PREPARED FOR APIC SIERRA CHAPTER CONFERENCE

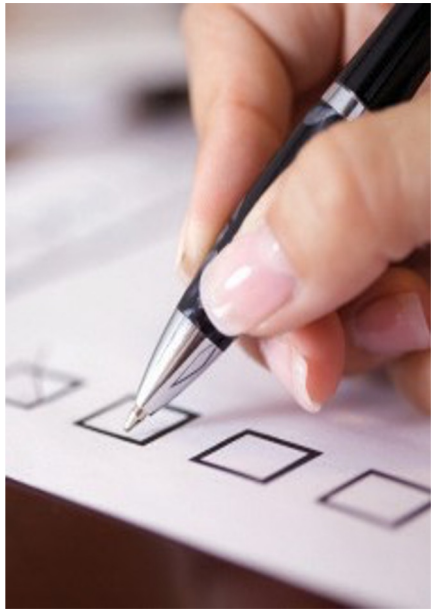
Optimizing Postoperative Outcomes: The Role of Nutrition

7 | November 2024

Abbott

Agenda

- Discuss the healthcare landscape specific to surgical care and malnutrition.
- Define the relevance of nutrition status in relation to risk of infectious and overall complications.
- Analyze key evidence and foundational guidelines addressing the use of perioperative nutrition, as well as related clinical outcomes.
- Highlight best practices and example pathways incorporating nutrition in perioperative care.



Healthcare Landscape

Prevalence of Malnutrition in Specific Patient Types in the Medical and Surgical ICU

Heterogenous group
37.8%-78.1%

Elderly group
23.2%-34.4%

Cardiac surgery
5.0%-20.0%

Liver transplantation
52.6%

Acute kidney injury
82.0%

Lew C, et al. *JPEN J Parenter Enteral Nutr*. 2017;41(5):744-758.

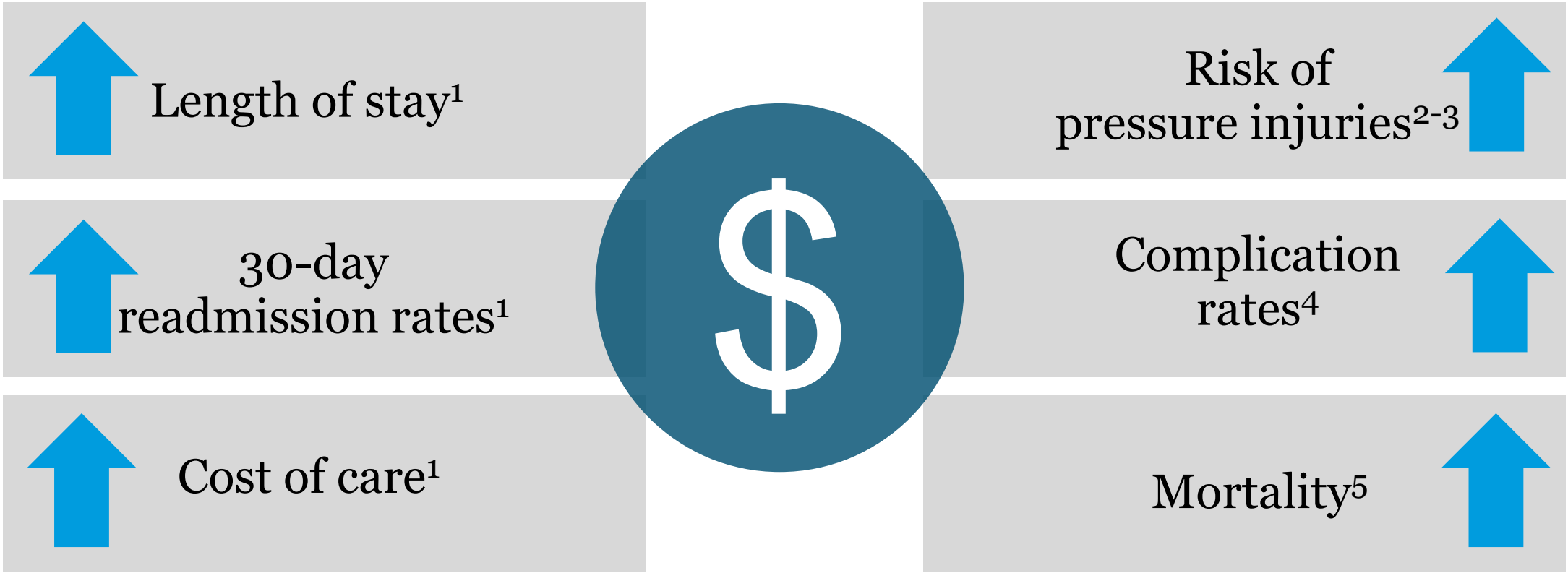
Commonalities Exist Among Diagnostic Criteria for Malnutrition, Sarcopenia, and Frailty

1. Verstraeten LMG, et al. *Clin Nutr*. 2021; 40:4090-4096.
2. White JV, et al. *JPEN J Parenter Enteral Nutri*. 2012 May;36(3):275-283.
3. Cederbalm T, et al. *J Cachexia Sarcopenia Muscle*. 2019 ;10(1):207-2172.
4. Cruz-Jentoft AJ, et al. *Age Ageing*. 2019;48(1):16-31.
5. Allison II R, et al. *Am Fam Physician*. 2021;103(4):219-226.

^ Diagnostic criteria from The Academy and ASPEN Indicators to diagnose Malnutrition (AAIM)
* Diagnostic criteria from the Global Leadership Initiative on Malnutrition (GLIM)

ASPEN: American Society for Parenteral and Enteral Nutrition

Nutrition Risk and Malnutrition Are Associated with Costly Consequences



1. Philipson TS, et al. *Am J Manag Care*. 2013;19(2):121-128.*
2. Munoz N, et al. *Advances in Skin and Wound Care*. 2022;35:156–65.
3. Fry DE, et al. *Arch Surg*. 2010:;45(2):148-151.
4. Thomas MN, et al. *Nutrition*. 2016;32:249-254.
5. Correia MI, et al. *Clin Nutr*. 2003;22:235-239.*

* Study funded by Abbott.

Malnutrition is Among the Few Modifiable Preoperative Risk Factors Associated with Poor Surgical Outcomes[1]

At 31%, SSI are among the most common and costly healthcare associated infections (HAIs) in the US.[2-3]

Up to 65% of surgical patients are at nutrition risk. Society guidelines recommend diet optimization and oral nutrition supple-mentation to address malnutrition and reduce risk of surgical complications.[4-9]

Postoperative wound dehiscence and surgical site complications are associated with increased cost, LOS, and mortality.[10-12]

* Referenced society guidelines include those from the American Society for Enhanced Recovery, and European Society for Clinical Nutrition and Metabolism (ESPEN Guidelines for Geriatrics and Hydration and Surgery)

HAI: Hospital-Acquired Infection **LOS:** Length of Stay **SSI:** Surgical Site Infection

1. Vaid S, et al. *Perm J*. 2012;16(4):10-7
2. Kelly K, et al. *Ann Surg*. 2018;268:650-656.
3. Forrester JD, Maggio PM, Tennakoon L. *J Patient Saf*. 2022 Mar 1;18(2):e477-e479.
4. Wischmeyer PE, et al. *Anesth Analg*. 2018;126(6):1883-1895.
5. Gomes F, et al. *Crit Care Med*. 2018;46(10):1668–1676.
6. Thomas MN, et al. *Nutrition*. 2016;32:249–254.
7. Geurden B, et al. *Acta Chir Belg*. 2015;115:341–347.
8. Volkert D, et al. *Clin Nutr*. 2022;41:958-989.
9. Weimann A, et al. *Clin Nutr*. 2021;40:4745-4761.
10. Hou Y and Collinsworth A. *Surg Open Sci*. 2023;14:31-45.
11. Rencuzogullari A, et al. *Tech Coloproctol*. 2016;20(7):475-82.
12. Zhan C, & Miller MR. *JAMA*. 2003;290:1868-1874.

Identifying Risk

Average Nutritional Adequacy from an International Survey Shows Poor Intake

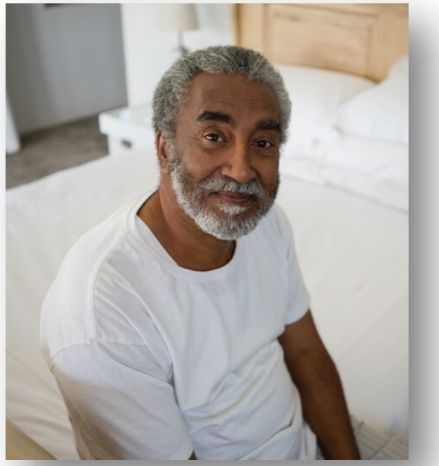
35% **of Prescribed Calories**	**42%** **of Prescribed Protein**
Frequent cessation of feeding is often due to:	Inadequate calorie and protein intake is associated with increased:
• Gastrointestinal intolerance • Routine nursing care activities • Procedures or diagnostic tests • Technical issues with feeding access	• Risk for infectious complications • Length of hospital stay • Mechanical ventilation • Risk of complications • Mortality

Heyland DK, et al. *JPEN J Parenteral Enteral Nutr*. 2018;42(2) 308-317.

