Nestlé Nutrition Institute

SURGICAL NUTRITION INTERVENTION: STANDARD OF CARE

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Surgical Complications

The Facts

- In the US, **48%** of hospital costs are related to surgery.
- **1 in 4** colon resections is readmitted in 90 days.
- Risk of 30 day readmission after general surgery increases **4-fold** if there is a complication; **Surgical site infection** is among those most commonly sited.
- Soft tissue surgical site infections attribute to **$1.6 billion** in direct costs annually.
  - A surgical site infection on average increases the cost of hospital stay by **$20,842.**

Weiss AJ et al. *AHRQ HCUP Stat Brief #170*;Feb 2014:1-12. Eappen S et al. *JAMA* 2013;309(15):1599-1606.
Wick EC et al. Dis Colon Rectum 2011; deLissovoy G et al. *Am J Infect Control* 2009;37:387-397. Kassin et al, *J Am Coll Surg* 2012;(3)215:322-330.

CMS Initiatives

- Triple Aim
  - Better Care, Better Health, and Lower Costs Through Improvement
  - 5 components:
    - partnership with individuals and families, redesign of primary care, population health management, financial management, and macro system integration
- HAC Present on Admission Indicator
  - Hospitals will not receive additional payment for cases in which one of the listed conditions was not present on admission
- Hospital Readmissions Reduction Program (HRRP)
  - Hospitals will receive reduced payments from Medicare if they have excess readmissions within 30 days of discharge for certain diagnoses including coronary artery bypass graft (CABG) and hip replacement.

Berwick D et al. 2008. The Triple Aim: Care, Health, And Cost. *Health Affairs*, 759-69.
https://www.cms.gov/Medicare/Medicare-Fee-for-ServicePayment/HospitalAcqCond/Downloads/FY_2013_Final_HACsCodeList.pdf
https://www.federalregister.gov/articles/2015/11/24/2015-29438
https://www.cms.gov/medicare/medicare-fee-for-service-payment/acuteinpatientpps/readmissions-reduction-program.html

HAC Reduction Program

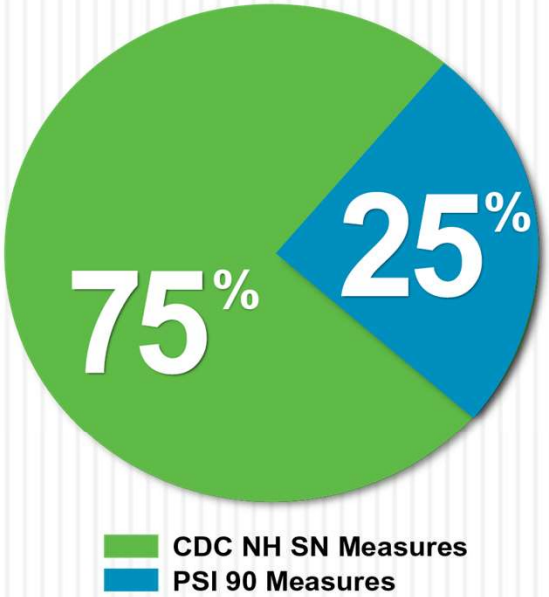
Hospitals performing in the bottom 25% have a 1% reduction in payment from CMS

Measures:

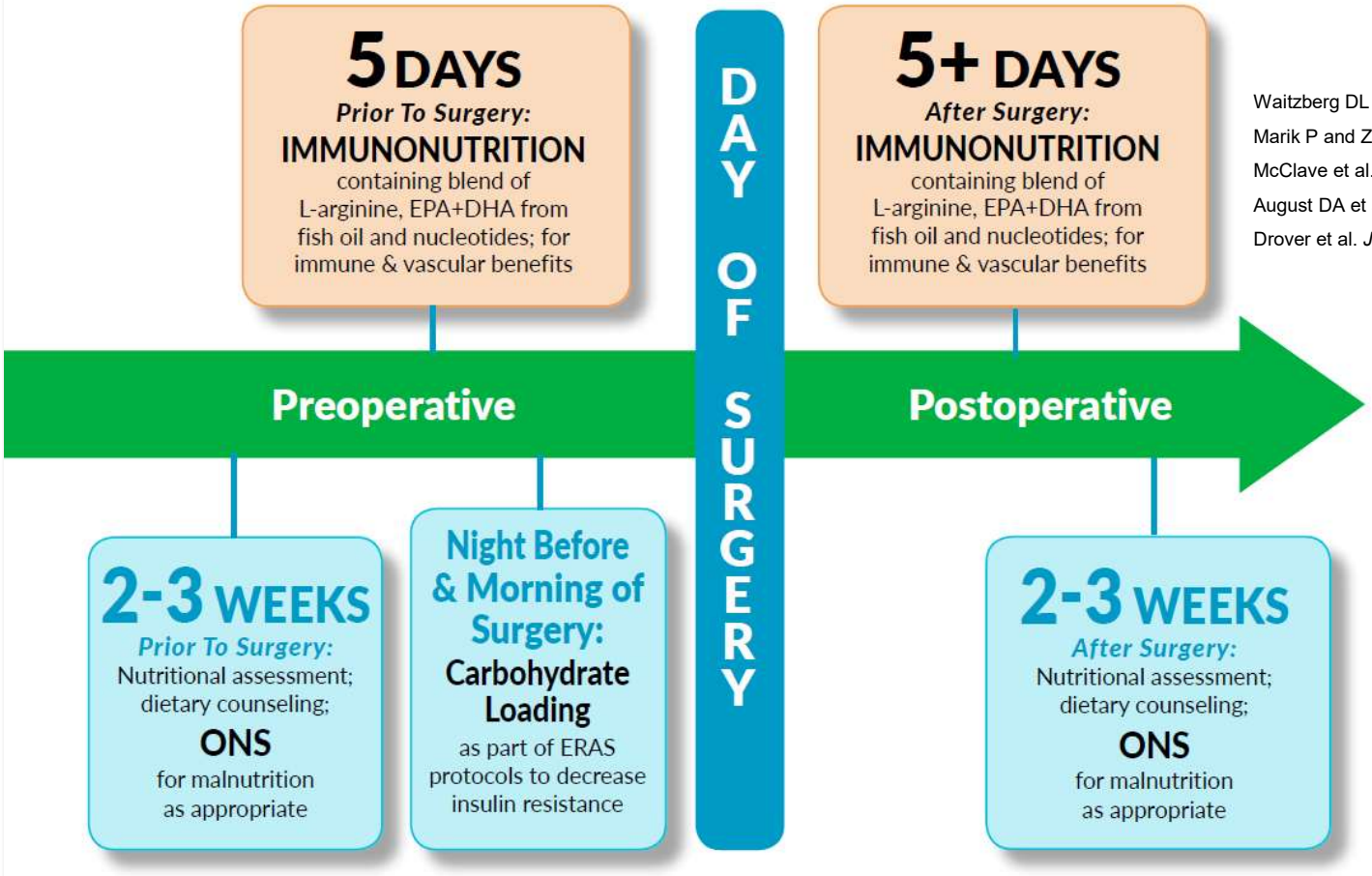
- PSI 90 Composite Measure (15 HACs)
  - Includes wound dehiscence rate
- CDC NHSN Measures
  - Central Line Associated Bloodstream Infections (CLABSI)
  - Catheter Associated UTIs (CAUTI)
  - **SSIs – colonic surgeries and abdominal hysterectomies** (added in 2016)
  - Methicillin-resistant *Staphylococcus aureus* (MRSA)
  - *Clostridium difficile* infection (CDI)

https://www.cms.gov/Medicare/Medicare-Fee-for-Service-Payment/AcuteInpatientPPS/HAC-Reduction-Program.html

WEIGHT OF MEASURES



A Timeline of Surgical Nutrition Interventions



Waitzberg DL et al. *World J Surg* 2006;30:1592-1604.
Marik P and Zaloga G. *JPEN* 2010; 34(4):378-386.
McClave et al. *JPEN* 2016;40(2):159-211.
August DA et al. *JPEN* 2009;33:472-500.
Drover et al. *J Am Coll Surg* 2011;212(3):385-399.

Today's Focus: Major Elective Surgery Consensus of Benefit for 15+ years

- Meta-analyses; Arginine-supplemented Immunonutrition
  - Heyland, JAMA 2001
  - Waitzberg, World J Surg 2006
  - Cerantola, Brit J Surg 2010
  - Marik and Zaloga, JPEN 2010
  - Drover, J Am Coll Surgeons JACS 2011
  - Marimuthu, Ann Surg 2012
  - Zhang, Surg Onc 2012
  - Osland, JPEN 2014
  - Mazaki, Ann Surg 2015
  - Wong and Aly, Int J Surg 2016

Arginine-supplemented Immunonutrition: Major Elective Surgeries Studied

- GI Cancer: Upper and Lower
- Cardiac- CABG and Valves
- Head/Neck Cancer
- Bladder Cancer
- Gyn-Onc Cancer
- Orthopedic- Hip, Knee, Shoulder
- Non-small cell Lung Cancer
- Ventral Hernia Repair

