

Navigating Sepsis and Septic Shock: Optimizing Nutrition and Pharmacotherapy in the ICU

Kristen Herceg, MS, RD, LD, CNSC
Clinical Education Manager, Dietitians On Demand

Kennedy Powers, PharmD, BCCCP
Clinical Pharmacy Specialist, Medication Respiratory Intensive Care Unit
VCU Health System



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Disclosure

- Kristen Herceg, MS, RD, LD, CNSC – No commercial relationships to disclose.
- Kennedy Powers, PharmD, BCCCP – No commercial relationships to disclose.

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Learning Objectives



Describe the pathophysiology of sepsis and septic shock and its impact on hemodynamics and metabolic demands.



Evaluate the role of vasopressor therapy in septic shock and its implications for enteral and parenteral nutrition strategies.



Identify evidence-based guidelines for initiating and advancing nutrition support in patients receiving vasopressors



Integrate interdisciplinary approaches between pharmacy and nutrition to optimize outcomes in critically ill septic patients



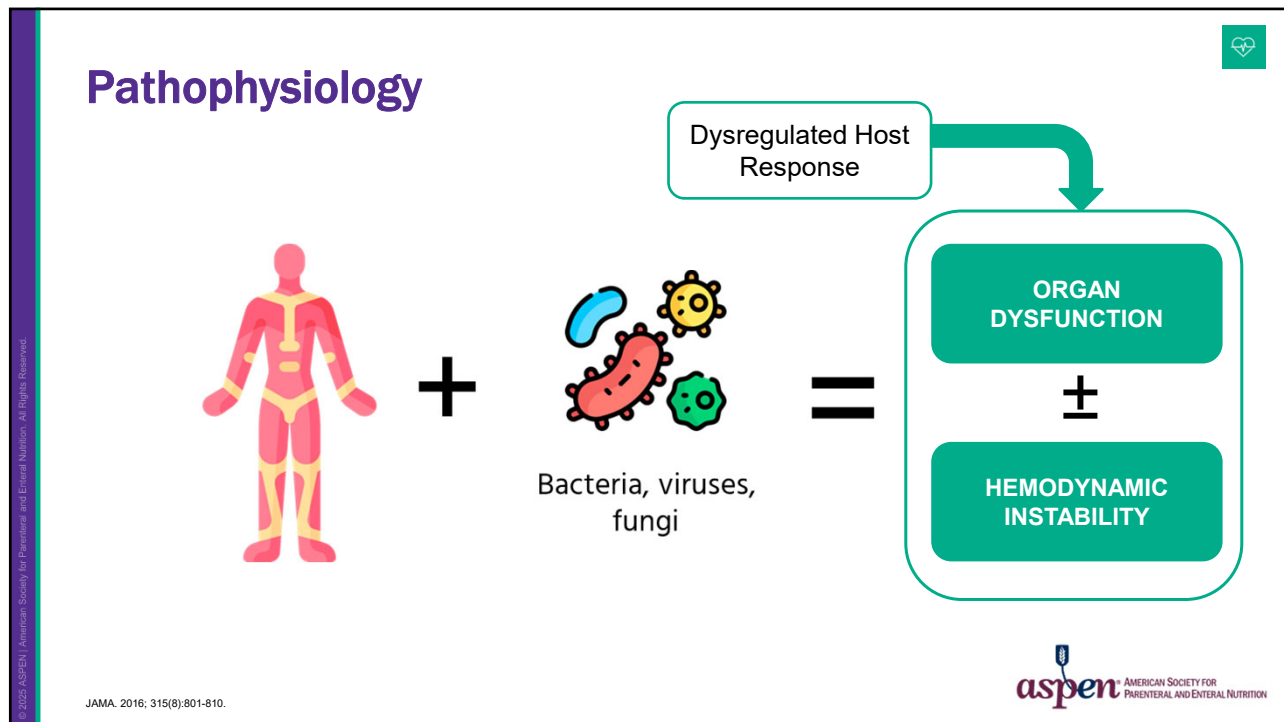
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Sepsis and Septic Shock