Understanding Various Clinical Presentations of Malnutrition

Malnutrition can occur in people of all body types, ages, genders and conditions:

Obesity



Elderly

Acutely or Chronically Ill

Underweight

1. White JV, et al. *JPEN J Parenter Enteral Nutr*. 2012;36(3):275-283.
2. CDC. Poor Nutrition. Accessed October 20, 2022. https://www.cdc.gov/chronicdisease/resources/publications/factsheets/nutrition.htm
3. Ellis E. What is Malnutrition. Published Sept 2020. Accessed October 20, 2022. https://www.eatright.org/food/nutrition/healthy-eating/what-is-malnutrition

As Nutritional Status and Lean Body Mass (LBM) Decline, Risk of Complications Increase

"As lean mass decreases, more consumed protein is used to restore LBM, with less being available to the wound."

Impaired immunity (infections)

10% Loss of Total Lean Body Mass

Potential complication:
- **Impaired immunity**
- **Increased infection**

Delayed healing

20% Loss of Total Lean Body Mass

Potential complication:
- **Decreased healing**
- **Thinning of the skin**

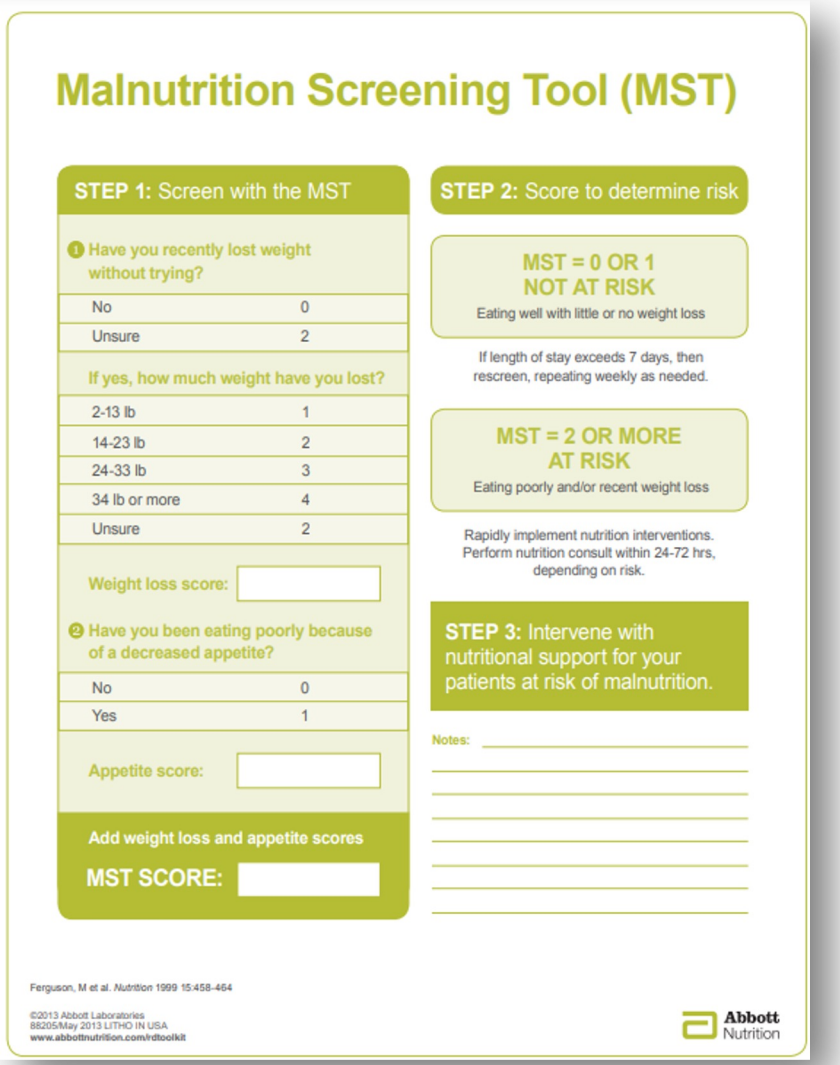
Pressure ulcers

30% Loss of Total Lean Body Mass

Potential complication:
- **New wound development**
- **Pneumonia**

Demling RH: Nutrition, anabolism, and the wound healing process: an overview. *Eplasty*. 2009;9:e9.

Risk Assessment Tools



Malnutrition Screening Tool (MST)

STEP 1: Screen with the MST

1. Have you recently lost weight without trying?

No	0
Unsure	2

If yes, how much weight have you lost?

2-13 lb	1
14-23 lb	2
24-33 lb	3
34 lb or more	4
Unsure	2

Weight loss score:

2. Have you been eating poorly because of a decreased appetite?

No	0
Yes	1

Appetite score:

Add weight loss and appetite scores

MST SCORE:

STEP 2: Score to determine risk

MST = 0 OR 1
NOT AT RISK
Eating well with little or no weight loss

If length of stay exceeds 7 days, then rescreen, repeating weekly as needed.

MST = 2 OR MORE
AT RISK
Eating poorly and/or recent weight loss

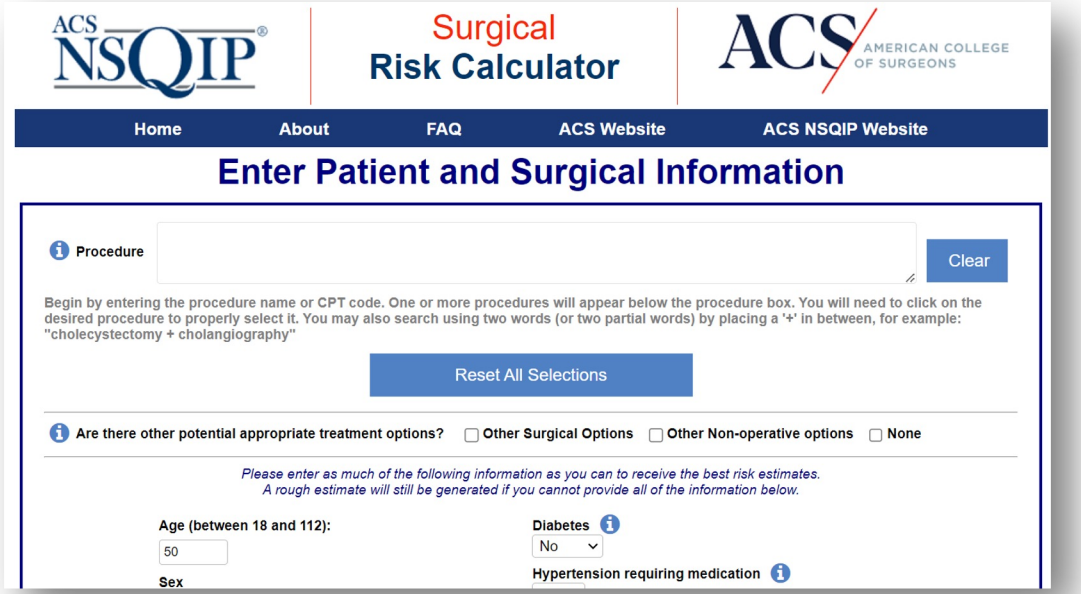
Rapidly implement nutrition interventions. Perform nutrition consult within 24-72 hrs, depending on risk.

STEP 3: Intervene with nutritional support for your patients at risk of malnutrition.

Notes:

Ferguson, M et al. *Nutrition* 1999 15:458-464

Abbott Nutrition



ACS NSQIP® Surgical Risk Calculator — ACS American College of Surgeons

Home | About | FAQ | ACS Website | ACS NSQIP Website

Enter Patient and Surgical Information

Procedure [Clear]

Begin by entering the procedure name or CPT code. One or more procedures will appear below the procedure box. You will need to click on the desired procedure to properly select it. You may also search using two words (or two partial words) by placing a '+' in between, for example: "cholecystectomy + cholangiography"

Reset All Selections

Are there other potential appropriate treatment options? ☐ Other Surgical Options ☐ Other Non-operative options ☐ None

Please enter as much of the following information as you can to receive the best risk estimates. A rough estimate will still be generated if you cannot provide all of the information below.