Objectives

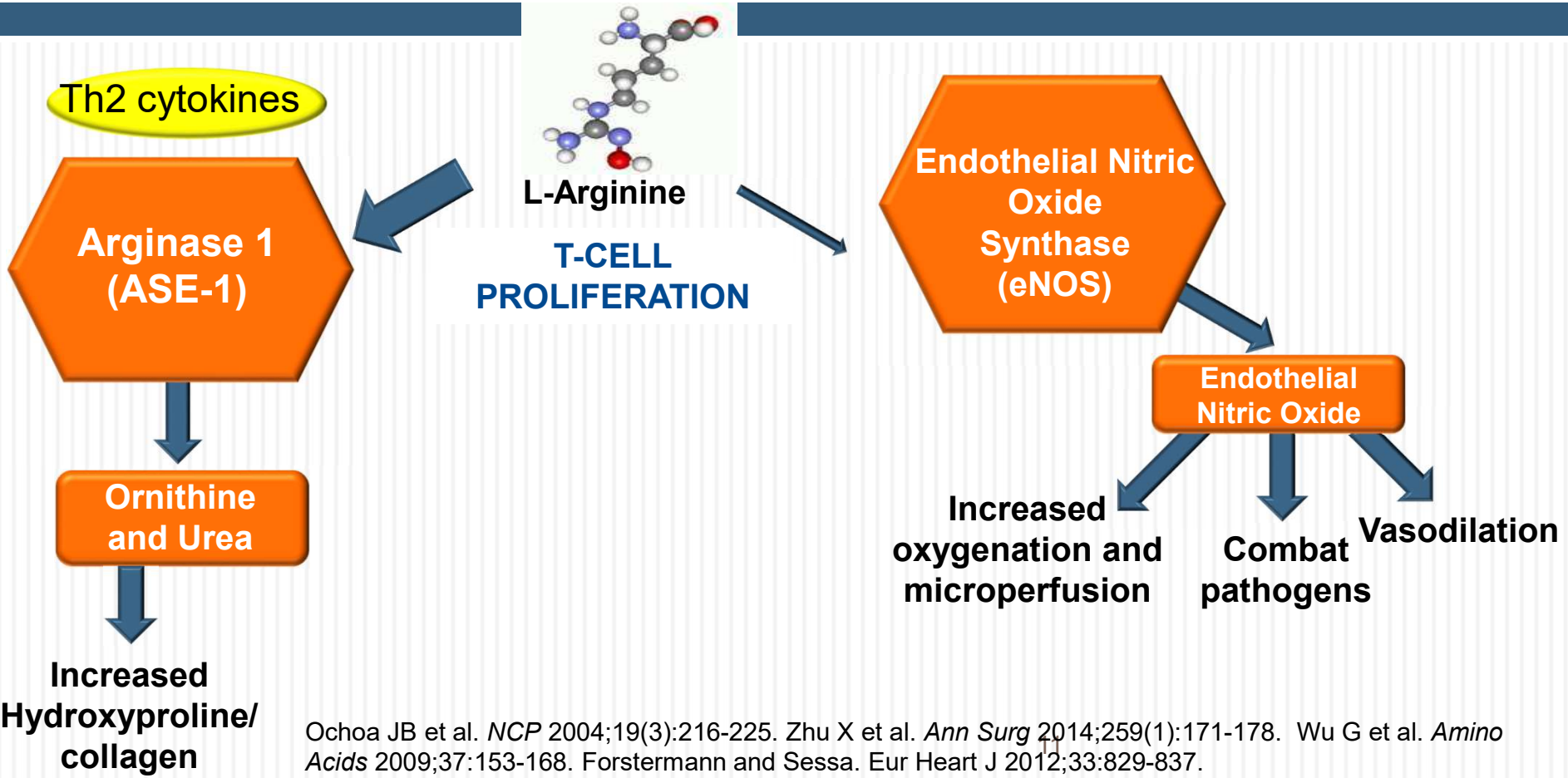
- Explain the basic science for use of supplemental immunonutrients in helping to reduce the risk of post-operative infectious complications
- Describe the clinical outcomes demonstrated in the literature when peri-operative use of arginine supplemented immunonutrition is applied in major elective surgery
- Discuss how the health economics associated with this nutrition intervention support the implementation of quality initiatives in major elective surgery

The Science behind the Standard

- Surgical trauma induces a state of Arginine Depletion
- Arginine depletion causes T lymphocyte dysfunction and effects microperfusion
- Immunonutrition intervention that includes supplemental arginine helps to restore immune function and optimize oxygen supply to the surgical wound

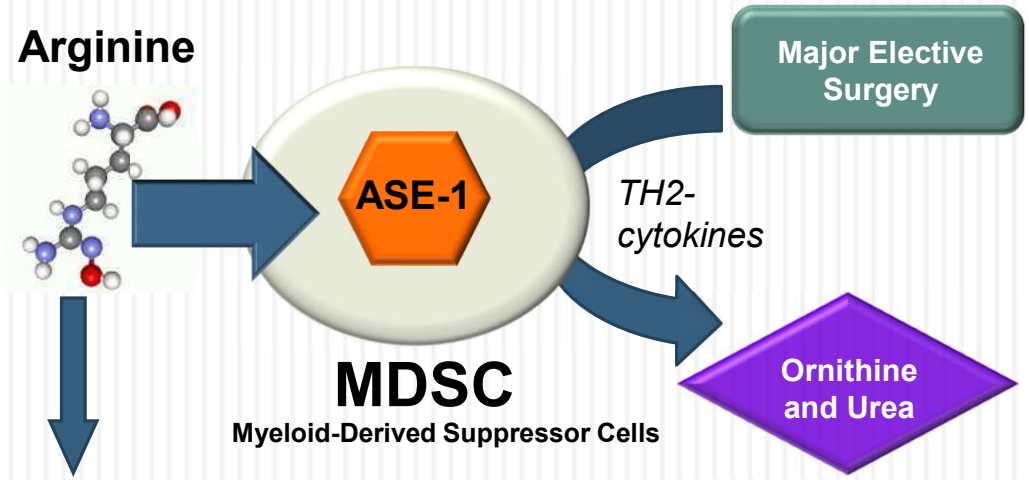
Zhu X et al. *Ann Surg* 2014;259(1):171-178.
Braga M et. al. *Surgery* 2002;132:805-14..

Arginine Metabolism after Immune Activation from Major Elective Surgery



Ochoa JB et al. *NCP* 2004;19(3):216-225. Zhu X et al. *Ann Surg* 2014;259(1):171-178. Wu G et al. *Amino Acids* 2009;37:153-168. Forstermann and Sessa. Eur Heart J 2012;33:829-837.

Arginase-1 in MDSCs Depletes Arginine after Major Surgery



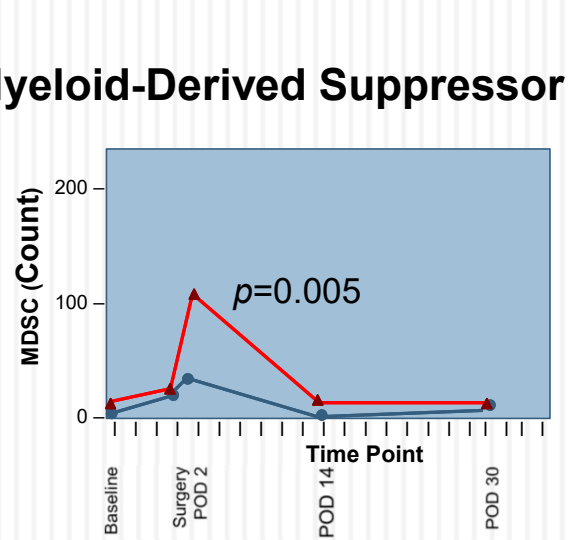
Arginine depletion =

- Increased risk of infection
- Increased risk of inadequate microperfusion

Hamilton-Reeves JM et al. *Euro Urol* 2016 69(3):389-392.
Gentile LF et al. *J Trauma Acute Care Surg* 2012;72(6):1491-1501.
Zhu X et al. *Ann Surg* 2014;259(1):171-178..
Makarenkova VP et al. *J Immun* 2006;176:2085-2094.

Effects of Peri-op Immunonutrition for Cystectomy on Immune Response and Infection Rates: A Pilot RCT