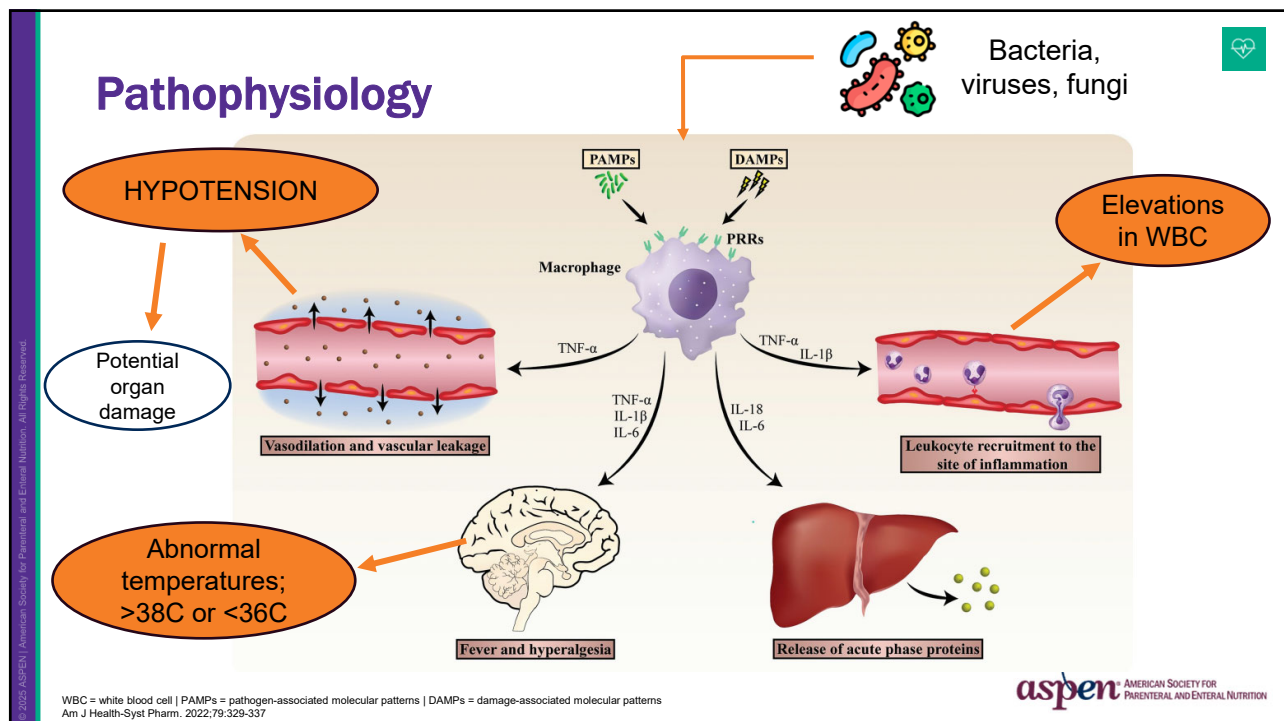
Reviewing of key background information



4



5



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Shift in Metabolic Demands

Innate immune cell recognition

- PAMPs
- DAMPs

Initiation of inflammatory response

Sepsis-induced hyperinflammation results in energy deficits

Cellular metabolism shifts from OXPHOS to glycolysis

PAMPs = pathogen-associated molecular patterns; DAMPs = damage-associated molecular patterns, OXPHOS = oxidative phosphorylation
Int. J. Mol. Sci. 2021, 22, 8295 | Clin Chest Med. 2016, 37(2): 321-331.

7

Metabolic Changes

Macronutrient metabolism dysregulation

- Hyperglycemia common due to altered glycogen metabolism and insulin resistance
- Accelerated protein breakdown leads to skeletal muscle wasting

Micronutrient metabolism changes

- Selenium
- Zinc
- Others?

Clin Chest Med. 2016, 37(2): 321-331.

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Vasopressor Utilization in Septic Shock

Surviving Sepsis Campaign Guidelines

For adults with sepsis-induced hypotension, we "suggest" initial IV crystalloid fluid bolus resuscitation followed by vasopressor support if hypotension persists.

For adults with septic shock, we "recommend" using norepinephrine as the first-line agent over dopamine, epinephrine, or selegressin.

For adults with septic shock on escalating doses of norepinephrine, we "suggest" adding vasopressin.

- Panelists using vasopressin initiate it at a median dose of 0.3 µg/kg/min of norepinephrine (IQR 0.2–0.5 µg/kg/min).

Critical Care Medicine, 2026;54(4): 725-812.



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Implications of Vasopressor Therapy on Nutrition

Norepinephrine and Epinephrine

Reduction in absolute flow of the superior mesenteric artery, jejunum, and pancreas

- Gastric and jejunal feeding implications?

No effect on jejunal microvascular blood flow

- No feeding implications?

Phenylephrine

Relatively no effect on splanchnic, jejunal, and pancreatic blood flow

- Any feeding implications? Depends on concomitant therapies?