Age (between 18 and 112): 50

Diabetes: No

Sex

Hypertension requiring medication

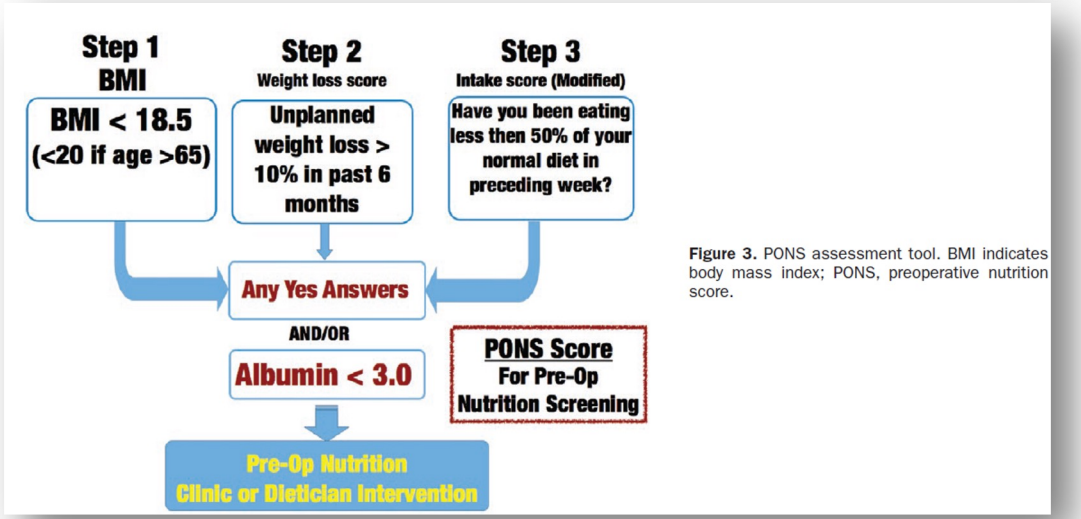


Figure 3. PONS assessment tool. BMI indicates body mass index; PONS, preoperative nutrition score.

1. Ferguson, M et al. *Nutrition*. 1999;15:458-464.
2. https://riskcalculator.facs.org/RiskCalculator/PatientInfo.jsp. Accessed September 13, 2024.
3. Wischmeyer PE, et al. *Anesth Analg*. 2018;126(6):1883-1895.

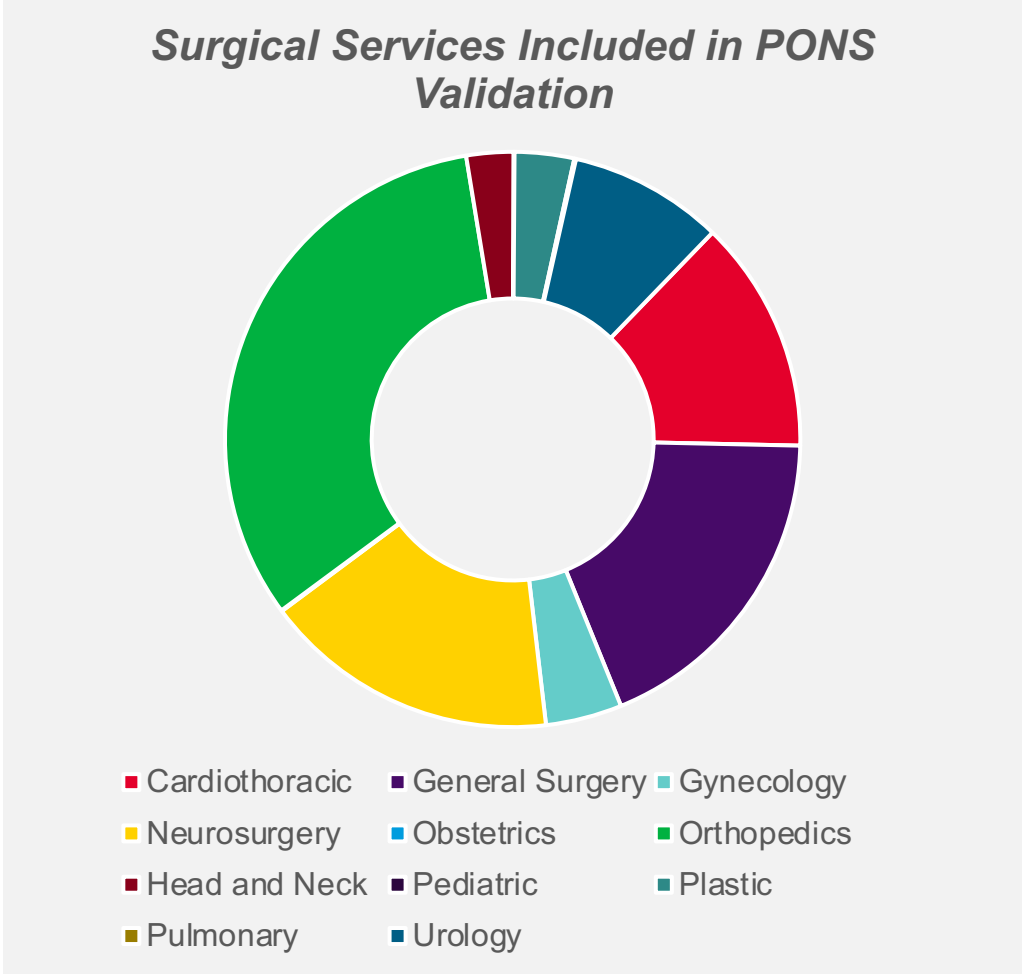
Risk Stratification for Prediction of Postoperative Outcomes

Study Overview:

- Perioperative nutrition risk assessed via PONS tool, comparing key clinical outcomes to individual and composite PONS components (BMI, intake, albumin, weight loss)
- n=3,151 adult surgical patients

Results:

- Unplanned weight loss associated with 22.4% increased LOS (P<0.0001) and increased 30-d readmissions (P<0.001)
- History of suboptimal oral intake associated with 25% increased LOS (P<0.001)
- **Pre-operative serum albumin level <3.0 g/dL associated with 29.9% increased LOS (P <0.001) and increased 30-d readmission rate (P<0.001)**
- Low BMI not associated with increased LOS by adjusted analysis, although was predictive by univariate analysis
- **Preoperative albumin <3.5 g/dL had a greater rate of postoperative complications including organ or space SSI, MI, CVA, return to OR within 30-d, wound infection, and sepsis (all P <0.005).***



Williams DGA, et al. *J Parenter Enteral Nutr*. 2022;1-9.

* Per US National Surgical Quality Improvement Program (NSQIP)

BMI: Body Mass Index **CVA:** Cerebrovascular Accident **LOS:** Length of Stay **MI:** Myocardial Infarction **OR:** Operating Room **PONS:** Perioperative Nutrition Screening Tool **SSI:** Surgical Site Infection

Evidence-based Interventions for Perioperative Recovery

Patient Perspective: What Does "Recovery" Mean to Them?

HOSPITAL-CENTERED MEASURES

Length of Stay

Infections

Mortality rate

PATIENT-CENTERED MEASURES

Returning home

Return to activities of daily living

Perception of quality of life

Status of symptoms and comfort

Lee L, et al. *Surgery*. 2014;155(2):211-216.

Nutrition Elements as Part of Enhanced Recovery Pathways[1-3]

ERAS® OVERVIEW[4]

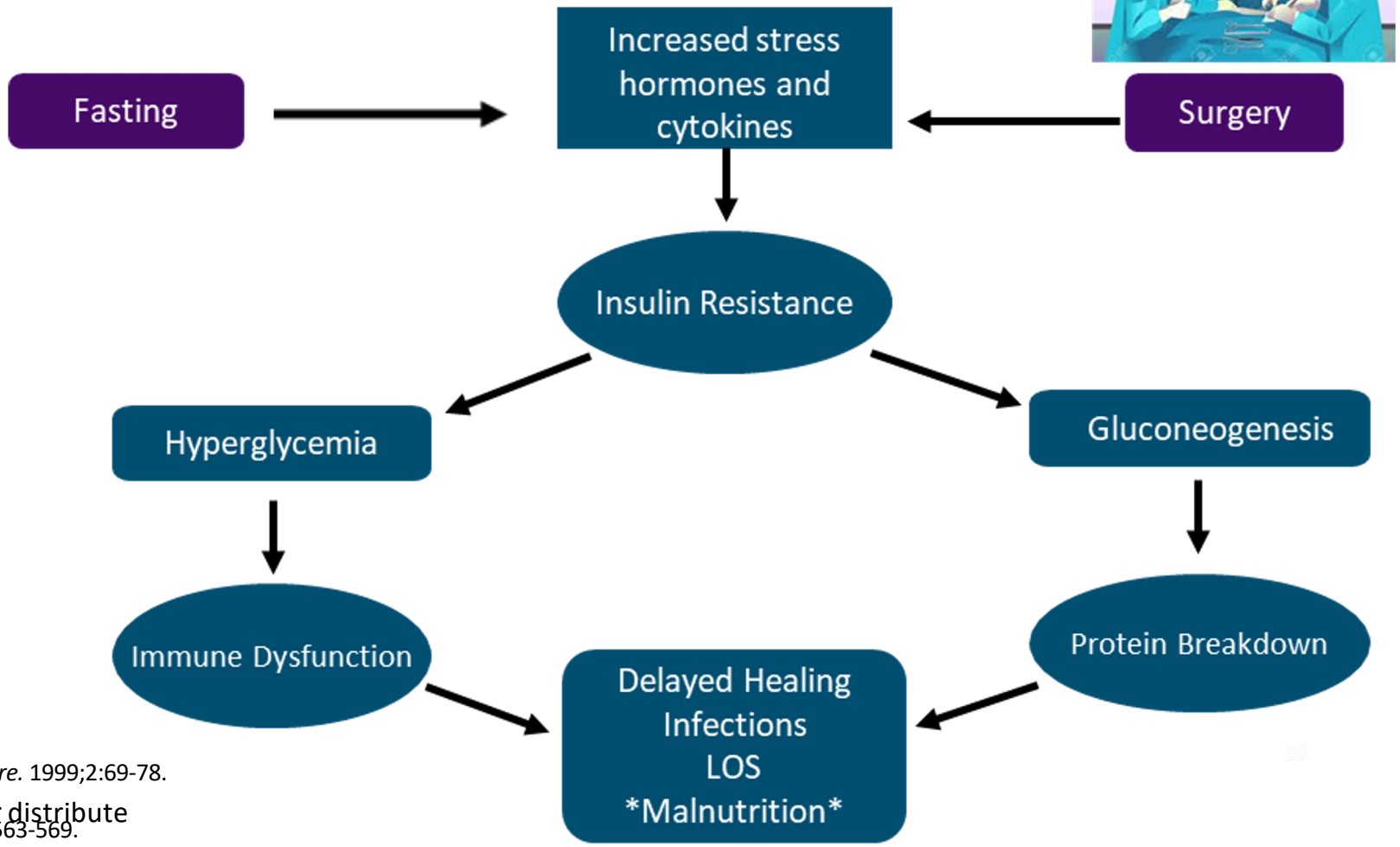
- Perioperative care programs are shown to improve outcomes after major surgery

