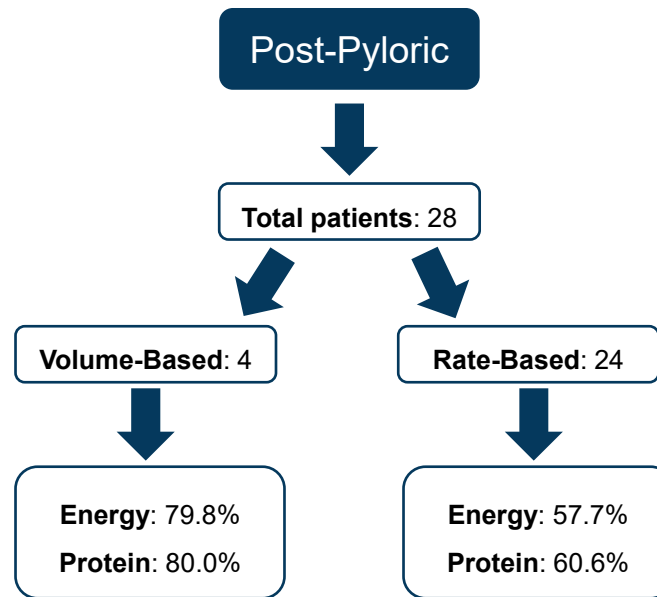
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Study Interpretations – Feeding Location



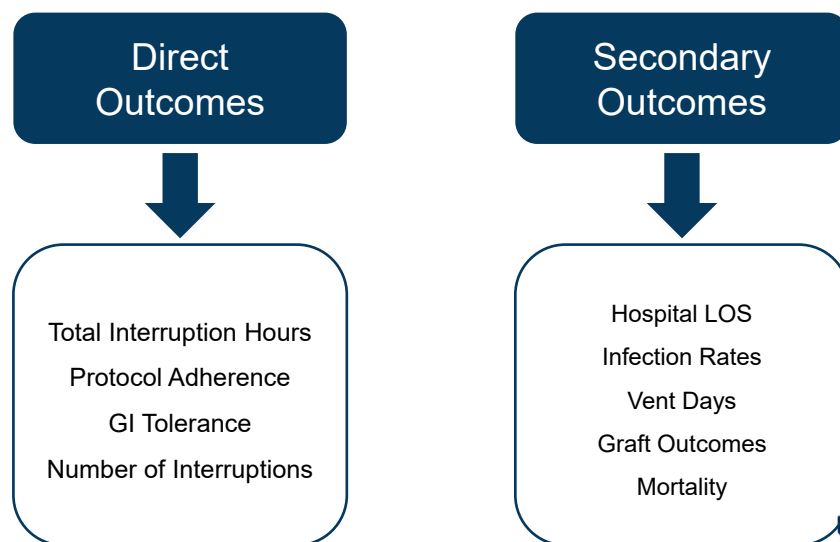
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Study Interpretations – Feeding Location



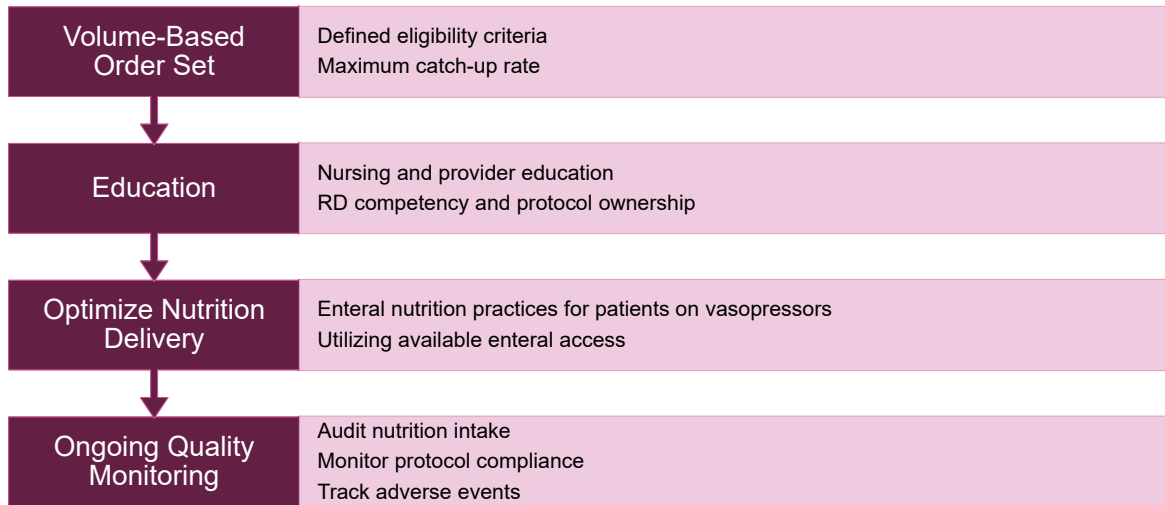
17

Study Interpretation – Future Directions



18

Volume-Based Feeding Implementation



19

Summary

Patients with severe burns are profoundly more hypermetabolic than other ICU populations

Patients with severe burns have more frequent interruptions in enteral nutrition compared to other ICU populations.

Volume-based feeding results in improved nutrition intake when compared to rate-based feeding.



Volume-Based Feeds

20

Nutrition cannot improve outcomes unless it is delivered.



21

Learning Assessment Question 1



Which of the following best describes the primary goal of volume-based feeding?

- A. Reduce resting energy expenditure after burn injury.
- B. Compensate for missed enteral nutrition following unavoidable feeding interruptions.
- C. Eliminate the need for post-pyloric feeding access.
- D. Reduce gastric residual volume.



22

Learning Assessment Question 1



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- D. Reduce gastric residual volume.



23

Learning Assessment Question 2



Which of the following is the leading cause of nutrition interruption in the ICU?

- A. Gradual increase
- B. Extubation
- C. Feed intolerance
- D. Tube malfunction



24

Learning Assessment Question 2



Which of the following is the leading cause of nutrition interruption in the ICU?

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25

Learning Assessment Question 3



Which of the following is an essential component of a successful volume-based feeding protocol?

- A. Routine placement of post-pyloric feeding tubes
- B. Automatic continuation of feeds during every operative procedure
- C. Daily indirect calorimetry for all patients
- D. Multidisciplinary education and a standardized order set

26

Learning Assessment Question 3



Which of the following is an essential component of a successful volume-based feeding protocol?

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- B. Automatic continuation of feeds during every operative procedure
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27

References List

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28