Vasopressin

Increasing doses of vasopressin (0.02-0.08u/min) led to decreased jejunal mucosal perfusion by ~20%

Gastrointestinal hypoperfusion also seen

Total hepatosplanchnic blood flow did not change with AVP administration (0.04u/min)

AVP = arginine vasopressin; u = units
Ann. Surg. 1998; 228(2):239-248. | Int Care Med. 2001; 27:593-601. | Crit Care Med. 2006; 34:1456-1463. | Acta Anaesthesiol Scand. 2009; 53:581-588. | Anesth. 2011; 114:1396-402.
Crit Care Med. 2003;7(Suppl 2):P047



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Guidelines Review

Surveying of applicable recommendations



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Society Guidelines and Recommendations

SCCM/ASPEN Guidelines 2009

EN recommended within the first 24-48 hours following admission to the ICU once resuscitation and hemodynamic stability have been achieved

Hold EN when "high-dose" catecholamine agents are utilized

SCCM/ASPEN Guidelines 2016

In the setting of hemodynamic compromise or instability, EN should be withheld until the patient is fully resuscitated and/or stable

Initiation/reinitiation of EN may be considered with caution in patients undergoing withdrawal of vasopressor support

ASPEN Guidelines 2021

Did not directly address feeding the hemodynamically unstable patient

Either EN or PN is acceptable in the first week of critical illness

kr1

EN = enteral nutrition
Critical Care Medicine. 2009;37(5):1757-1761. | J Parenteral Enteral Nutrition. 2016;40(2):159-211. | J Parenteral Enteral Nutrition. 2022; 46(1):12-41.

KP2



12

Slide 12

kr1 Happy to discuss if it should be changed back, but I kind of like the idea of this slide showing the progression of the ASPEN(/SCCM) guidelines over the past three iterations. And then I added a slide dedicated to the latest guidance from ASPEN (see next slide).

kristenherceg@gmail.com, 2026-07-10T20:28:18.350

KP2 Compher C, Bingham A, McCall M, et al. Guidelines for the provision of nutrition support therapy in the adult critically ill patient: The American Society for Parenteral and Enteral Nutrition. JPEN J Parenter Enteral Nutr. 2022;46(1):12-41 doi:10.1002/jpen.2267

Kennedy Powers, 2026-07-13T22:16:41.565

KP2 0 just adjusted the citation to the short citation as per the others

Kennedy Powers, 2026-07-13T22:16:54.112

kr2 1 Thank you!

kristenherceg@gmail.com, 2026-07-14T02:02:31.917

2022 ASPEN Consensus Statement

kr1

- Initiate EN within 48 hours of vasopressor initiation (dose-dependent)
- EN may be administered if MAP $\geq$ 60 mmHg, but should be held if MAP $<$ 50 mmHg
- Consider limiting to trophic feeds or withholding EN if vasopressor equivalent dose (VDE) score is $>$ 12
 - $VDE^* = (NE \text{ dose} \times 100) + (EPI \text{ dose} \times 100) + (PE \text{ dose} \times 10) + (DA \text{ dose} \times 1) + (AVP \text{ dose (U/min)} \times 250) + (ANG \text{ II dose} \times 1000) + (MET \text{ dose} \times 12.5)$

*Doses expressed in mcg/kg/min unless otherwise specified

NE = norepinephrine | EPI = epinephrine | PE = phenylephrine | DA = dopamine | AVP = arginine vasopressin | ANG II = angiotensin II | MET = metaraminol
J Parenter Enteral Nutr. 2022;46(7):1470-96.

KP2



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2022 ASPEN Consensus Statement, cont'd

If providing EN with concurrent vasopressor therapy, preference should be given for:

- Gastric feeding
- 1-1.2 kcal/mL EN formulas
- Low fiber (or fiber-free) EN formulas
- Higher protein EN formulas
- Either polymeric or semi-elemental formulas acceptable

EN = enteral nutrition
J Parenter Enteral Nutr. 2022;46(7):1470-96.



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kr1 I'm not entirely sure the demographic of our audience but based on the array of topics being presented, my guess is that not all will be those currently/recently working with critically ill adults. So I wanted to expand on this info. Let me know if you think it's overkill.

kristenherceg@gmail.com, 2026-07-10T20:31:02.450

KP1 0 I like this!

Kennedy Powers, 2026-07-13T22:19:54.400

KP2 Bechtold ML, Brown PM, Escuro A, et al. When is enteral nutrition indicated? JPEN J Parenter Enteral Nutr. 2022;46(7):1470-96. doi:10.1002/jpen.2

Kennedy Powers, 2026-07-13T22:18:32.225

KP1

International Guideline Recommendations

European Society for Clinical Nutrition and Metabolism (ESPEN), 2023

Delay EN if shock uncontrolled and hemodynamic goals not reached

Begin low dose EN once shock controlled with fluids and vasoactive medications – be vigilant in monitoring for signs of bowel ischemia

Korean Society for Parenteral and Enteral Nutrition, 2024

Recommends early EN if hemodynamic stability reached within 48 hours after start of treatment

Japanese Society of Intensive Care Medicine, 2024

Suggests providing EN to critically ill patients with hemodynamic instability

French Intensive Care Society (SRLF) and Pediatric Emergency Physicians and Intensivists (GFRUP), 2025

Suggest early EN within 48 hours of ICU admission for adults

Recommend that either EN or PN be used in the first week of ICU admission

Does not directly address the hemodynamically unstable patient

EN = enteral nutrition | PN = parenteral nutrition
Clin Nutr ESPEN. 2023;42:1671-1689. | Ann Clin Nutr Metab. 2024;16:89-111. | J Intensive Med. 2025;13:18. | Ann Intensive Care 2025;15:99.

aspen AMERICAN SOCIETY FOR PARENTERAL AND ENTERAL NUTRITION

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kr1

A Literature Perspective

Evaluating primary research

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Slide 15

KP1 I combined all the guidelines into one slide for an easier visual representation.. We can totally change it back though if you'd rather!