GOALS of ERAS®[5]

- Reduce the surgical stress response to improve postoperative function and recovery
- Shorten hospital LOS and reduce complications
- Preserve muscle mass[2]

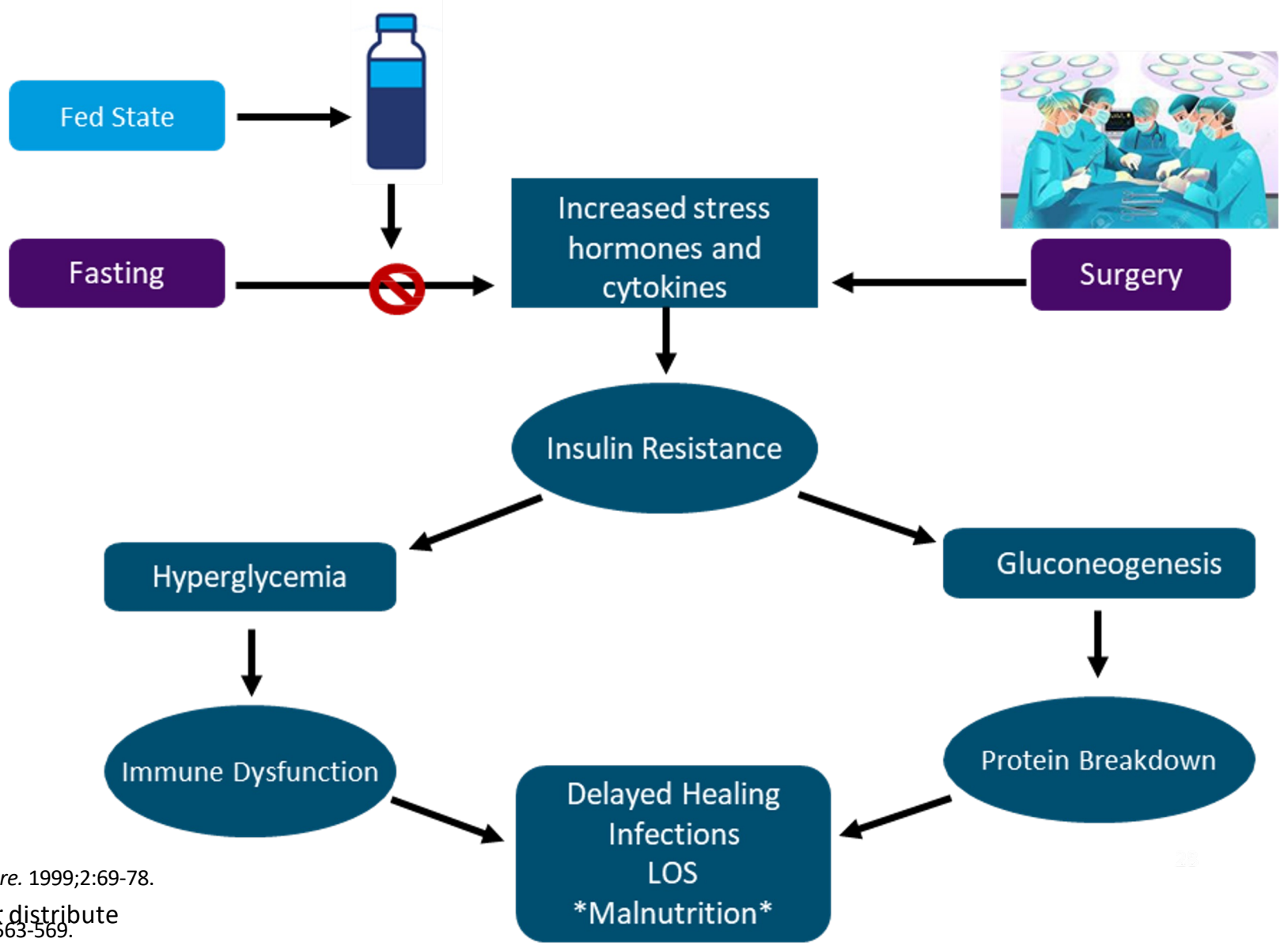
1. www.erassociety.org Accessed September 13, 2024.
2. Huang J. *J Anesth PerioperMed*. 2014;1:50-56.
3. Wischmeyer PE, et al. *Anesth Analg*. 2018;126(6):1883-1895.
4. Ljungqvist O. *JPEN J Parenter Enteral Nutr*. 2014;38(5):559-566.
5. Yuill KA, et al. *Clin Nutr*. 2005;24(1):32-37.

Carbohydrate Loading Reduces Stress Hormones and Cytokines[1-3]



1. Thorell A, et al. *Curr Opin Clin Nutr Metab Care.* 1999;2:69-78.
2. Ljungqvist O, et al. *Scand J Nutr.* 2000;44:3-7.
3. Noblett SE, et al. *Colorectal Disease.* 2006;8:563-569.

Carbohydrate Loading Reduces Stress Hormones and Cytokines[1-3]



1. Thorell A, et al. *Curr Opin Clin Nutr Metab Care.* 1999;2:69-78.
2. Ljungqvist O, et al. *Scand J Nutr.* 2000;44:3-7.
3. Noblett SE, et al. *Colorectal Disease.* 2006;8:563-569.

Example Carbohydrate Loading Protocol

WHAT:

~400 mL of ~12.5% complex carbohydrate (50 g dose), lower osmolality compared to typical sports drink

WHEN/HOW:

- Night before surgery, before bedtime within fasting window: 100 g complex carbohydrate (~800 mL)
- Day of: 50 g complex carbohydrate (~400 mL)
  - 2-3 h before anesthesia
  - Orally consumed within 5-10 minutes (not sipped over time)

Arginine Promotes Blood Flow and Protein Production[1]

- **Stimulant for Wound Healing[2]**
  - Serves as an intermediate amino acid during proline synthesis, which is required for collagen synthesis
- **Nitric Oxide Production for Intracellular Signaling[3]**
  - Vasodilates blood vessels
  - Increases vascular permeability
- **Supports Immune Function[3]**
  - Is directly bactericidal
  - Used by macrophages and leukocytes to destroy pathogens

1. Mitchell KW, et al. *Clin Nutr*. 2017;36(6): 1573-1579.
2. Rosenthal MD, et al. *Int J Crit Care Emerg Med*. 2016;2(2):2474-3674.
3. Patel JJ, et al. *Nutr Clin Pract*. 2016;31(4):438-444.

Ramifications of Arginine Deficiency

Arginine production and availability are greatly reduced in critically-ill septic patients.[1-2]

Arginine deficiency leads to T-Lymphocyte suppression[3]

- Recurrent nosocomial infections
- Poor wound healing
- Skewed inflammatory markers

Critical illness leads to perpetual energy depletion[3]

- 2 molecules of adenosine triphosphate for every 1 arginine replenished[3]
  - With nutrition supplementation this could be reversed allowing body to conserve its energy for other vital needs.[3]

1. Luiking YC, et al. *Amer J Clin Nutr.*, 2009; 142-152.
2. Deutz NEP, et al. *Clin Nutr*. 2021;40(5):2876-2897.
3. Rosenthal MD, et al. *Int J Crit Care Emerg Med.* 2016;2(2):2474-3674.