Total Myeloid-Derived Suppressor Cells



Adapted from Figure 1A

Antibiotic Use	IM	ONS
90 days	14%	53%

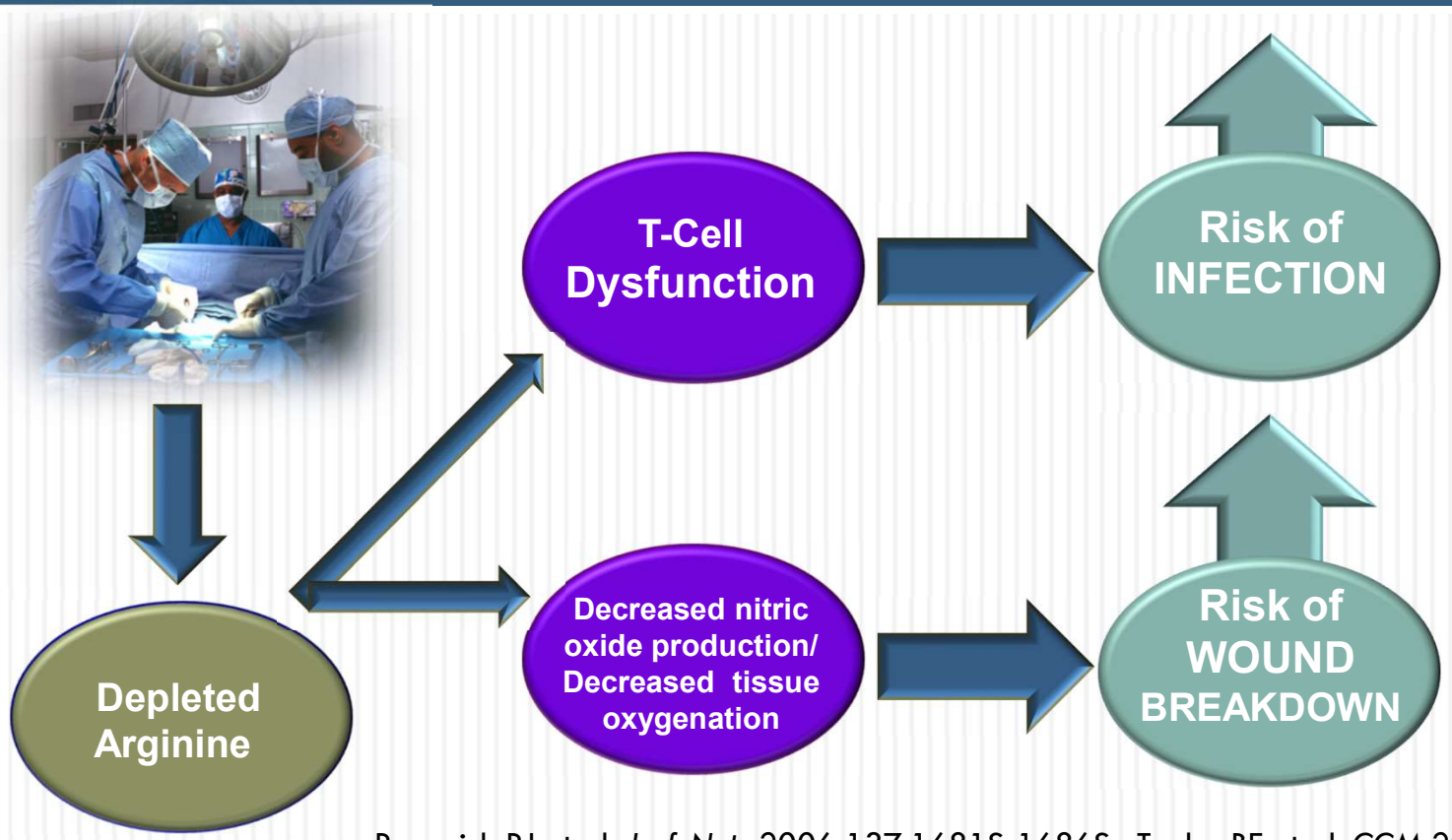
p=0.027

Adapted from Table 1

***The IM intervention contained supplemental L-arginine, fish oil, and nucleotides**

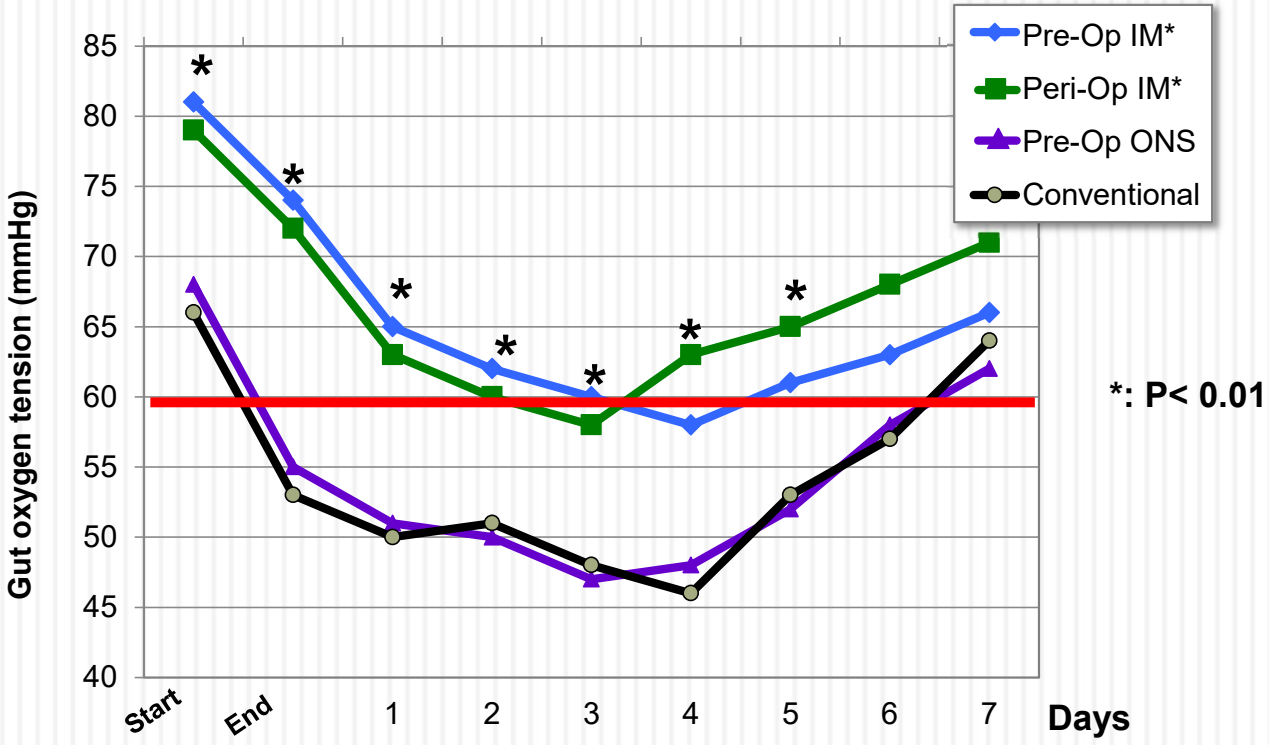
Hamilton-Reeves JM et al. *Euro Urol* 2016;69(3):389-392.

Arginine Depletion in Surgery Patients Increases Risks of Infection and Wound Breakdown



Popovich PJ et al. *J of Nutr* 2006;137:1681S-1686S. Taylor BE et al. CCM 2016; 44(2):390-438. Zhu X et al. *Ann Surg* 2014;259(1):171-178. Braga M et. al. *Surgery* 2002;132:805-14.

Arginine-supplemented Immunonutrition increases Tissue Oxygenation



*The IM intervention contained supplemental L-arginine, fish oil, and nucleotides

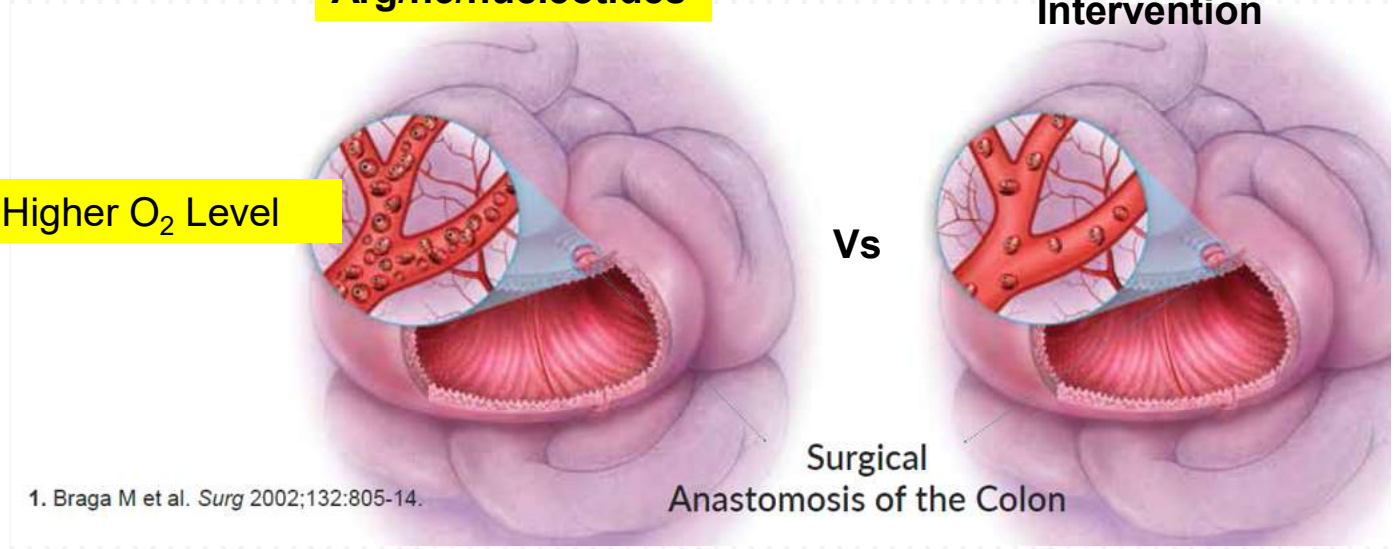
Braga et al. *Surgery* 2002;132:805-14.

IM Formula Shown to Increase Oxygenation to the Surgical Wound

IM Formula with Arg/n3/nucleotides

Standard Formula or No Intervention

Higher O_2 Level



Vs

Surgical Anastomosis of the Colon

1. Braga M et al. *Surg* 2002;132:805-14.

Arginine Is Not the Whole Story

- n-3 fatty acids
  - EPA and DHA from Fish Oil
    - Minimize inflammatory response

      by decreasing production of inflammatory mediators,
      and increasing production of resolvins, protectins and maresins
    - Increase immune response by enhancing lymphocyte function
    - Interaction with Arginine

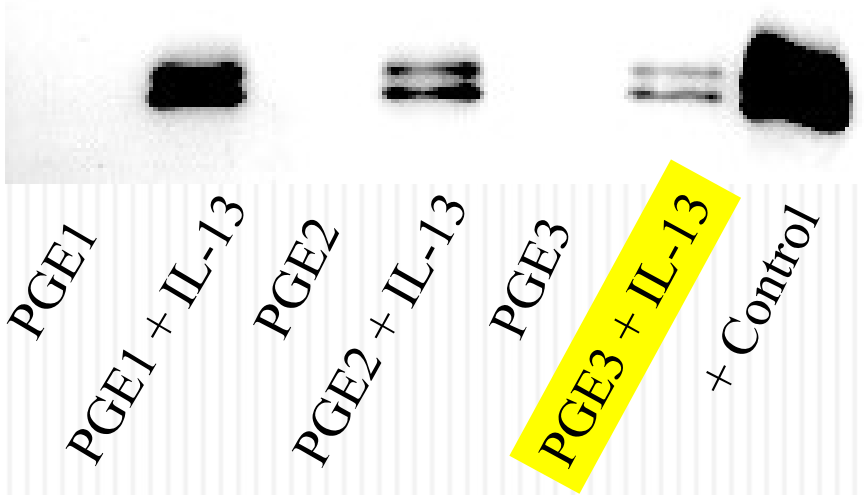
Calder PC. *Biochimica et Biophysica Acta* 2015;469–484.

Proof of Concept – Fish Oil may Blunt Arginase-1 Expression

PGE1 – Borage Oil

PGE2 – Corn Oil

PGE3 – Fish Oil



Arginase expression may be <u>modified by the type of Fatty Acid</u>

Bansal and Syres *JPEN* 2005

The Role of Nucleotides

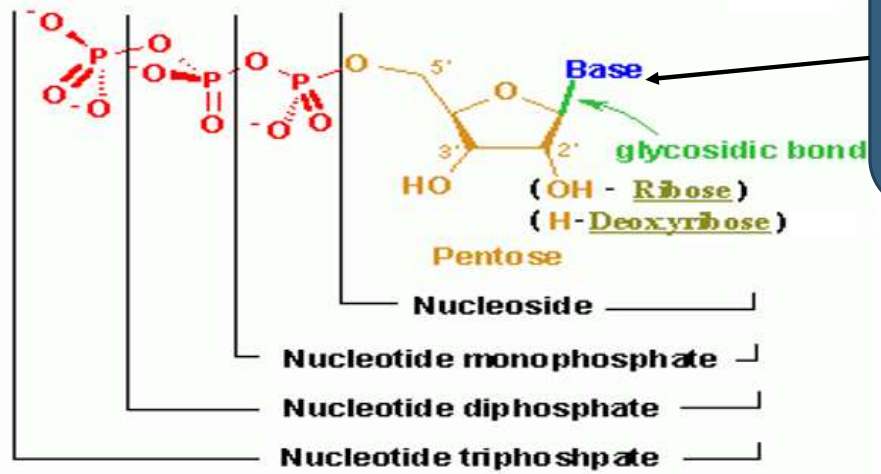
- Building blocks for DNA and RNA
- Indispensable in stressed states
- Essential for rapidly replicating cells to help support immune function
  - Gut Associated Lymphoid Tissue (GALT) and immune cells in the blood are overlapping entities
- ***Preview:*** Drover et al found the combination of arginine, fish oil and nucleotides required for statistically significant benefit in major elective surgical patients

Hess JR and Greenberg NA. *NCP* 2012;27(2):281-294. Santora and Kozar et al. J Surg Res 2010;161:288-294. Gil A. Eur J Clin Nutr 2002;56(Suppl 3):S1. Drover et al. *J Am Coll Surgeons* 2011;212(3):385-399.