Kennedy Powers, 2026-07-13T22:34:08.746

kr1 0 Thank you!! I really like this and must admit that graphics within PPT are not my strong suit. So I appreciate you!

kristenherceg@gmail.com, 2026-07-14T02:03:19.155

Slide 16

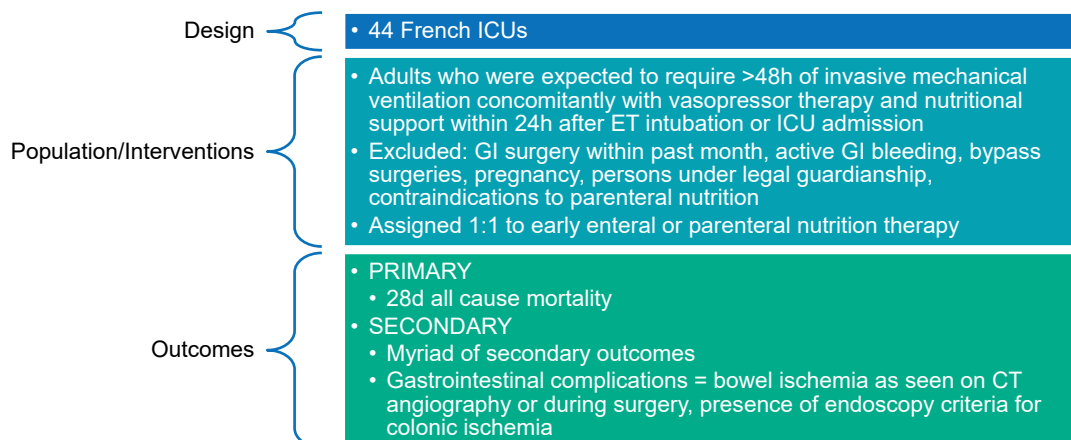
kr1 I like this section divider. I added a few other section dividers using the template provided, but I don't mind this one being different since it's the bulk of the presentation. We could also consider changing this to match the others for consistency.

kristenherceg@gmail.com, 2026-07-12T15:37:17.705

KP1 0 I like consistency

Kennedy Powers, 2026-07-13T23:15:23.878

Enteral versus parenteral early nutrition in ventilated adults with shock: a randomized, controlled, multicenter, open-label, parallel-group study (NUTRIREA-2)

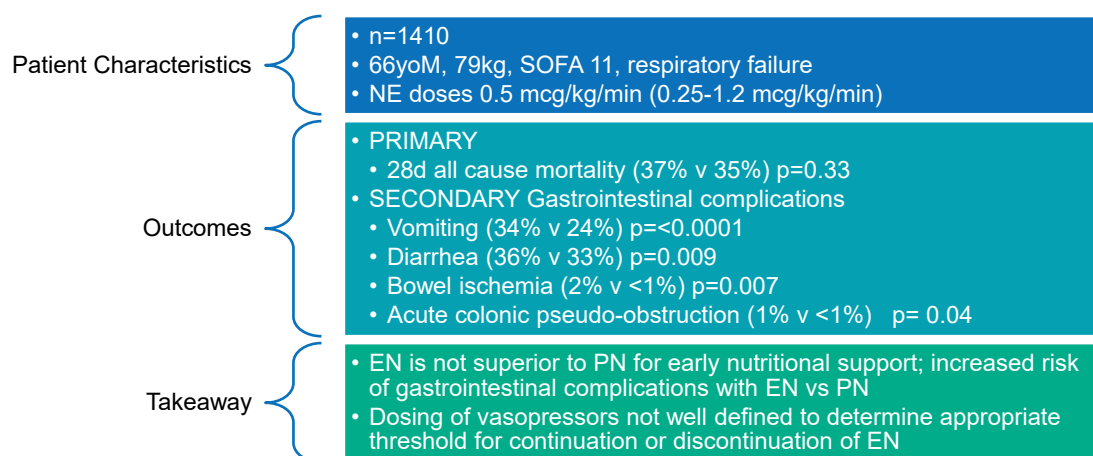


EN = enteral nutrition | ICU = intensive care unit | GI = gastrointestinal | ET = endotracheal | CT = computed tomography
Lancet 2018;391:133-43.