Specific Nutrients for Skin Integrity and Wound Healing

Nutrient	Role in Skin Integrity and Healing	Recommended or Suggested Daily Intake	Proposed Benefit
Calories	Energy source	30–35 kcal/kg body weight[1]	Provide energy; preserve lean body mass (LBM)
Protein	Tissue maintenance and repair	1.2–1.5 g/kg body weight[1]	Builds LBM. Supports new tissue growth and strength
Collagen	Tissue maintenance and repair	No specific daily recommended amount	Stimulates internal collagen production
Arginine	Regulates many metabolic and physiologic functions involved in wound healing and tissue repair	17 - 24 g of arginine per day is suggested to provide benefits for wound healing[2]	Supports protein synthesis needed for wound healing
Glutamine	Tissue repair and cell proliferation	0.57 g/kg is the daily suggested maximum[2]	Supports protein synthesis and offsets muscle glutamine depletion
HMB	May inhibit breakdown of LBM	3 g CaHMB, along with arginine and glutamine, support collagen deposition[3]	Helps maintain and rebuild lean body mass

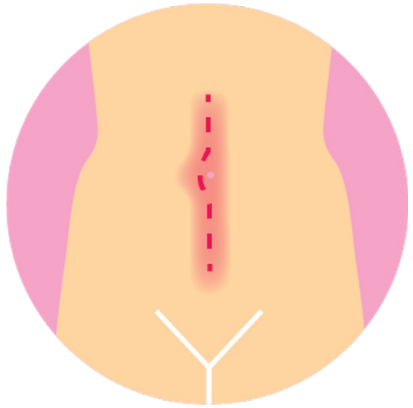
1. European Pressure Ulcer Advisory Panel, National Pressure Ulcer Advisory Panel and Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline. The International Guideline. Emily Haesler (Ed.) EPUAP/NPIA/PPPIA: 2019.
2. Molnar JA: Nutrition and Wound Healing. *CRC Press*. 2007.
3. Williams JZ, Abumrad N, Barbul A. *Ann Surg*. 2002;236:369-74.

Specific Nutrients for Skin Integrity and Wound Healing

Nutrient	Role in Skin Integrity and Healing	Recommended or Suggested Daily Intake	Proposed Benefit
Vitamin B12	Role in maintenance of red blood cells and connective tissue	RDA=2.4 mcg/day for males and females; UL=not established[1] Supplement if deficient.	Increased tensile strength of wounds during the early phases of wound healing
Vitamin C	Connective tissue, collagen synthesis and tensile strength.	RDA=90 mg/day for males; 75 mg/day for females; UL=2000 mg/day[2] Supplement if deficient.	Promotes neutrophil and fibroblast activity; Hydroxylation of proline and lysine
Vitamin E	Antioxidant	RDA=15 mg/day for males and females; UL=1000 mg/day[2] Supplement if deficient.	Quenches free radicals and helps maintain membrane integrity
Zinc	Cell mediated immunity and anti-oxidant	RDA=11 mg/day for males; 8 mg/ day for females; UL=40 mg/day[3] Supplement if deficient.	Cell replication and growth and protein synthesis

1. National Institutes of Health. Office of Dietary Supplements. B12 Fact Sheet for Health Professionals. Available at https://ods.od.nih.gov/factsheets/VitaminB12-HealthProfessional/ Accessed February 13, 2024.
2. Food and Nutrition Board: Institute of Medicine: Dietary Reference Intakes for Vitamin C, Vitamin E, Selenium and Carotenoids. Washington, DC, National Academies Press, 2000.
3. Food and Nutrition Board: Institute of Medicine: Dietary Recommendation Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Magnesium, Molybdenum, Nickel, Silicon, Vanadium, and Zinc. Washington, DC, National Academy Press, 2001.

Immunonutrition (IMN) in gynecological surgery for malignancy is associated with improved postoperative outcomes



78% Reduction in SSI

Compared with a standard formula, gynecologic oncology patients who received IMN supplementation perioperatively had[1]:

- Higher immunologic response via CRP and WBC in the postoperative period ($P < 0.05$)
- Lower LOS, wound infections and wound dehiscence rates ($P < 0.05$)

Among gynecologic oncology patients who underwent laparotomy, patients who received post-operative IMN ($n = 112$) had[2]:

- Fewer wound complications ($P = 0.049$) associated with a 78% reduction in the incidence of CDC SSI class 2 and 3 infections (OR = 0.22, CI: 0.05 - 0.95, $P = 0.044$) compared to standard diet ($n = 226$)

1. Celik JB, et al. *Eur J Gynaec Oncol*. 2009;30(4):418-421.
2. Chapman JS, et al. *Gynec Oncol*. 2015;137:325-328.

SSI: Surgical Site Infections
CDC: Centers for Disease Control
CRP: C-reactive protein
WBC: White blood cell count

Preoperative Oral Arginine and Glutamine are Associated with Decreased Fistula Recurrence, Infectious Complications, and Postoperative Inflammation

Objective:

- To determine the effect of preoperative enteral glutamine and arginine in the surgical repair of enterocutaneous fistula (ECF)

Design:

- A prospective, randomized trial (n=40)
  - **The experimental group** (n=20) received the standard of care and supplemental arginine (4.5 g) and glutamine (10 g) preoperatively for 7 days
  - **The control group** (n=20) received the standard of care

Primary endpoint: ECF recurrence

Secondary endpoints: serum concentrations of interleukin-6, serum C-reactive protein, and infectious complications (urinary tract infection, central line infection, and bacteremia)

Martínez JL, et al. *J Gastrointest Surg*, 2020;24(2):426-434.

Preoperative Oral Arginine and Glutamine are Associated with Decreased Fistula Recurrence, Infectious Complications, and Postoperative Inflammation

Selected Results:

	Control Group (n=20)	Experimental group (n=20)	P-value for Univariate Analysis
Fistula recurrence	9	2	**0.031**
Infectious complications	6	0	**0.026**
Number of infectious complications	13	0	**0.000**
Postoperative stay	90.0 (148.8)	15.1 (6.88)	**0.028**
Death	2	1	**1.000**

Supplemental arginine and glutamine showed significant differences in IL-6 and CRP when compared to the control group the day before definitive surgery (P<0.05) and on postoperative days 1,3 and 7 (P<0.01)

Martínez JL, et al. *J Gastrointest Surg*. 2020;24(2):426-434.

IL-6 Interleukin-6
CRP – C-reactive protein

Perioperative immunonutrition (IMN) is associated with better outcomes vs. standard nutrition[1]

Meta-Analysis	# RCTs	Surgery	Outcomes
Zheng, et al. 2007	13	GI	? Post-op infections, ☐ LOS, ☐Lymphocyte ct,☐IL-6
Drover, et al. 2011	35	GI, Cardiac, Head & Neck	☐Post-op infections, ☐ LOS
Waitzberg, et al. 2006	17	GI, Cardiac, Head & Neck	☐Post-op infection, ☐LOS, ☐anastomotic leaks
Marik, et al. 2012	21	GI	☐Post-op infections, ☐LOS
Cerantola, et al. 2011	21	GI	☐overall complications, ☐postop infections, ☐LOS (not pre-op)
Marimuthu, et al. 2012	26	GI	☐Infectious complications, ☐non-infectious complications (post-op); ☐LOS (peri-op+post-op)
Zhang, et al. 2012	19	GI	☐Postop infections, ☐LOS, ☐non-infectious complications (IMN peri-op)
Osland, et al. 2014	21	GI	☐Post-op infections, ☐LOS (peri-op+post-op); ☐non-infectious complications (post-op); ☐ anastomotic leaks (peri-op)
Hegazi, et al. 2014	15	GI	No effect on post-op infections or LOS

1. Modified from Bharadwaj S, et al. *Gastroenterology Report.* 2016;4(2):87-95.

Impact of an Interdisciplinary Malnutrition Quality Improvement Project at a Large Metropolitan Hospital

The objective of this project was to make a series of institution-wide care improvements for patients who are malnourished or at risk of malnutrition to reduce LOS, infection rates, and 30-day hospital readmissions.

Use of the MQii toolkit among patients with/at risk for malnutrition led to:

25% overall reduction in LOS for malnourished/ at-risk patients (from 8 days to 6 days, $P < 0.01$)

35.7% decline in infection rates among malnourished patients (from 14 to 9%, $P < 0.01$)

No significant difference between pre- and post-intervention groups for 30–60-day readmission rates. ($P = 0.58$)

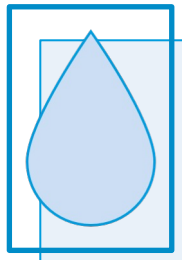
The staff and researchers believe that the QI infrastructure provided by this focus on malnutrition care not only showcased the improvement in malnutrition care gaps, but also resulted in creating an environment that will ensure the uptake and adoption of future nutrition-focused initiatives across delivery settings.

Pratt KJ, et al. *BMJ* Open Qual. 2020 Mar;9(1):e000735.