Nucleotide Metabolism

A chemical compound that consists of 3 portions:

- a heterocyclic base
- a sugar
- one or more phosphate groups



Rate- limiting factor in Salvage pathway

Cytosine
Uracil
Guanine
Adenine

Yeast Extract (RNA)

1. *de novo* Synthesis
2. Salvage Pathway

Santora and Kozar et al. J Surg Res 2010;161:288-294. Gil A. Eur J Clin Nutr 2002;56(Suppl 3):S1.

Perioperative Use of Arginine-supplemented Diets in Major Elective Surgery: A Systematic Review of the Evidence Drover Meta-analysis (n=3438)

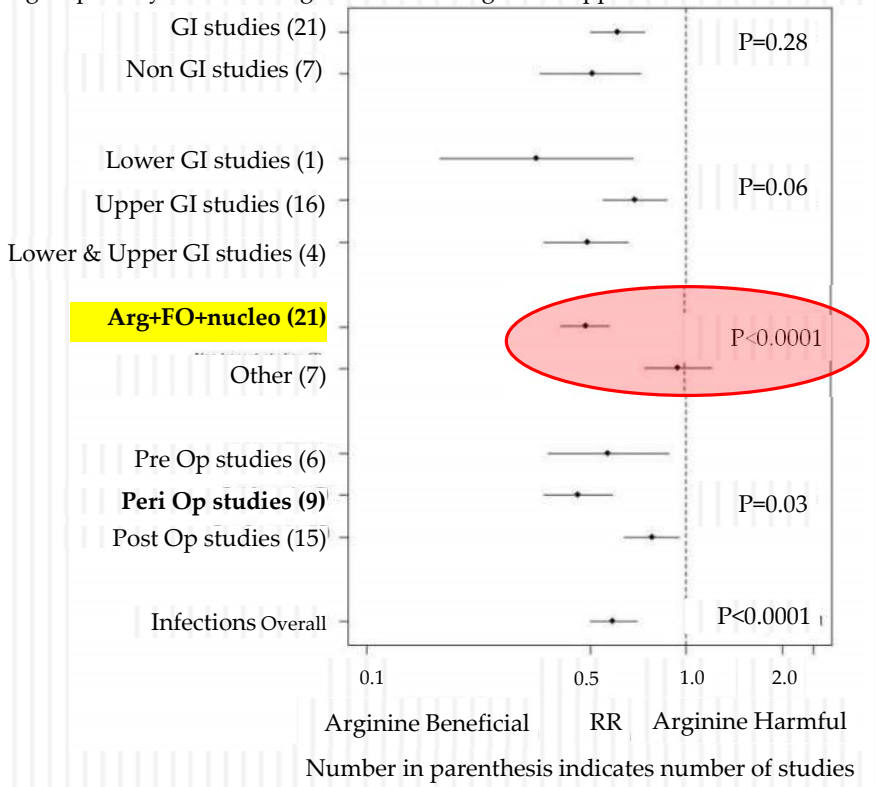
- Primary outcome: Infectious complications
  - 41% reduction across 28 pre, peri and post-op studies ($p<0.00001$)
- Secondary outcomes:
  - Hospital LOS
    - Reduced 2.38 days across 29 pre, peri and post-op studies ($p<0.00001$)
  - Mortality
    - No change

Drover et al. *J Am Coll Surgeons* Mar 2011

Sub-analyses of Arginine supplemented diets on Infection

- Same benefit shown for GI surgery vs non GI surgery
- Same benefit shown for Lower and Upper GI surgeries
- Peri-operative use showed greatest benefit (↓ 54%)
  - Preop- ↓43%
  - Postop- ↓22%
- Arg-n3-nucleotide formula showed significant benefit vs. standards (p<0.0001). Other IM formulas did not (NS)

Figure 4. Results of Subgroup Analyses examining the Effect of Arginine Supplemented Diets on Infection



Adapted from Drover et al. *J Am Coll Surgeons* Mar 2011

Arginine-Supplemented Formulas Studied by Drover

Supplemented Immunonutrients per 1000 kcal except as indicated	Arginine (g)	Glutamine (g)	EPA + DHA (g)	Nucleotides (g)
Impact®	**12**	**---**	1.7	1.2
Impact Advanced Recovery® Drink (3 cartons; 600 kcal; 534 mL)	**12.6**	**---**	3.3	1.3
Stresson®	**7.1**	**----**	3.0	**----**
Reconvan®	**6.7**	10	2.5	**----**
Nutrison® Intensive	**5**	**----**	**----**	**----**
Standard formula plus free Arg	**3.9,5,7.8,8.1, 8.5,9.9,18.2**	**----**	**----**	**----**

Containing added arginine, n-3 fatty acid from fish oil and nucleotides

Van Bokhorst- De van der Schueren MA et al. *AJCN* 2001;73:323-332. Daly JM et al. CCM 1990;18(Suppl):S86-S93. Casas-Rodera P et al. *Nutr Hosp* 2008;23:105-110. de Luis DA et al. *Eur J Clin Nutr* 2002;56:1126-1129. de Luis DA et al. *Eur J Clin Nutr* 2004;58:1505-1508. de Luis DA et al. *Eur J Clin Nutr* 2007;61:200-204. de Luis DA et al. *Eur Rev Med Pharmacol Sci* 2009;13:279-283. Lobo DN et al. *Clin Nutr* 2006;25:716-726. Klek S et al. *Clin Nutr* 2008;27:504-512.; Riso S et al. *Clin Nutr* 2000;19:407-412.

Lower vs. Higher Carbohydrate IM Formula Shows Decreased Plasma Glucose and Insulin Response

n= 12 nl volunteers

	Lower ONS-r	Higher ONS
Serving size	6 oz	8 oz
Calories	200	340
Protein (intact & L-arginine) (g)	18.1	18.1
L-arginine (g)	4.2	4.2
Nucleotides (mg)	430	430
Total fat (g)	7.9	9.2
MCT (g)	1.3	2.6
Total carbohydrate (g)	15	45
Sugar (g)	13	29.2
Fiber (g)	0	3.3

Schwartz S et al. CNW 2017 abstract

RESULTS

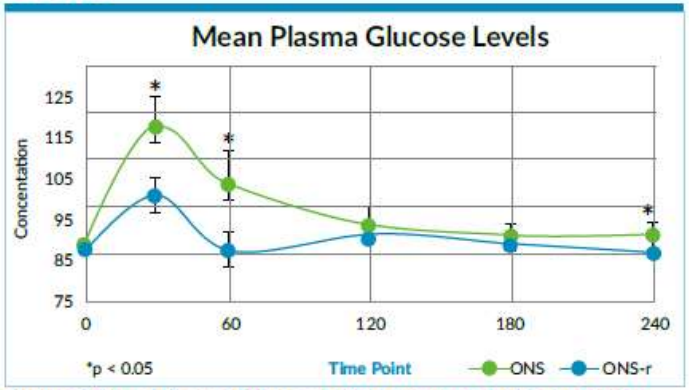


Figure 2. Mean Plasma Glucose Levels Between ONS and ONS-r

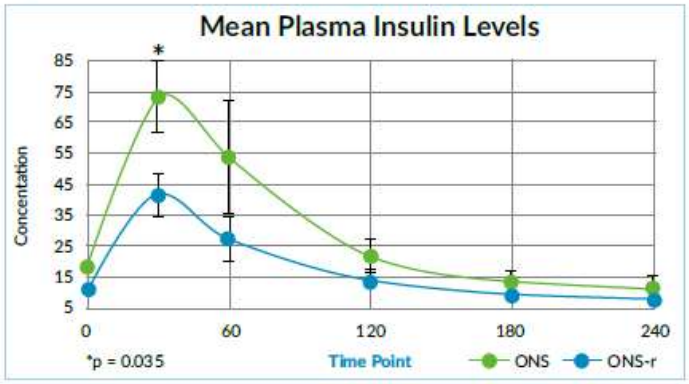


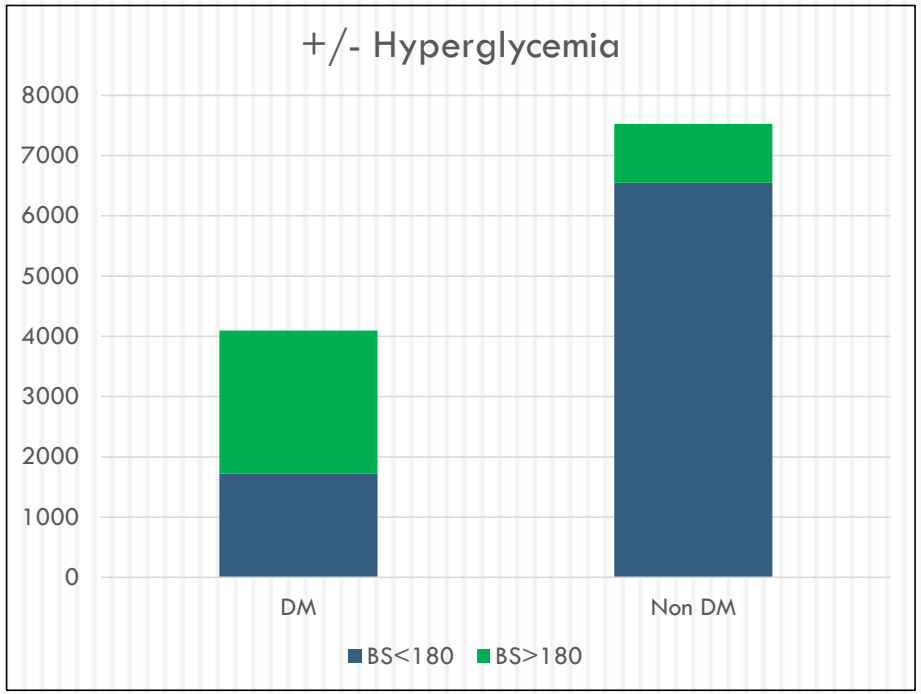
Figure 3. Mean Plasma Insulin Levels Between ONS and ONS-r