17

Enteral versus parenteral early nutrition in ventilated adults with shock: a randomized, controlled, multicenter, open-label, parallel-group study (NUTRIREA-2)

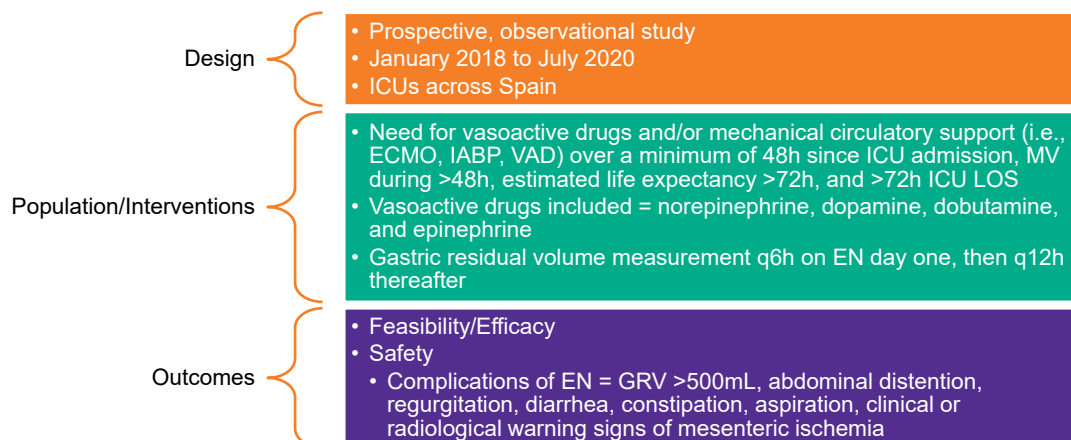


Lancet 2018;391:133-43.



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Enteral nutrition in critically ill patients under vasoactive drug therapy: The NUTRIVAD Study



ICU = Intensive care unit | ECMO = extracorporeal membrane oxygenation | IABP = intra-aortic balloon pump | VAD = ventricular assist device | LOS = length of stay | q6h/q12h = every x hours
J Parenter Enteral Nutr. 2022;46: 1420-1430.



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Enteral nutrition in critically ill patients under vasoactive drug therapy: The NUTRIVAD Study

Patient Characteristics

- n=200
- 60yoM, SOFA 11.7, Medical intensive care
- NE doses 0.71 mcg/kg/min (0.63-0.8) [First 48h]
- NE doses 0.29 mcg/kg/min (0.26-0.33) [Overall]

Outcomes

- Feasibility/Efficacy
 - Total negative energy expenditure balance
- Safety
 - Suspected/Confirmed mesenteric ischemia 5%
 - High GRV 34.5%
 - Abdominal distention 26.5%
 - Constipation/Diarrhea 24.5/28.5%
 - Vomiting/Regurgitation 22.5%
 - Aspiration 1%
 - Patients with complications 77%
 - Complications requiring EN discontinuation 38.5%

Takeaways

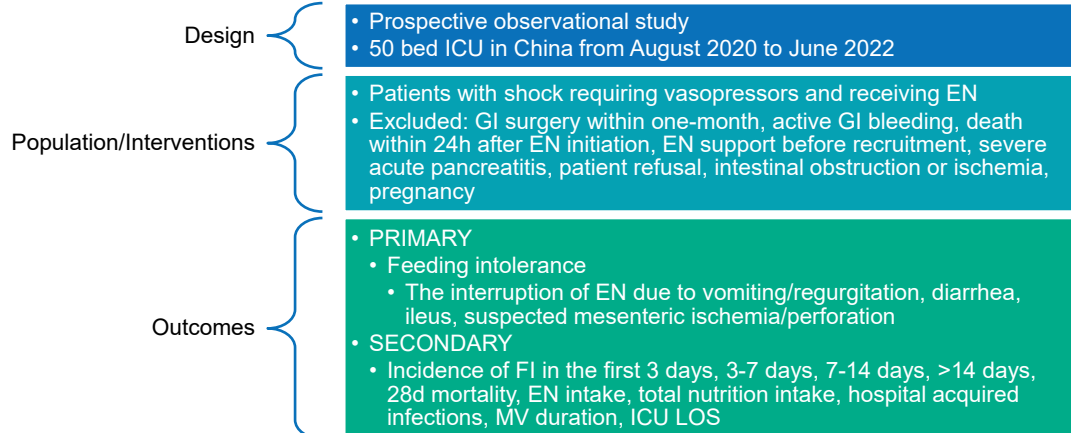
EN in critically ill patients is feasible and safe if provided after the resuscitation stage and conducted under "adequate supervision"

NE = norepinephrine | GRV = gastric residual volumes
J Parenter Enteral Nutr. 2022;46: 1420-1430.



20

Association of Vasopressors Dose Trajectories with EN in Patients with Shock: A Prospective Observational Study; Wang et al.



EN = enteral nutrition | ICU = intensive care unit | GI = gastrointestinal | FI = feeding intolerance | MV = mechanical ventilation | LOS = Length of stay
Nutrients. 2022; 17: 5393.