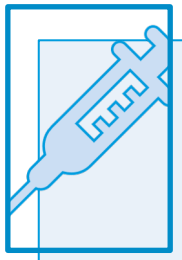
Nutrition Interventions for Special Populations

Characteristics Associated with Higher Odds of Surgical Complications[1-10]

Frailty[1,2]



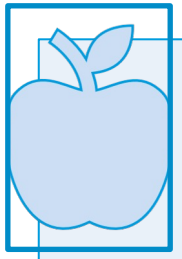
Anemia[3]



Hyperglycemia[4,5,6]

Smoking[7,8,9]

Low albumin <32.6 g/L[10]



Malnutrition[10]

Traumatic injury and ASA ≥ 3[10]

1. McIsaac DI, er al. Anesth Analg. 2017 May;124(5):1653-1661.
2. Choi JY, et al. J Am Coll Surg. 2015; 221:652-60
3. Thome S, et al. HPB 2016:255–261
4. Kwon S, et al. Ann Surg. 2013;257:8–14
5. Kotagal M, et al. *Ann Surg*. 2015;261:97–103.
6. Duggan EW, et al. *Curr Diab Rep*, 2016;16: 34
7. Wong J, et al. Anesth Analg. 2018;
8. Thomsen T, Villebro N, Møller AM. Cochrane Database Syst Rev. 2014
9. Saxony J. J Surg Res 2017
10. Ren M, et al. Geriatr. Gerontol. Int. 2018;1–5.

Evidence-Based Guidelines Supporting the Use of Oral Nutrition Supplements (ONS) for Malnutrition & Nutrition Risk

Society/Organization	Guideline
ESPEN Practical Guideline: Clinical Nutrition and Hydration in Geriatrics[1]	"Hospitalized older persons with malnutrition or at risk of malnutrition shall be offered ONS, in order to improve dietary intake and BW and to lower the risk of complications and readmission." "After discharge from the hospital, older persons with malnutrition or at risk of malnutrition shall be offered ONS in order to improve dietary intake and BW and to lower the risk of functional decline."
ESPEN Guideline on Nutritional Support for Polymorbid Medical Inpatients[2]	"In polymorbid medical inpatients who are malnourished or at high risk of malnutrition and can safely receive nutrition orally, ONS shall be offered as cost-effective way of intervention towards improved outcomes."
ESPEN Practical and Partially Revised Guideline: Clinical Nutrition in the Intensive Care Unit[3]	"In non-intubated patients not reaching the energy target with an oral diet, oral nutritional supplements should be considered first and then EN."

BW: Body Weight **EN:** Enteral Nutrition **ESPEN:** European Society for Clinical Nutrition and Metabolism

1. Volkert D, et al. ESPEN guideline on clinical nutrition and hydration in geriatrics. *Clin Nutr*. 2022;41:958-989.
2. Wunderle C, et al. ESPEN guideline on nutrition support for polymorbid internal medicine patients. *Clin Nutr*. 2023;42:1545-1568.
3. Singer P, et al. ESPEN practical and partially revised guideline: Clinical nutrition in the intensive care unit. *Clin Nutr*. 2023;42:1671-1689.

Evidence-Based Guidelines Supporting the Use of Oral Nutrition Supplements (ONS) for Malnutrition & Nutrition Risk cont'd

Society/Organization	Guideline
KDOQI Clinical Practice Guideline for Nutrition in CKD[1]	"In adults with CKD 3-5D or posttransplantation at risk of or with protein-energy wasting, we suggest a minimum of a 3-month trial of oral nutritional supplements to improve nutritional status if dietary counseling alone does not achieve sufficient energy and protein intake to meet nutritional requirements."
National Institute for Health and Care Excellence (UK): NICE Guidance[2]	"Healthcare professionals should consider oral nutrition support to improve nutritional intake for people who can swallow safely and are malnourished or at risk of malnutrition [...]"
NPIAP: Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guideline[3]	"Offer high calorie, high protein fortified foods and/or nutritional supplements in addition to the usual diet for adults who are at risk of developing a pressure injury and who are also malnourished or at risk of malnutrition, if nutritional requirements cannot be achieved by normal dietary intake."
American Society for Enhanced Recovery and Perioperative Quality Initiative Joint Consensus Statement on Nutrition Screening and Therapy within a Surgical Enhanced Recovery Pathway[4]	"We recommend patients who are screened as being at nutritional risk before major surgery receive preoperative ONSs for a period of at least 7d." "We recommend posthospital high-protein ONS in all patients after major surgery to meet both calorie and protein needs, especially in the previously malnourished, elderly and sarcopenic patient."

CKD: Chronic Kidney Disease **KDOQI:** Kidney Disease Outcomes Quality Initiatives **NICE:** National Institute for Health and Care Excellence **NPIAP:** National Pressure Injury Advisory Panel **ONS:** Oral Nutrition Supplement

1. Ikizler TA, Burrowes JD, Byham-Gray LD, et al; KDOQI Nutrition in CKD Guideline Workgroup. KDOQI clinical practice guideline for nutrition in CKD: 2020 update. *AM J Kidney Dis*. 2020;76(3)(suppl 1):S1-S107.
2. Nutrition support for adults: oral nutrition support, enteral tube feeding and parenteral nutrition – Clinical Guidance [CG32]. National Institute for Health and Care Excellence. Updated August 7, 2017. Accessed March 16, 2024. https://www.nice.org.uk/guidance/cg32/chapter/Recommendations#oral-nutrition-support-in-hospital-and-the-community
3. European Pressure Ulcer Advisor Panel, National Pressure Injury Advisory Panel and Pan Pacific Pressure Injury Alliance. Prevention and Treatment of Pressure Ulcers/Injuries: Clinical Practice Guidelines. Emily Haesler (Ed.). EPUAP/NPIAP/PPPIA: 2019.
4. Wischmeyer PE, et al; American Society for Enhanced Recovery and Perioperative Quality Iniatitive Joint Consensus Statement on Nutrition Screening and Therapy within a Surgical Enhanced Recovery Pathway. *Anesth Analg*. 2018;126(6):1883-1895.

AND: Evidence-based Nutrition Practice Guidelines – Malnutrition in Older Adults

Summary of Recommendations:

	• Use a validated screening tool to identify nutritional risk
	• Consider food fortification to improve intake and nutritional status
	• Recommend home-delivered meals and referrals to congregate meal sites for older adults living in the community, especially those considered malnutrition or at risk
	• Incorporate oral nutrition supplements (ONS) as part of an individualized and comprehensive nutrition intervention for older adults with malnutrition risk discharged from acute care to the community
	• Offer ONS 1 – 2 times per day to meet caloric and protein deficits
	• Include a registered dietitian at every level of care (i.e., acute care discharge, community)

AND: Academy of Nutrition and Dietetics | ONS: Oral Nutrition Supplement

Academy of Nutrition and Dietetics. Malnutrition in Older Adults. Accessed April 7, 2024. https://www.andeal.org/topic.cfm?menu=6064

Trauma and Wound Complications

$37B

The annual cost of national inpatient trauma care is estimated at $37 billion.[1-2]

10-30%

Approximately 10% of trauma patients develop wound infections, increasing to 30% among those who spend >48 hours in the ICU.[3]

10%

Infections are the leading cause of late organ failure and potentially contribute to 10% of all trauma-related deaths.[3]

Wound healing is a physiological process required for maintenance of an intact skin barrier. The role of nutrition, both in promoting healing and avoiding complications associated with trauma, has long been acknowledged in acute care surgery; however, it is often neglected.[3]

B: Billion

1. Knowlton LM & Haut ER. *JAMA Netw Open*. 2023;6(1):e2252526. doi:10.1001/jamanetworkopen.202252526. 2. Velopulos CG, et al. *J Surg Res*. 2013;184(1):444-449. 3. Ochoa JB. *Nestle Nutr Inst Workshop Ser*. 2013;77:29-45.

Critical Care Guidelines[1]

SURGICAL SUBSETS

TRAUMA

M1b: Use of immune-modulating formulations containing arginine and FO is suggested for patients with severe trauma

POSTOPERATIVE SICU

O3: Suggest use of an immune-modulating formula [containing both arginine and fish oils] for the postoperative patient requiring EN therapy

PERIOPERATIVE SICU

E2, O3: Immune-modulating formulations [arginine with other agents including EPA, DHA, glutamine, nucleic acid] should be considered perioperatively for SICU patients