Higher CHO

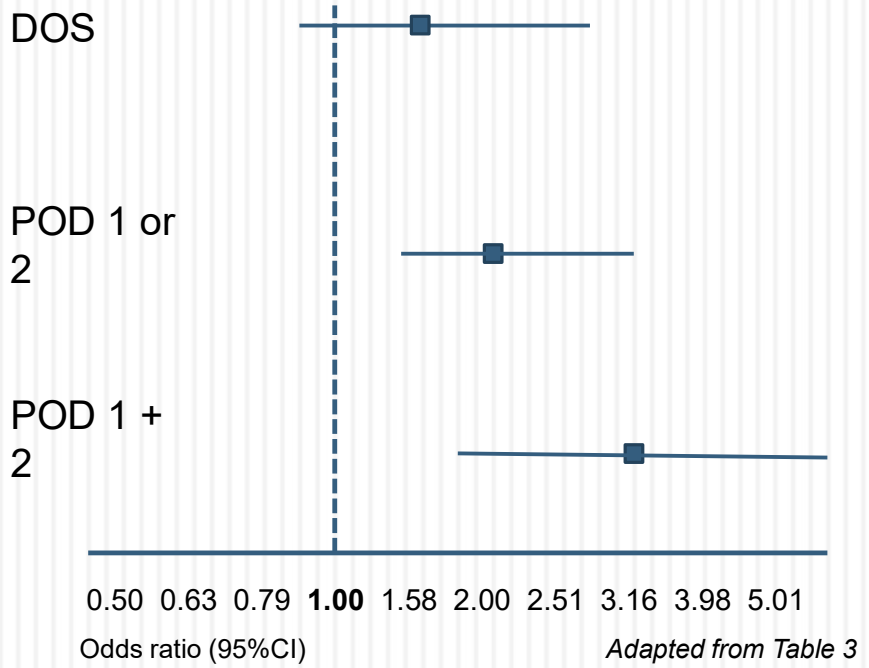
Lower CHO

Hyperglycemia Increases Risk Postop

Effect of DM Dx



Risk of Infection with BS>180



Kwon S et al. Ann Surg 2013;257:8-14.

Preop Arg-supp IM and Bladder Cancer Surgery

- Case-control pilot study (n=60) in bladder cancer patients
- Compared to retrospective control, the group consuming preop arg-supp IM* showed:
  - Lower 30 day post-operative complication rate (40% vs. 76.7%; p = 0.008)
  - Lower infection rate (23.3% vs. 60%; p = 0.008)
  - Lower rate of paralytic ileus at day 7 (6.6% vs. 33.3%; p = 0.02)

***The IM intervention contained supplemental L-arginine, fish oil, and nucleotides**

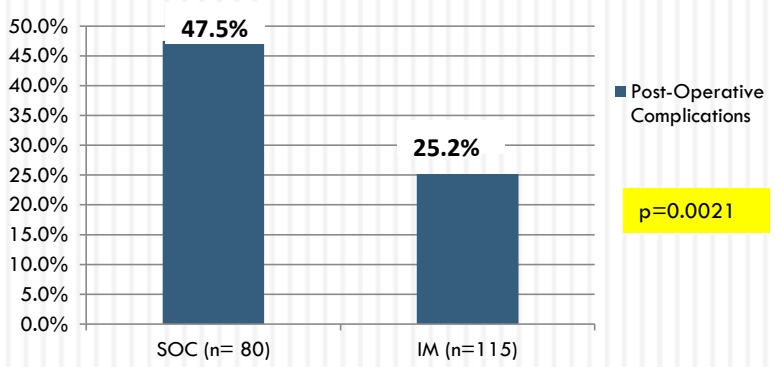
Bertrand J et al. *World J Urol* 2014;32:233-237. Engel DR et al. *Nature Med* 2010;16:1407-1413.

Utility and Feasibility of a Perioperative Nutritional Intervention High-Risk Head and Neck Cancer Patients- UPMC QI

- Prospective, non-randomized interventional cohort study (n= 195)
  - Study group was ordered an IM* drink preoperatively for 5 days and IM tube feeding post-operatively, whereas the comparative cohort (SOC) received standard tube feeds post-op
- Post operative complication rates:
  - 25.2% in those receiving IM
  - 47.5% in those not receiving IM
- Pharyngeal leaks/fistulas
  - most common cx
  - more frequent in the SOC group

p=0.0007

- Length of Stay:
  - Reduced by 2.8 days on average in immunonutrition group



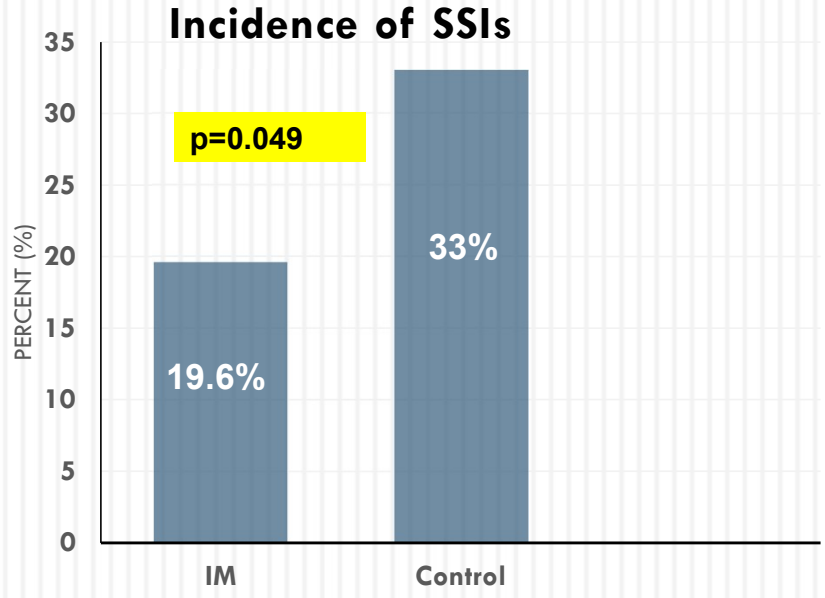
p=0.0021

p=0.02

***The IM intervention contained supplemental L-arginine, fish oil, and nucleotides**

Rowan NR et al. *Oral Onc* 2016;54:42-46.

Post-operative Enteral Immunonutrition for Gynecologic Oncology Patients Undergoing Laparotomy Decreases Wound Complications (SSI) n=338



- 41% Reduction in SSIs with IM* compared to control
- 78% less likely to develop CDC SSI class 2&3 infections (p=0.044)
- Patients on IM had fewer morbid SSIs (11.6% vs. 21.2%;p=0.03) and required fewer interventions such as:
  - IV antibiotics, readmissions, operative procedures, interventional radiology, wound packing, neg pressure wound tx

*The IM intervention contained supplemental L-arginine, fish oil, and nucleotides

Chapman JS et al. *Gynecologic Oncology 2015*;137:523-528.

Surgical Immunonutrition Protocol

5 Days Preoperatively

3 servings IM oral formula or
at least 1000 kcal IM enteral formula/day

At least 5 Days Postoperatively if feasible

3 servings IM oral formula or at least
1000 kcal IM enteral formula/day

Waitzberg DL et al. *World J Surg* 2006;30:1592-1604. Marik P and Zaloga G. *JPEN* 2010; 34(4):378-386. McClave et al. *JPEN* 2016;40(2):159-211. August DA et al. *JPEN* 2009;33:472-500. Drover et al. *J Am Coll Surg* 2011;212(3):385-399. Wischmeyer PE et al. *Anesth Analg* 2018;126(6): 1883-1895.

IM= Immunonutrition Formula containing arginine-n3 fatty acid-nucleotides

Critical Care Nutrition Guidelines – Immunonutrition and Surgery

- Immune-modulating enteral formulations (arginine with other agents including EPA, DHA, glutamine, nucleic acids) should be considered for perioperative use in the surgical ICU (E2, O3)
  - EN to be provided within 24 hours of surgery as appropriate (O2)
- Immune-modulating formulas containing arginine and fish oils are suggested for routine use in the post-operative patient in the surgical ICU and suggested for the severe trauma patient (O3)
- When advancing the diet postoperatively, it is suggested that patients be allowed solids as tolerated and that clear liquids are NOT required as the first meal (O6)

McClave SA et al. *JPEN* 2016;40(2):159-211.

A Standard to Optimize Care

- Immunonutrients appear to synergize in alleviating arginine depletion
- Complication rates, LOS and readmission have all shown improvement with the use of a proven surgical immunonutrition intervention
- A potential financial upside can be illustrated for the use of peri-operative immunonutrition in major elective surgery

Surgical Immunonutrition: What's it Worth?

- Reductions in infectious complications and LOS and readmission provide:
  - Better outcomes for patients, clinicians, institutions and the Healthcare system
  - Health economic savings potential
    - Opportunity to demonstrate this to:
      - Surgeons, Surgical Clinic nurses
      - Administrators
      - Payers
        - FYI- Peri-operative immunonutrition is fully reimbursed by the government for GI Cancer Surgery patients in France

The Challenge: Integrate Immunonutrition with Surgical Protocols

- The evidence-base is strong but awareness and implementation lags behind
- Seize this opportunity to improve care and get some well deserved recognition for the value of surgical immunonutrition
- How? Quality Improvement (QI) is the best way to demonstrate feasibility and value to decision-makers

Strong for Surgery

- Started as a public health campaign in Washington State, with an initial focus on colo-rectal surgeons, patients and other important stakeholders.