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Association of Vasopressors Dose Trajectories with EN in Patients with Shock: A Prospective Observational Study

Table 2. Clinical outcomes in patients with shock by NEQ Trajectory Groups.

Characteristics	Total (n = 210)	L-NEQ (n = 98)	M-NEQ (n = 74)	H-NEQ (n = 21)	R-NEQ (n = 17)	p Value
EN starting time from ICU admission (hours), median (IQR)	30.6 (18.1–54.2)	25.1 (17.8–46.4)	34.8 (17.1–60.1)	35.6 (18.7–72.3)	36.7 (20.2–71.8)	0.457
The EN intake at first week after EN initiation, median (IQR)						
Energy (kcal/kg)	8.6 (5.2–12.4)	8 (4.8–11.9)	9.9 (6.8–14.2)	7.7 (4.1–10.8)	5.5 (3.4–11)	0.017
Protein (g/kg)	0.3 (0.2–0.5)	0.3 (0.2–0.5)	0.4 (0.3–0.6)	0.3 (0.2–0.4)	0.2 (0.1–0.5)	0.014
Fat (g/kg)	0.2 (0.1–0.4)	0.2 (0.1–0.4)	0.3 (0.1–0.4)	0.2 (0–0.3)	0.2 (0–0.4)	0.465
The total nutrition intake at first week after EN initiation, median (IQR)						
Energy (kcal/kg)	8.6 (5.2–12.4)	8 (4.8–11.9)	9.9 (6.8–14.2)	7.7 (4.1–10.8)	5.5 (3.4–11)	0.017
Protein (g/kg)	0.3 (0.2–0.5)	0.3 (0.2–0.5)	0.4 (0.3–0.6)	0.3 (0.2–0.4)	0.2 (0.1–0.5)	0.014
Fat (g/kg)	0.2 (0.1–0.4)	0.2 (0.1–0.4)	0.3 (0.1–0.4)	0.2 (0–0.3)	0.2 (0–0.4)	0.465
FI—no. (%)						
Diarrhea	8 (3.81)	3 (3.06)	4 (5.41)	1 (4.76)	0 (0)	
Vomiting	4 (1.9)	0 (0)	1 (1.35)	1 (4.76)	2 (11.76)	
Abdominal pain	2 (1.0)	0 (0)	1 (1.35)	1 (4.76)	0 (0)	
Suspected mesenteric ischemia	4 (1.9)	0 (0)	1 (1.35)	1 (4.76)	2 (11.76)	
Confirmed mesenteric ischemia	2 (1.0)	0 (0)	1 (1.35)	1 (4.76)	0 (0)	
Hospital infections—no. (%)	52 (24.88)	17 (17.53)	23 (31.08)	7 (33.33)	5 (29.41)	0.150
MV (day), median (IQR)	12 (6.5–21.1)	12.5 (5.5–23.1)	15 (9.9–25.3)	10.9 (5.4–17.6)	6.6 (5.1–7.7)	<0.001
ICU Length of stay (day), median (IQR)	15.8 (10.6–24)	17.5 (11.8–25.3)	17 (12–27.1)	12 (7–18.2)	7.6 (6–9)	<0.001
28-days mortality—no. (%)	73 (34.76)	15 (17.35)	28 (37.83)	13 (61.9)	17 (100)	<0.001

Study Takeaway: The higher/more rapid the dose escalation the more FI was exhibited

Clinician Takeaway: Review trends of vasopressors before initiation of EN

All p values are two-tailed. Differences was analyzed among L-NEQ Group, M-NEQ Group, H-NEQ Group and R-NEQ Group. EN enteral nutrition; FI feeding intolerance; NEQ, norepinephrine equivalent dose; ICU intensive care unit; IQR, interquartile range; MV mechanical ventilation; L-NEQ, low-dose stable NEQ; M-NEQ, moderate-dose stable NEQ; H-NEQ, high-dose stable NEQ; R-NEQ, rapidly rising NEQ.

Nutrients. 2022; 14: 5393



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Early versus delayed enteral nutrition in mechanically ventilated patients with circulatory shock: a nested cohort analysis of an international multicenter, pragmatic clinical trial

Design	Population/Interventions	Outcomes
- Nested cohort study using data from EFFORT study - Multicenter, international	- EFFORT: Critically ill adults, mechanically ventilated, nutritionally high risk, eligible to receive nutrition support - This subset: received any vasopressor/inotrope for $\geq$ 2h, received EN, and had complete electronic report available - Early = within 48h of ICU admission - Delayed = > 48h from ICU admission	- PRIMARY 28d persistent organ dysfunction (PODS)+death - SECONDARY - ICU LOS, mechanical ventilation LOS, readmission rate, vasopressor duration, renal replacement therapy, ICU and 60d mortality, and EN intolerance

EN = enteral nutrition | ICU = intensive care unit | LOS = length of stay | PODS = persistent organ dysfunction
Critical Care. 2022;26:173.