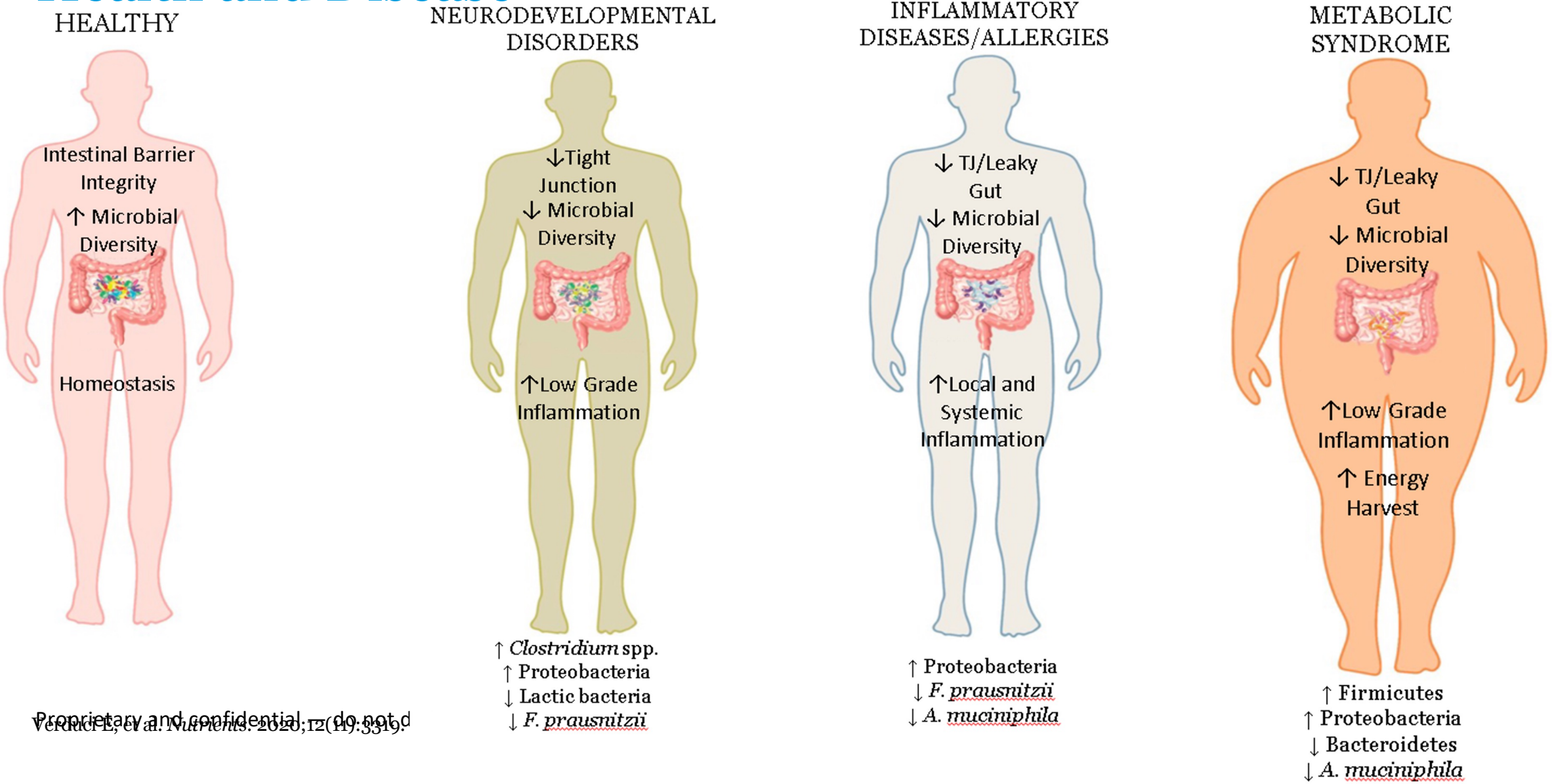
TRAUMATIC BRAIN INJURY (TBI)

E2, M2b: In patients with TBI, consideration of immune-modulating formulations [arginine with other agents including EPA, DHA, glutamine, nucleic acid] is suggested

2016 SCCM/ASPEN Critical Care Nutrition Support Therapy Guidelines.
1. McClave SA, et al. *JPEN J Parenter Enteral Nutr.* 2016;40(2):159-211.

Abbott

Variations in Gut Integrity and Microbial Signatures in Health and Disease



Verduci E, et al. *Nutrients*. 2020;12(11):3319.

Dietary Fiber And Enteral Feeding Intolerance And Clinical Outcomes In Patients With Critical Illness

Design

Meta-analysis of 13 RCTs (n = 709) on the association between fiber-containing enteral feeding with enteral feeding intolerance and hospital outcomes in patients with critical illness

Incidence of Diarrhea
$P < 0.001$
OR: 0.46; 95% CI, 0.30-0.69

Incidence of Regurgitation
$P = 0.001$
OR: 0.28; 95% CI, 0.13-0.6

Incidence of Vomiting
$P = 0.03$
OR: 0.4; 95% CI, 0.17-0.92

Incidence of Constipation
$P < 0.001$
OR: 0.21; 95% CI, 0.09-0.47

Time to meet full EN
$P = 0.04$
MD: -2.08; 95% CI, -4.05--0.12

Duration of Hospital & ICU LOS
$P < 0.00001$
MD: -5.15; 95% CI, -6.81- -3.48

Mortality
$P = 0.031$
MD: 0.34; 95% CI, 0.13 - 0.91

Liu1, et al. *Intensive Crit Care Nurs*. 2023;74:103326.

Beneficial Effects of Prebiotics on GI Health[1-2]

"A dietary prebiotic is a selectively fermented ingredient that results in specific changes, in the composition and/or activity of the gastrointestinal microbiota, thus conferring benefit(s) upon host health."[1]

Prebiotics expand the growth/activity of beneficial bacteria resulting in:[2]

- Inhibition of growth of exogenous and/or harmful bacteria
- Stimulation of immune functions
- Aid in digestion and/or absorption of food ingredients/minerals
- Synthesis of vitamins

1. Roberfroid MB, et al. *Br J Nutr.* 2010.
2. Gibson GR, Roberfroid MB. *J Nutr.* 1995.

Use of Arginine/Glutamine/HMB in Surgical Recovery

Malafarina, et al. 2017[1]

- HMB-enriched ONS BID in elderly patients with **sarcopenia**, **post hip fracture.**
- BMI and appendicular lean mass stable in HMB group while these parameters decreased in the control group (standard diet).
- Concentration of proteins and vitamin D increased more in the HMB group vs. the control group.

Nishizaki, et al. 2015[2]

- ARG/GLN/HMB drink BID x 5d pre-op + 28d post Elective **TKA**
- Quadriceps muscle strength was maintained in TKA patients receiving the intervention drink
- Counterparts receiving orange juice placebo had significant reduction in muscle strength between preop and 14 days

Norouzi, et al. 2022[3]

- ARG/GLN/HMB BID x 30d preop **cardiac surgery**
- SOFA score lower in AA group (2 vs. 5); lower levels of cTN, CPK-MB, and bilirubin
- LOS ~1 day shorter in AA group
- Preop "supplementation with ARG/GLN/HMB enhances the recovery, reduces myocardial injury and decreases time in hospital"

Hendrickson, et al. 2022[4]

- **Pelvic and extremity fractures**; CEAAs BID (Juven) x 2 weeks vs. standard nutrition control
- CEAA group had lower overall complications vs. control
- Fat free mass decreased significantly at 6 weeks in control (-9 kg, p = 0.025) vs. maintenance in CEAA subjects (NS)

1. Malafarina V, et al. *Maturitas.* 2017; 101:42-50. 2. Nishizaki K, et al. *Asia Pac J Clin Nutr.* 2015;24(3):412-420. 3. Norouzi M et al. *Trials.* 2022;23:649. 4. Hendrickson NR, et al. *J Bone Joint Surg Am.* 2022;104(9):759-766. **AA:** Amino acid **ARG:** Arginine **BMI:** Body Mass Index **CEAA:** Conditionally essential amino acid **GLN:** Glutamine **HMB:** beta-Hydroxy-beta-methylbutyrate **ONS:** Oral Nutrition Supplement **TKA:** Total Knee Arthroplasty

From Publication to Practice: Application of the Evidence

Example Pathway: Perioperative Nutrition*

NUTRITION TO HELP YOU PREPARE FOR AND RECOVER FROM SURGERY

1 PREOPERATIVE

Immunonutrition

Ensure® Surgery immunonutrition shake

2-3 shakes/day
for 5-7 days before surgery

2 SURGERY

Carbohydrate loading

Ensure® Pre-Surgery clear carbohydrate drink

2 bottles *the night before surgery, before bedtime within fasting window*
1 bottle *up to 2 hours before surgery*

3 POSTOPERATIVE

Immunonutrition

Ensure® Surgery immunonutrition shake

2 shakes/day
for 5-7 days after surgery

4

Targeted nutrition

Juven® targeted nutritional therapy

2 packets/day
for continued recovery

PIVOT® 1.5 CAL

For patients requiring tube feeding, Pivot® 1.5 Cal may be used as a source of perioperative immunonutrition.

Use under medical supervision.

* Two servings of Juven® daily provide a recommended level of HMB.