- Now an initiative of the American College of Surgeons

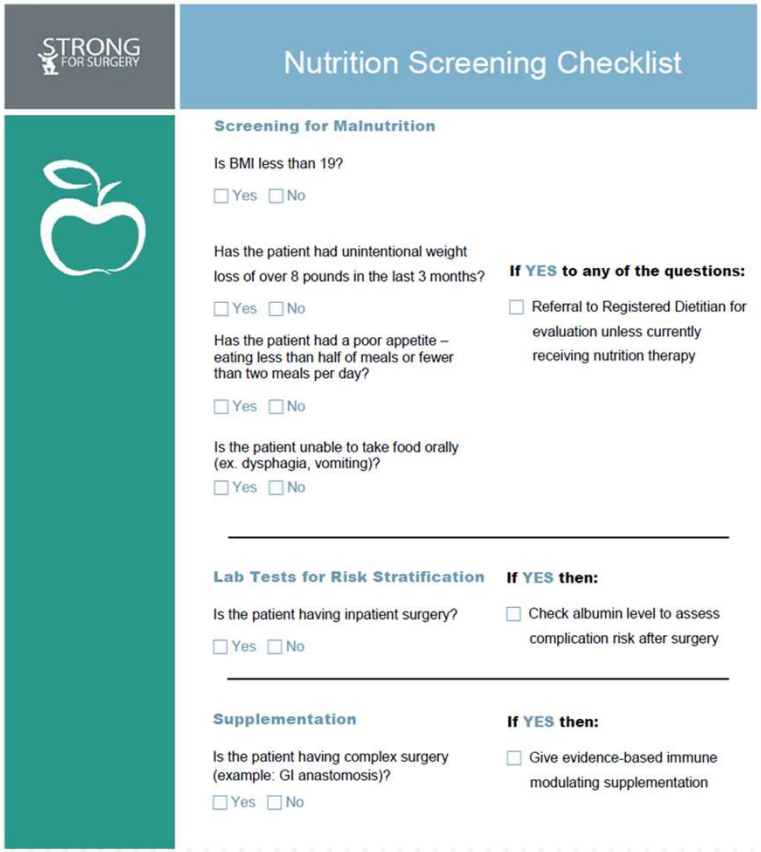
  - Interactive tools to help optimize patients prior to surgery
    - Pre-Surgical Checklists
      - Optimizing Nutrition- Utilizes Preoperative Arginine-supp IM, evidence based
      - Smoking Cessation
      - Medications
      - Blood sugar control

  - A 23% lower risk of prolonged LOS was shown in the nutrition check listed group receiving IM. (RR 0.77;95%CI,0.58-1.01 p=0.05)

Thornblade LW et al. *Dis Colon Rect* 2017;60:1.

- www.facs.org/quality-programs/strong-for-surgery

Strong for Surgery Nutrition Checklist



STRONG FOR SURGERY

Nutrition Screening Checklist

Screening for Malnutrition

Is BMI less than 19?

☐ Yes ☐ No

Has the patient had unintentional weight loss of over 8 pounds in the last 3 months?

☐ Yes ☐ No

Has the patient had a poor appetite – eating less than half of meals or fewer than two meals per day?

☐ Yes ☐ No

Is the patient unable to take food orally (ex. dysphagia, vomiting)?

☐ Yes ☐ No

If YES to any of the questions:

☐ Referral to Registered Dietitian for evaluation unless currently receiving nutrition therapy

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Lab Tests for Risk Stratification

Is the patient having inpatient surgery?

☐ Yes ☐ No

If YES then:

☐ Check albumin level to assess complication risk after surgery

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Supplementation

Is the patient having complex surgery (example: GI anastomosis)?

☐ Yes ☐ No

If YES then:

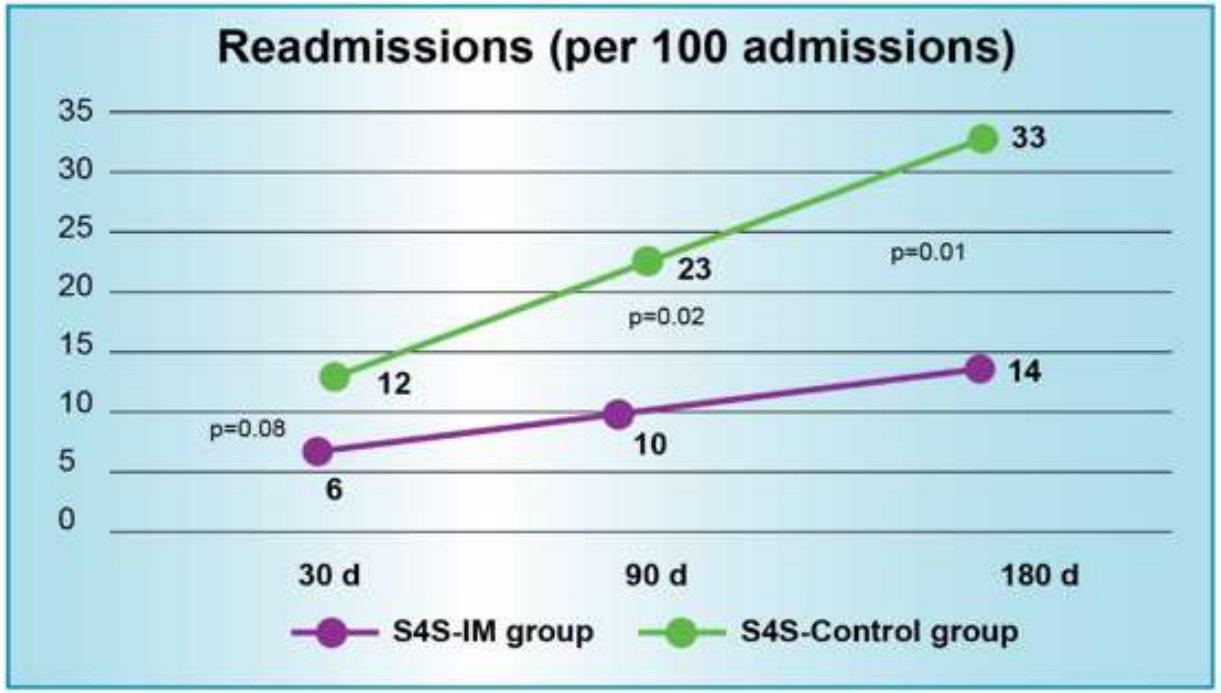
☐ Give evidence-based immune modulating supplementation

Malnutrition Screen

Assess Surgical Risk

Utilize Evidence-Based Immunonutrition

Effects of arginine-based immunonutrition on inpatient total costs and hospitalization outcomes for patients undergoing colorectal surgery

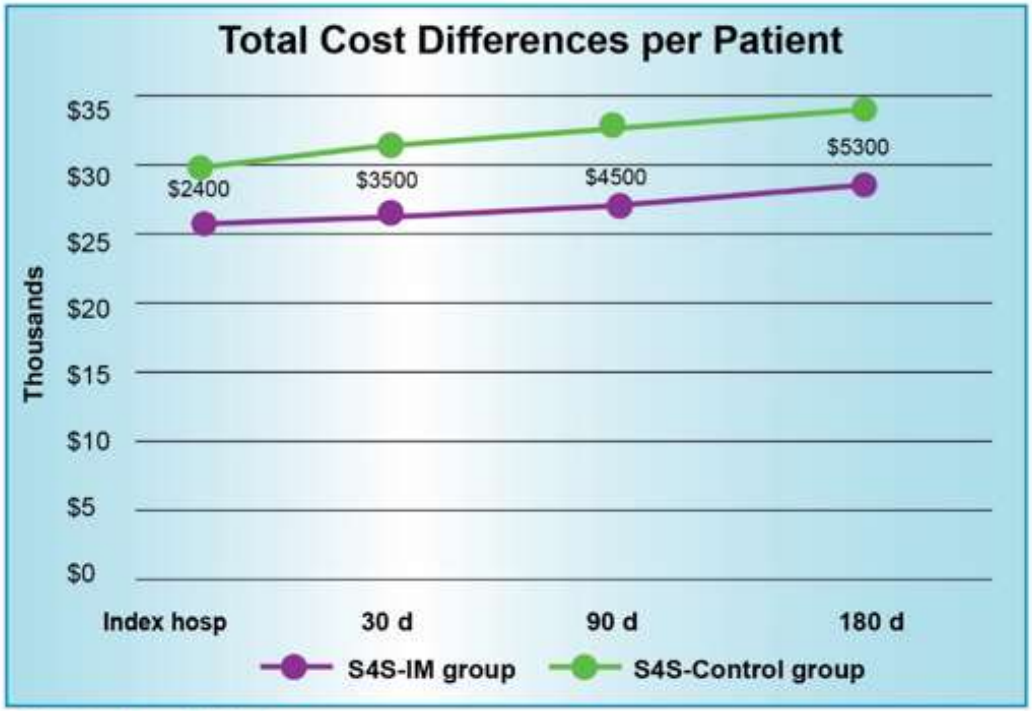


Adapted fom Table 4

- n= 716 colorectal surgery patients
- **Strong for Surgery** (S4S) study group- Provided with preop IM containing supplemental arginine, n-3 fatty acids and nucleotides
- Clinical Outcomes
  - Readmission decreased 50-58%
  - Decreased risk of SSI (0% vs 2.65%; p=0.04)
  - Decreased risk of thromboembolism (1.3% vs. 5%; p=0.05)

Banerjee et al. Nutr 2017;42:106-13.
Strong for Surgery is a Quality Program of the American College of Surgeons

Effects of arginine-based immunonutrition on inpatient total costs and hospitalization outcomes for patients undergoing colorectal surgery