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Early versus delayed enteral nutrition in mechanically ventilated patients with circulatory shock: a nested cohort analysis of an international multicenter, pragmatic clinical trial

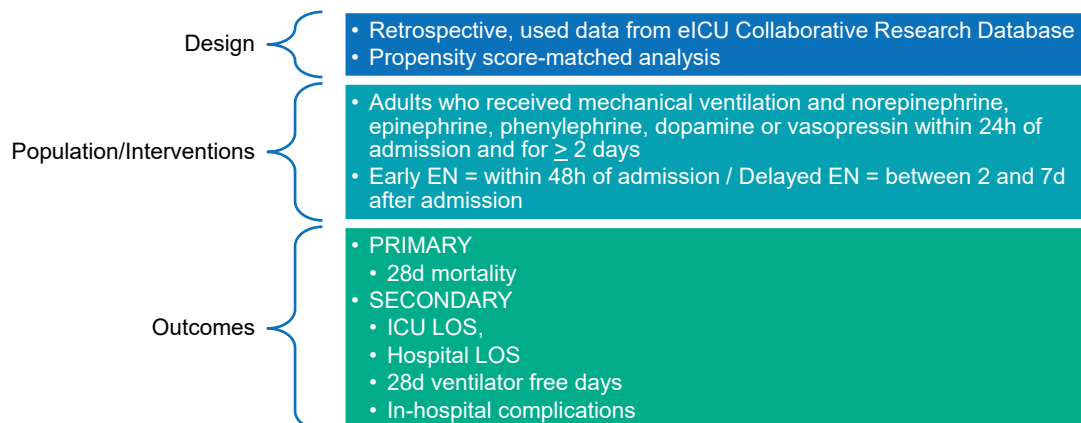
Patient Characteristics	Outcomes	Takeaways
- n = 626 patients (from 52 ICUs across 14 countries included) - No significant difference in any vasopressor dose in first 48h of treatment between the two groups	- PRIMARY 42% (EEN) vs. 53% (DEN) with PODS + death, p=0.04 - SECONDARY - EEN with significantly more ICU-free days, fewer mechanical ventilation days, shorter ICU LOS and shorter hospital LOS - No difference observed in EN intolerance between the groups 2 incidences of necrotic gut ischemia in EEN group	There are clinical benefits to EEN in the critically ill, mechanically ventilated patient with shock being treated with vasopressors

EEN = early enteral nutrition | DEN = delayed enteral nutrition | PODS = persistent organ dysfunction
Critical Care. 2022;26:173.



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Early versus late enteral nutrition in critically ill patients receiving vasopressor support



JPEN J Parenter Enteral Nutr.2022;46:130-140.



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Early versus late enteral nutrition in critically ill patients receiving vasopressor support

Patient Characteristics

- n = 1701 (1148 propensity matched)
- Most commonly used vasopressor was norepinephrine
- Delayed EN group was more likely to have a second vasopressor

Outcomes

- PRIMARY
 - No difference in 28d mortality
- SECONDARY
 - No difference in 28d ventilator-free days or hospital LOS
 - Early EN group with significantly shorter ICU LOS and less likely to need renal replacement therapy
 - 1 incidence of bowel ischemia in Early EN group

Takeaways

Some secondary benefits to early EN in critically patients requiring vasopressors, however no benefit found in 28d mortality

JPEN J Parenter Enteral Nutr.2022;46:130-140.



26

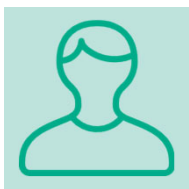
Case Study^{kr1}

Applying information to a case scenario



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Case Study – JS



68yoM

PMH:

- Asthma, HTN, hypercholesterolemia, gout

Home Medications:

- Budesonide/formoterol 160/4.5 mcg as needed SOB/wheezing
- Lisinopril 20mg daily
- Atorvastatin 40mg daily
- Allopurinol 100mg daily

HPI:

- Presented to ED with cough, shortness of air, and chest pain for 3 days

Vital Signs on Admission:

BP 78/52 mmHg, HR 132 bpm, T 39.1C, 88% NRB

Objective Data:

- Respiratory pathogen panel + influenza A
- Chest X-ray positive for bilateral opacities
- Chest CT pending

Emergency Department Plan:

- Intubated for hypoxia
- Lactated Ringers 2000mL IV once
- Azithromycin 500mg IV once, Ceftriaxone 2000mg IV once
- Norepinephrine titrated to MAP 65mmHg

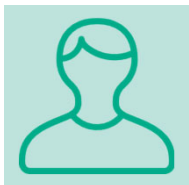
HTN = hypertension | ED = emergency department | SOB = shortness of breath | HPI = history of present illness | NRB = non-rebreather | CT = computed tomography
MAP = mean arterial pressure