Juven® : Therapeutic Nutrition for Wound Healing

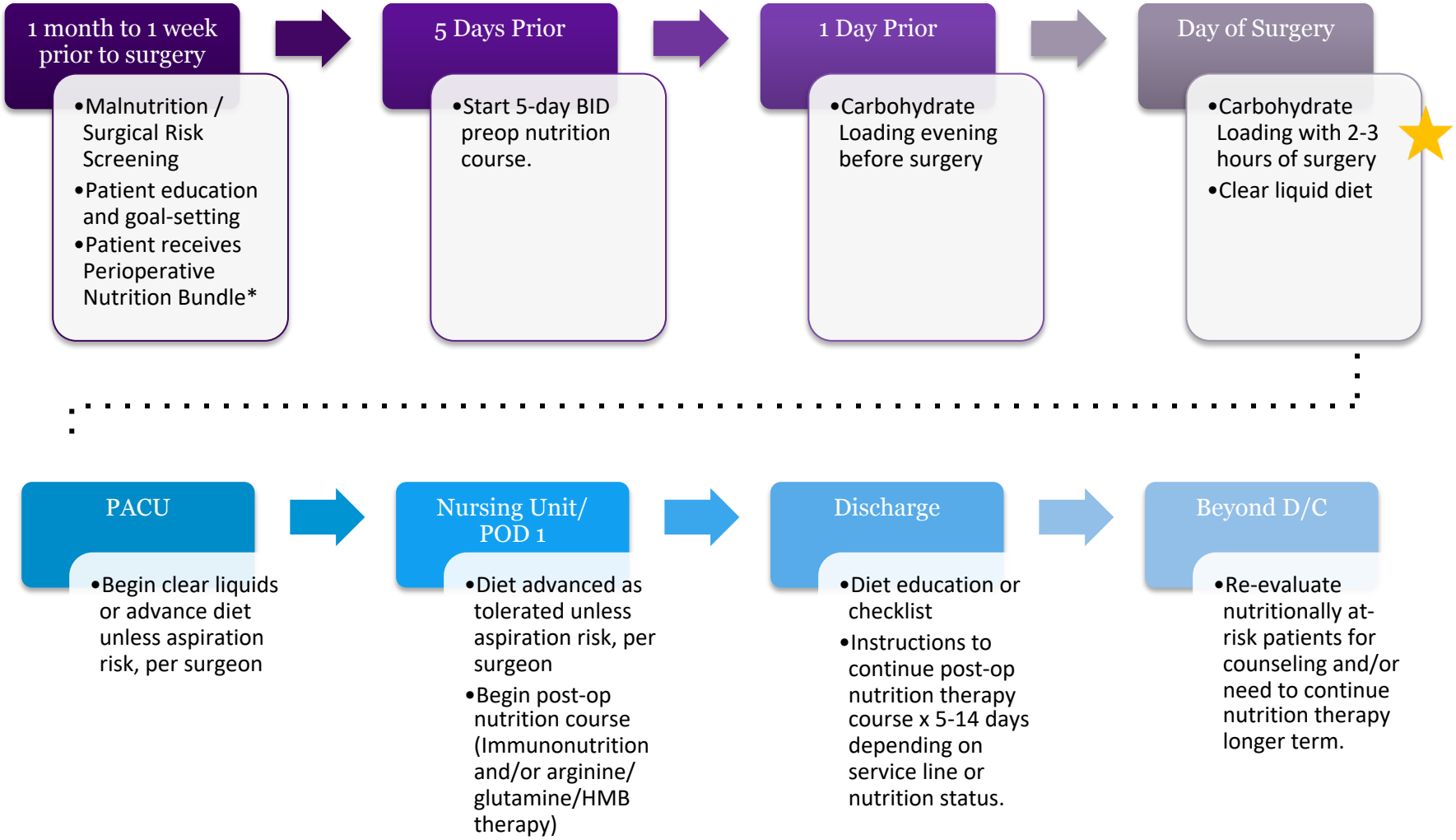
- Clinically shown to support wound healing by enhancing collagen production in as little as 2 weeks,[1,3]
- Clinically shown to build lean body mass in 4 weeks‡,[2]
- Formula Includes
  - Arginine
  - Glutamine
  - HMB
  - Hydrolyzed collagen protein
  - Micronutrients

Use under medical supervision in addition to a complete, balanced diet

‡ In patients with cancer cachexia.

1. Williams JZ, et al. Ann Surg. 2002:236:369-375.
2. May PE, et al. Am J Surg. 2002;183:471-479.
3. Jones MS, et al. Surgical Infections 2014; 15(6):. 708-712

Example Surgical Patient Journey: Perioperative Nutrition

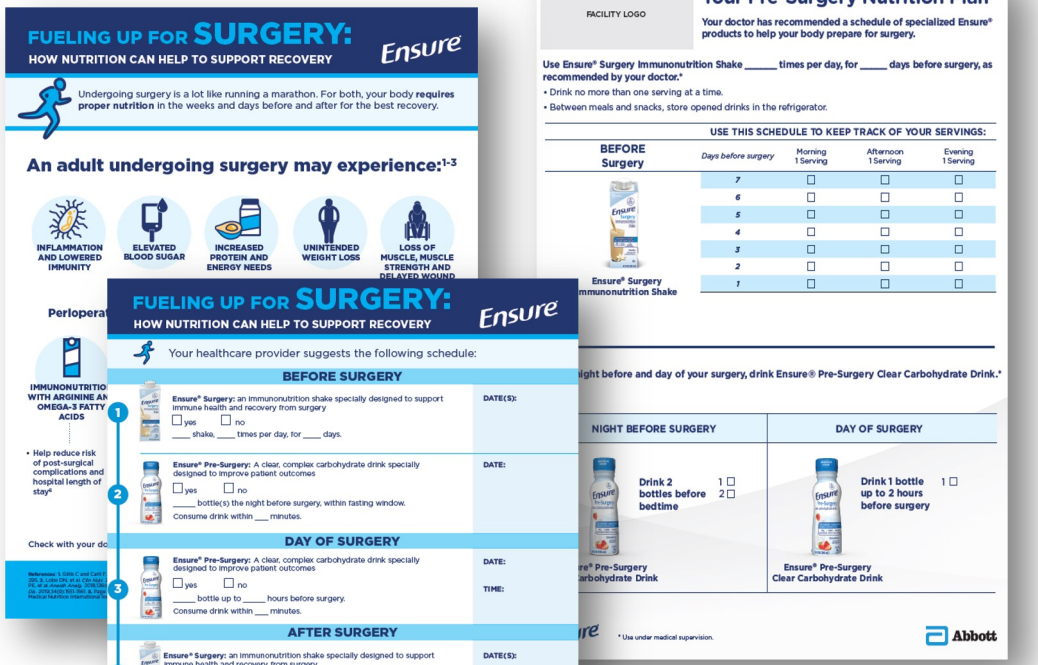


* Depending on surgical service line, perioperative nutrition bundle may include carbohydrate loading, immunonutrition or high-protein beverage, and/or amino acid therapy

★ Emergent Surgery pathway begins here

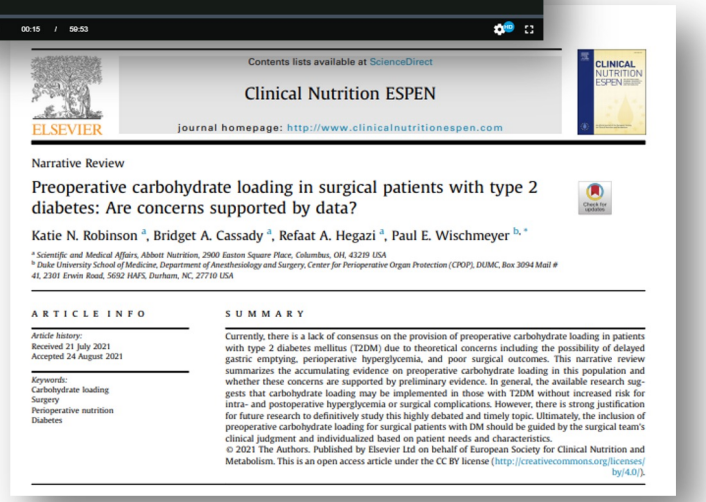
Resources – Perioperative Nutrition

Patient Education



Access & Coupons

Provider Resources



Summary & Next Steps

Malnutrition and deconditioning are prevalent in patients undergoing various types of elective and even emergent surgery.[1]

Preoperative carbohydrate loading is associated with reduced postoperative insulin resistance, decrease LOS, and improve patients' well-being pre- and postoperatively.[1]

Investing in a perioperative QI program has been associated with significant savings associated with reduced LOS and reduced complications, as well as improving upon patient-centered outcomes and patient satisfaction.[1-3]

Studies incorporating *arginine, glutamine, and HMB* as part of a comprehensive perioperative intervention demonstrated improvements in functional status and complications (wound healing, infectious, etc.).[2-5]

Consider evaluating current order sets & perioperative pathways for inclusion of evidence-based nutrition.

1. Wischmeyer PE, et al. American Society for Enhanced Recovery and Perioperative Quality Iniatitive Joint Consensus Statement on Nutrition Screening and Therapy within a Surgical Enhanced Recovery Pathway. *Anesth Analg*. 2018;126(6):1883-1895.
2. Shafrin J, et al. *Clinicoecon Outcomes Res*. 2023; 15:753-764.
3. Pratt KJ, et al. *BMJ* Open Qual. 2020 Mar;9(1):e000735.
4. Hendrickson NR, et al. J Bone Joint Surg Am. 2022;104(9):759-766.
5. Norouzi M et al. Trials. 2022;23:649.

Thank you!

For questions on data, resources, or quality improvement examples shown here, please reach out to:

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