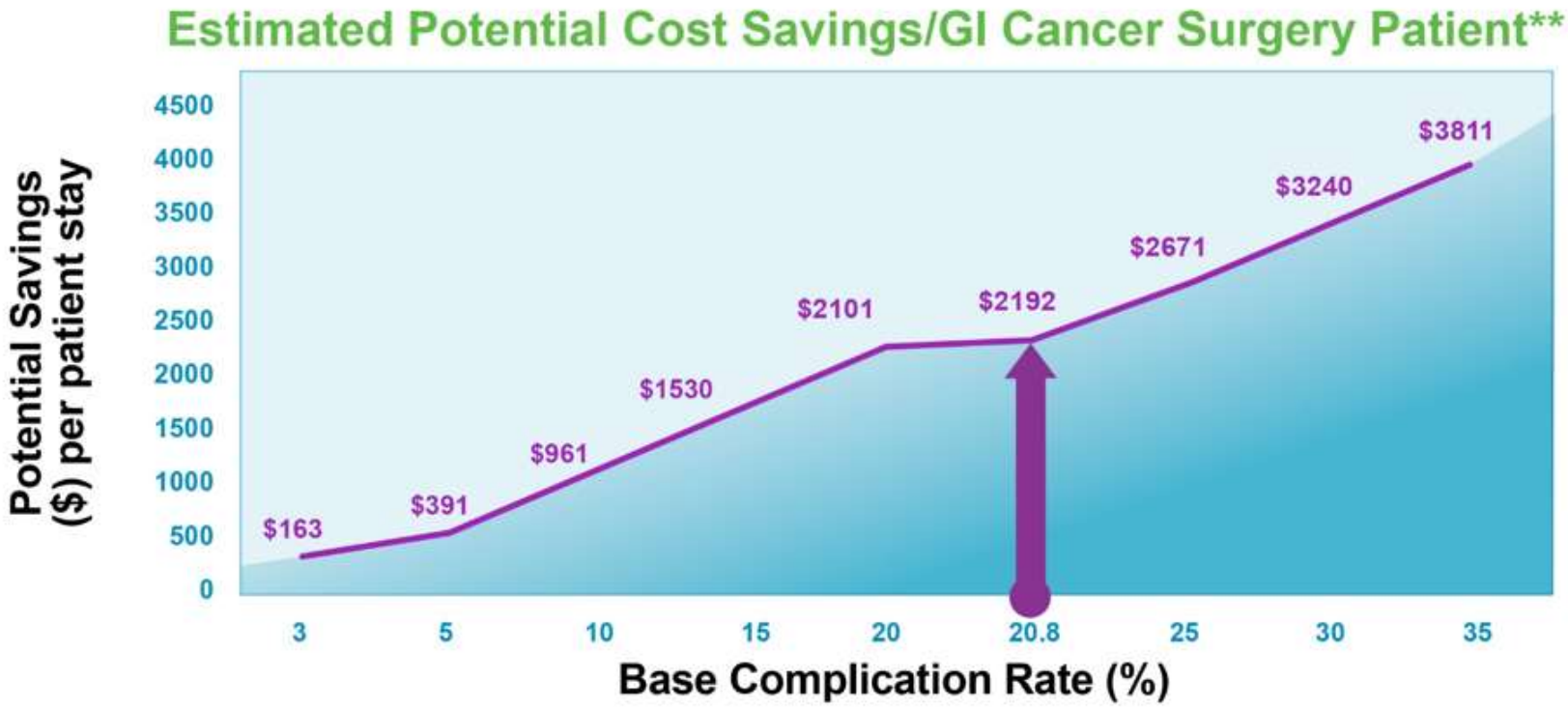


Adapted fom Table 2

- From Index Hospitalization to 180 days post-discharge, mean cost of care was $5300 less for the **Strong for Surgery** (S4S)-IM group vs. (S4S)-control group.

Banerjee et al. Nutr 2017; 42: 106-13. Strong for Surgery is a Quality Program of the American College of Surgeons

Health Economics – Perioperative



Waitzberg DL et al. *WJS* 2006;30:1592-1604. Drover JW et al. *JACS* 2011;212(3):385-399. Mauskopf J et al. *WJSO* 2012;10(136) e-pub 7/6/2012. HCUP Nationwide Inpatient Sample 2008.

*Containing arginine, n-3 fatty acids and nucleotides; Cost of perioperative immunonutrition not included.

**Estimated potential cost savings included in this health economics model are for illustrative purposes only and are not intended to guarantee any specific reductions in cost at a particular facility.

Impact of a Novel Preoperative Patient-Centered Surgical Wellness Program

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*Grace S. Rozycki, MD, FACS,|| and C. Max Schmidt, MD, PhD, MBA, FACS**††*

Outcome Measure	Pre-intervention (n= 9202)	Intervention (n=6538)	P value
Surgical site infection (SSI)	52	22	0.044
Catheter associated urinary tract infection (CAUTI)	27	6	0.007
Clostridium difficile infection (CDI)	78	34	0.016
Patient safety indicators (PSI)	55	0	<0.001
Ventilator associated event (VAE)	14	6	0.367
Central line associated bloodstream infection (CLABSI)	7	3	0.538
Methicillin resistant staph aureaus (MRSA)	3	2	1.000

Kelley KE et al. Ann Surg 2018;268(4):650-56.

Preop Wellness Bundle Contents:

- Chlorhexidine
- Mupirocin
- Incentive spirometer
- Smoking cessation information
- Immunonutrition drink containing arginine, n-3 fatty acids and nucleotides

Types of Surgery:

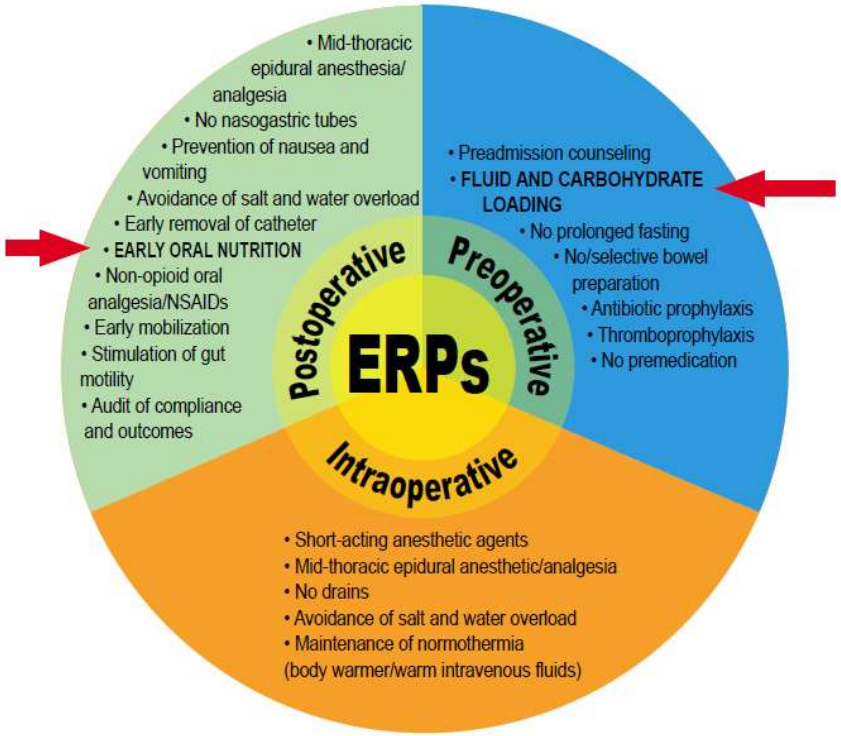
- General
- Neuro
- Urology
- Ortho
- Thoracic
- Cardiovascular
- ENT
- Plastics
- Gyn
- Oral Maxillofacial

Outcomes:

- SSI, CAUTI, CDI and PSI were significantly reduced
- Total compliance to bundle elements lowered risk of HAI by 50% (p=0.003)
- Cost of Wellness Bundle kits was recovered in addition to 1 Mill. in cost savings

What is an Enhanced Recovery Protocols (ERP) Bundle?

Protocol components implemented Pre-, Intra- and Postoperatively



Lassen K et al. *Clin Nutr* 2012;31:817-830.
Zhuang CL et al. *Dis Colon Rectum* 2013;56(5):667-678.

Clinical Outcomes with an ERP Bundle

- Implementation of the ERP bundle of protocols in colorectal surgery have demonstrated a reduction in complications by 30%-50% and a 2-3 day reduction in LOS.
  - QI studies from Duke and UVA support these findings.
- The bundle of protocols has been required to achieve significant improvements in clinical outcomes.
- Use of carbohydrate loading shows limited evidence of clinical benefit when used as a separate intervention in elective surgery.
  - No difference in LOS when compared with water or placebo.

Zhuang CL et al. Dis Colon Rectum 2013;56(5):667-668. Smith MD et al. Cochrane Database Review 2014. Miller T et al. Anesth Analg 2014;118(5):1052-1061. Thiele RH et al. JACS 2015;220:430-443. Li L et al. Surg Today 2012;42:613-624. Amer MA et al. BJS 2016; published on-line Sept 2016