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kr1 Thank you for beefing up this section and making it better!
kristenherceg@gmail.com, 2026-07-14T02:06:14.420

Case Study – JS



Hospital Day 1: Patient admitted to the Medical Intensive Care Unit

- Vasoactive medications: Norepinephrine 25 mcg/min, vasopressin 0.03 u/min
- Sedative medications: fentanyl 50mcg/hour, propofol (20mcg/kg/min) 11.2 mL/hr

Anthropometrics and Nutrition screening:

Ht: 177.8 cm // Wt: 90 kg // BMI: 28.5 kg/m² // MST: 2

What factors are important for the PharmD to consider and monitor?
What factors are important for the RD to consider and monitor?

U = units | BMI = body mass index | MST = Malnutrition Screening Tool



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kr1

Learner Assessment

Test your knowledge!



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Slide 32

kr1 I need to go back and fix color formatting on answer slides.
kristenherceg@gmail.com, 2026-07-10T22:39:26.312

Learning Assessment Question 1



Septic shock results in which of the following because of shifts in metabolic demands?

- A. Hyperglycemia
- B. Decreased protein breakdown
- C. Gluconeogenesis
- D. Lack of immune response



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Learning Assessment Answer 1



Septic shock results in which of the following because of shifts in metabolic demands?

- A. **Hyperglycemia**
- B. Decreased protein breakdown
- C. Gluconeogenesis
- D. Lack of immune response



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Learning Assessment Question 2



Which of the following enteral formula properties was **NOT** recommended by the 2022 ASPEN Consensus Statement when providing EN concurrently with vasopressors?

- A. 1-1.2 kcal/mL
- B. Low protein
- C. Low fiber
- D. Standard, polymeric or semi-elemental



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Learning Assessment Answer 2



Which of the following enteral formula properties was **NOT** recommended by the 2022 ASPEN Consensus Statement when providing EN concurrently with vasopressors?

- A. 1-1.2 kcal/mL
- B. **Low protein**
- C. Low fiber
- D. Standard, polymeric or semi-elemental



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Learning Assessment Question 3



Which statement best represents current guidelines and research's position on PN in early critical illness?

- A. PN should be avoided entirely
- B. PN should be used preferentially over EN
- C. PN should be delayed until the second week of ICU admission
- D. Either PN or EN is acceptable in the first week of ICU admission



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KP1

Learning Assessment Answer 3



Which statement best represents current guidelines and research's position on PN in early critical illness?

- A. PN should be avoided entirely
- B. PN should be used preferentially over EN
- C. PN should be delayed until the second week of ICU admission
- D. Either PN or EN is acceptable in the first week of ICU admission**



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KP1 How many questions do we have to have? I always like to make one question per objective to assess the objective to see how it went.. I am wondering about adding a question about vasopressor dosing and initiating of feeds.. But I think it'll require a little more literature dig

Kennedy Powers, 2026-07-13T23:13:05.938

kr1 0 Minimum 3, max of 6. I thinking adding 1-2 more would be good! Maybe even just 1 question on the differences in vasopressors as well? I'm with you that ideally we could have one that more directly addresses dose/tolerance/safety relationship.

kristenherceg@gmail.com, 2026-07-14T02:08:09.007

Learning Assessment Question 4



AN was admitted to the Surgical Intensive Care Unit overnight and doses of norepinephrine have ranged from 15-35 mcg/min, the provider team is planning to initiate vasopressin at 0.04 units/min to help maintain a MAP of 65 mmHg.

Which of the following is the best course of action regarding nutrition in this patient?

- A. Initiate PN to ensure that early nutrition is implemented to improve the sepsis.
- B. Initiate EN to provide gastrointestinal microbiome integrity
- C. Initiate EN to improve mortality outcome in this patient
- D. Hold EN and PN in this patient due to vasopressor trends and the timing of admission.



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Learning Assessment Question 4



AN was admitted to the Surgical Intensive Care Unit overnight and doses of norepinephrine have ranged from 15-35 mcg/min, the provider team is planning to initiate vasopressin at 0.04 units/min to help maintain a MAP of 65 mmHg.

Which of the following is the best course of action regarding nutrition in this patient?

- A. Initiate PN to ensure that early nutrition is implemented to improve the sepsis.
- B. Initiate EN to provide gastrointestinal microbiome integrity
- C. Initiate EN to improve mortality outcome in this patient
- D. **Hold EN and PN in this patient due to vasopressor trends and the timing of admission.**



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Navigating Sepsis and Septic Shock: Optimizing Nutrition and Pharmacotherapy in the ICU

Kristen Herceg, MS, RD, LD, CNSC
Clinical Education Manager, Dietitians On Demand

Kennedy Powers, PharmD, BCCCP
Clinical Pharmacy Specialist, Medication Respiratory Intensive Care Unit
VCU Health System