ASER Implementation Guide

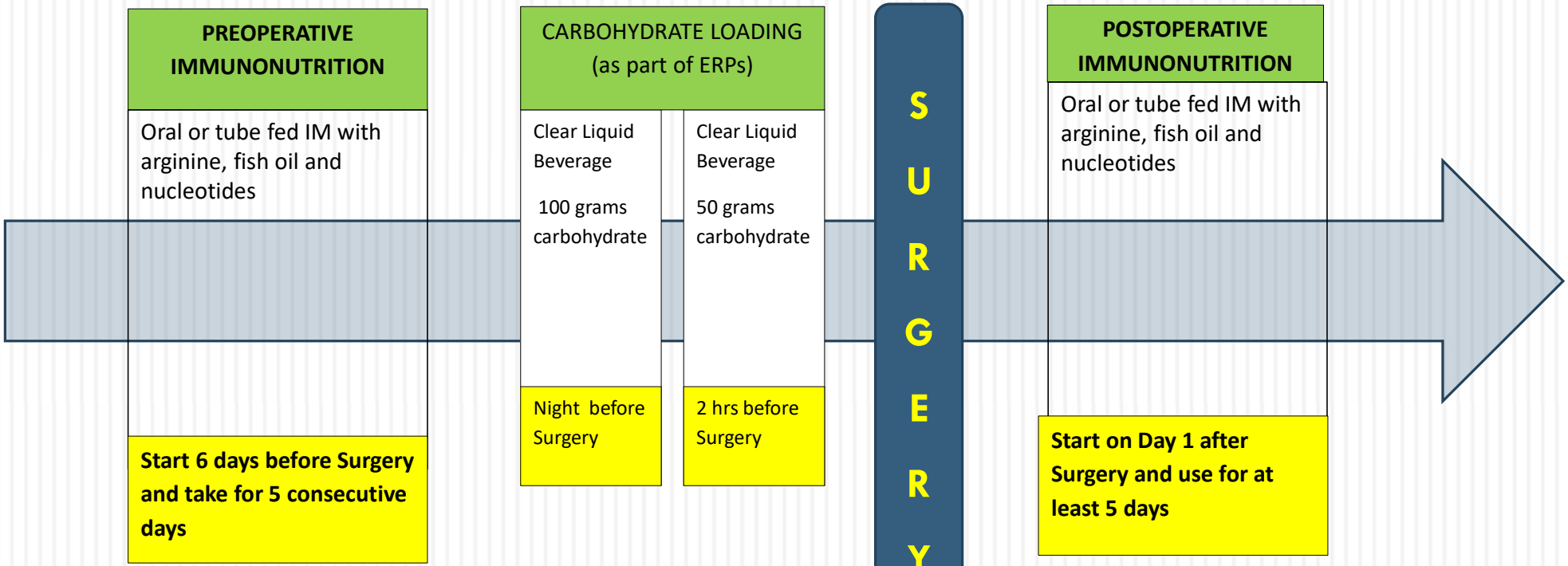
http://aserhq.org/

- American Society of Enhanced Recovery (ASER)
  1. Reduce the preoperative starvation period
  2. Carbohydrate loading may be given 12 hrs prior to surgery and up to two hours before anesthesia*
  3. Immunonutrition containing supplemental arginine, n-3 fatty acids (EPA & DHA) and nucleotides found beneficial when given 5-7 days preoperatively and 5-10 days postoperatively

*Pts with Type 1 DM are excluded

ASER. Enhanced Recovery Implementation Guide. Sept 2016

Immunonutrition (IM) & Carbohydrate Loading in ERPs: Complementary Protocols for Major Elective Surgery



McClave SA et al. *JPEN* 2013;37(1):99S-105S.
Drover JW et al. *JACS* 2011;212(3):385-399.
Braga M et al. *Surg* 2002;132:805-814.
Zhuang CL et al. *Dis Colon Rectum* 2013;56(5):667-668.

Multi-modal Perioperative Care Plus Immunonutrition versus Traditional Care in Total Hip Arthroplasty: A Randomized Pilot Study

- Methods (n=32)
  - n=15 in ACERTO Group
    - Pre-op IM* for 5 days leading up to surgery
    - 2 hours before surgery 200mL-12.5% maltodextrin beverage
    - Restricted IV fluids-only 1000mL fluids post-op
  - n=17 in Control Group
    - Standard diet-NO IM
    - Fasting until surgery
    - IV hydration until Post-op Day 1
- Results
  - Shows ERP Bundle (including preoperative IM and carb loading) enhanced recovery by decreasing LOS and lowering inflammation.

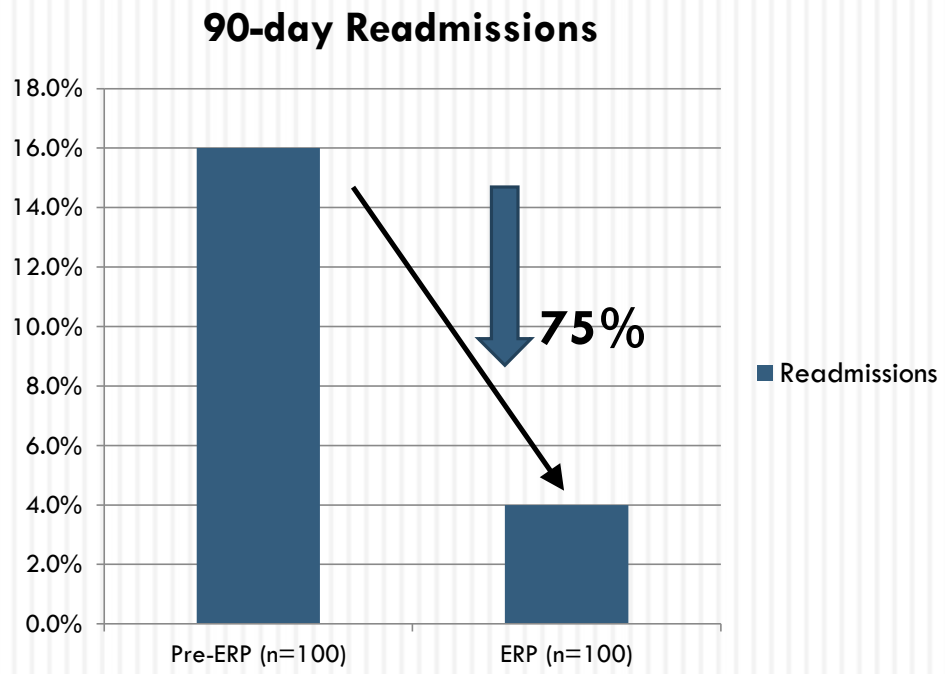
adapted from Table 3

Variable	Control Group		ACERTO Group		
	Mean	Median	Mean	Median	
LOS		6 days		3 days	p<0.01
CRP (mg/L)					
Preop	10.2	8	10.1	8	p=0.96
Postop Day 2	80.6	79	66.5	66	p<0.01

*The IM intervention contained supplemental L-arginine, fish oil, and nucleotides

Alito Aprelino M and de Aguilar-Nascimento JE. *Nutrition Journal* 2016, 15:34

ERP Bundle Plus Immunonutrition- Ventral Hernia Repair (n=200)



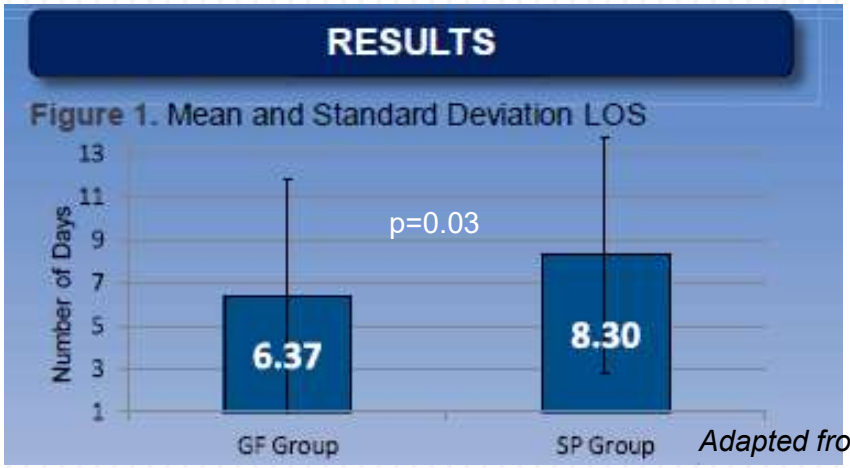
- A 75% reduction in 90-day readmission was associated with the ERP bundle, including evidence-based IM.
- Other associated outcomes were:
  - Reduced LOS
  - More rapid diet advancement and time to flatus and bowel movement
  - Shorter time to oral narcotics

***The IM intervention contained supplemental L-arginine, fish oil, and nucleotides**

Majumder A et al. *J Am Coll Surg* 2016;222:1106-1115.

ERP Bundle with Immunonutrition (IM) in GI Surgery – Grant funded vs. Self-Pay IAR

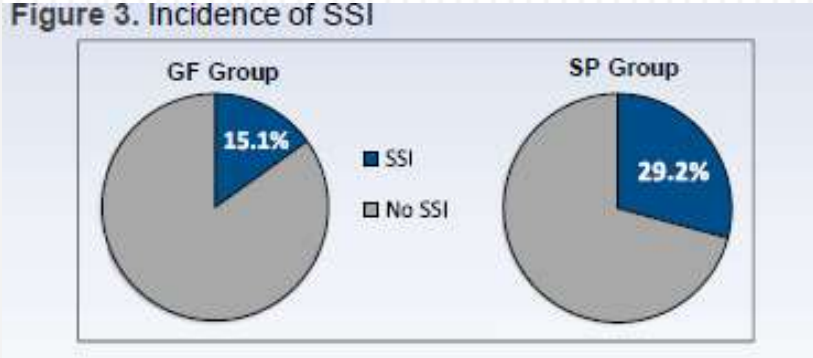
Cross Sectional- Retrospective Study of Real World Evidence



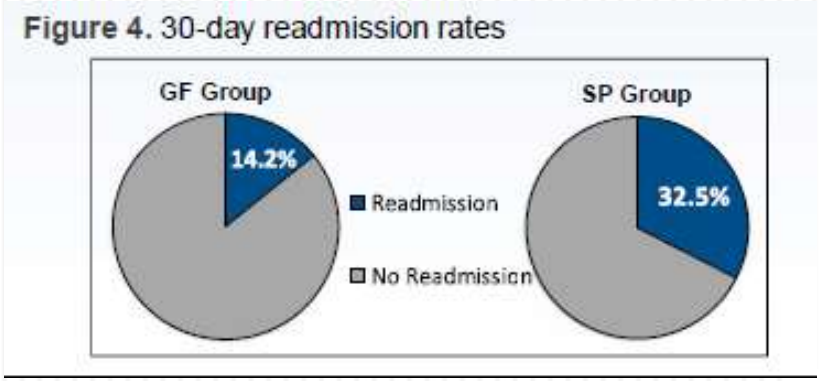
Adapted from Fig. 1

Grant funded IM* group (n=120)

Self-Pay IM* group (n=120)



Adapted from Fig. 3



Adapted from Fig. 4

Kavanaugh E et al abstract at ERAS USA 2018

*containing arginine, n-3 fatty acids and nucleotides

Nestlé HealthScience

It's All About Outcomes

- Clinical
- Health Economic

Summary

- Pre-, Peri- and Post-operative use of supplemental arginine, n3 fatty acids and nucleotides are proven effective vs. other combinations studied to improve outcomes following major elective surgery.
- All three immunonutrients discussed have a mechanistic role in the support of immune function.
- The health economics associated with this studied blend of immunonutrients support the implementation of quality initiatives in major elective surgery

Thank You

Questions

Nutrition-related resources and tools are available
from Nestlé Nutrition Institute:
www.nestlenutrition-institute.org

Visit the New and improved MyCE site at
MyCEeducation.com
Offering CE to dietitians and nurses

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