Prevention and Treatment of Wounds Through Optimal Nutritional Intervention

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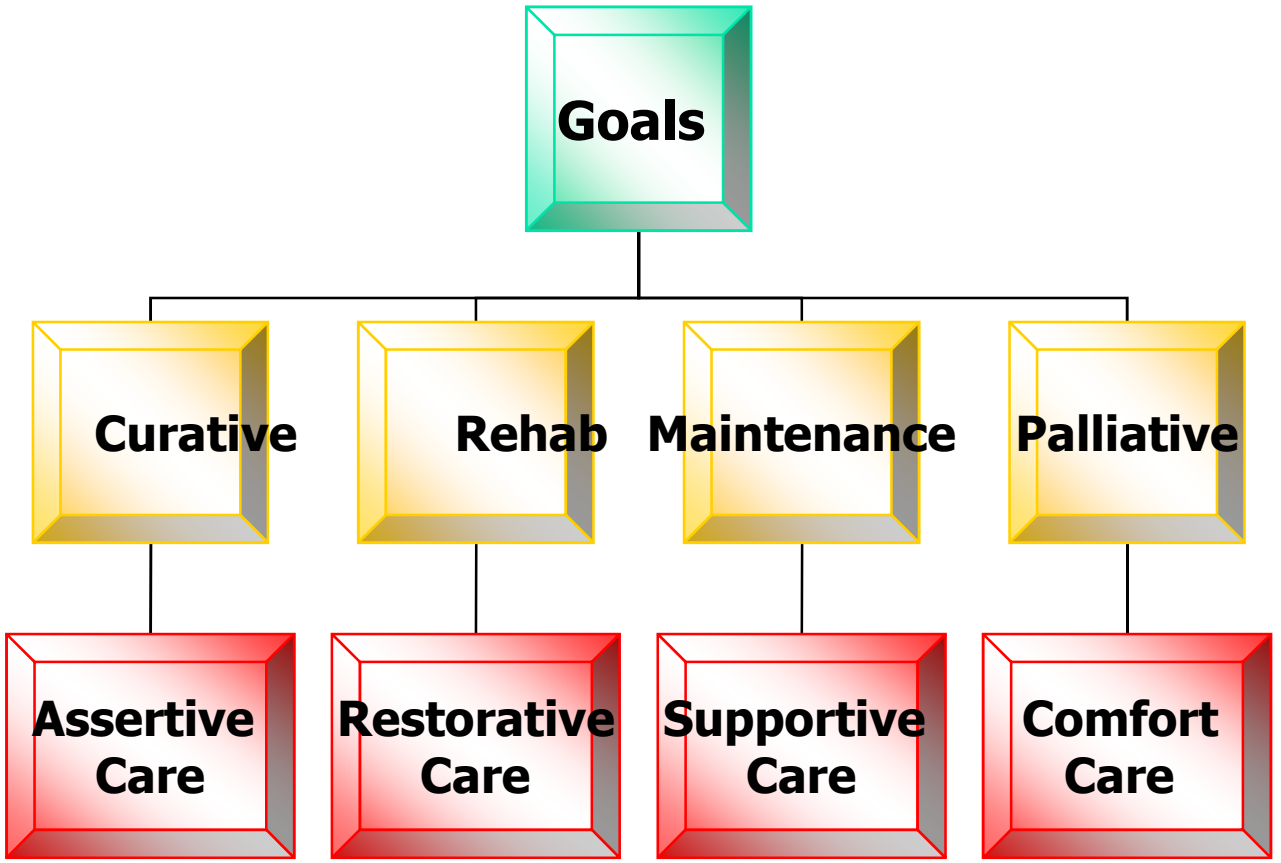
What is Enough?
Define the Outcome Expectations



Guiding Principles

- Begin with the least costly, least invasive interventions
- Advance to more invasive, more costly interventions as needed
- Advance interventions in a timely manner
- Document all interventions—no matter how basic or routine

General Goals of Medical Nutritional Therapy (MNT)

- Meet:
  - Caloric (energy) needs
  - Protein needs
- Provide:
  - Adequate fluids
  - Vitamin and mineral supplementation
  - Adjuvant treatments as indicated
- Maintain optimal body composition

Body Composition

- The proportion of muscle, bone, fat, and other tissue that make up a person's body weight (BW)
- BW = fat + lean tissue (including water)
- 10% loss of lean body mass ⇨ infections
- 40% loss of lean body mass ⇨ may be fatal

Lean vs Fat Mass

Fat Mass	Lean Mass
25% of body composition	75% of body composition
Relatively inactive metabolically	Metabolically active tissue
Pure energy source	70% H_2O; 20% Protein 10% Mineral
Expands/contracts with energy demand	Muscle, skin, collagen, organs, antibodies, enzymes

Photo courtesy of R.H. Demling, MD

Progressive Complications of Loss of LBM

% Loss of Total LBM	Complications	Associated Mortality (%)
10	Decreased immunity, increased infections	10
20	Decreased healing, weakness, infection	30
30	Too weak to sit, pressure ulcers, pneumonia, no healing	50
40	Death, usually from pneumonia	100

Example of downward weight trend

- Sept. 1 120 pounds
- Oct. 1 117 pounds (30 days = 2.5% loss)
- Nov. 1 115 pounds
- Dec. 1 113.5 pounds
- Jan. 1 116 pounds
- Feb. 1 112.5 pounds
- Mar. 1 109 pounds (180 days = 9.2% loss)

Evaluating Protein Lab Data

Protein	Half-Life	Other
Albumin	20 days	Low sensitivity for acute changes in protein nutrition
Transferrin	10 days	Intermediate sensitivity for acute protein deficiency
Prealbumin	48 hours	Sensitive for acute dietary deprivation and refeeding
Retinol-binding protein	12 hours	Sensitive for acute dietary deprivation and refeeding

Serum Albumin

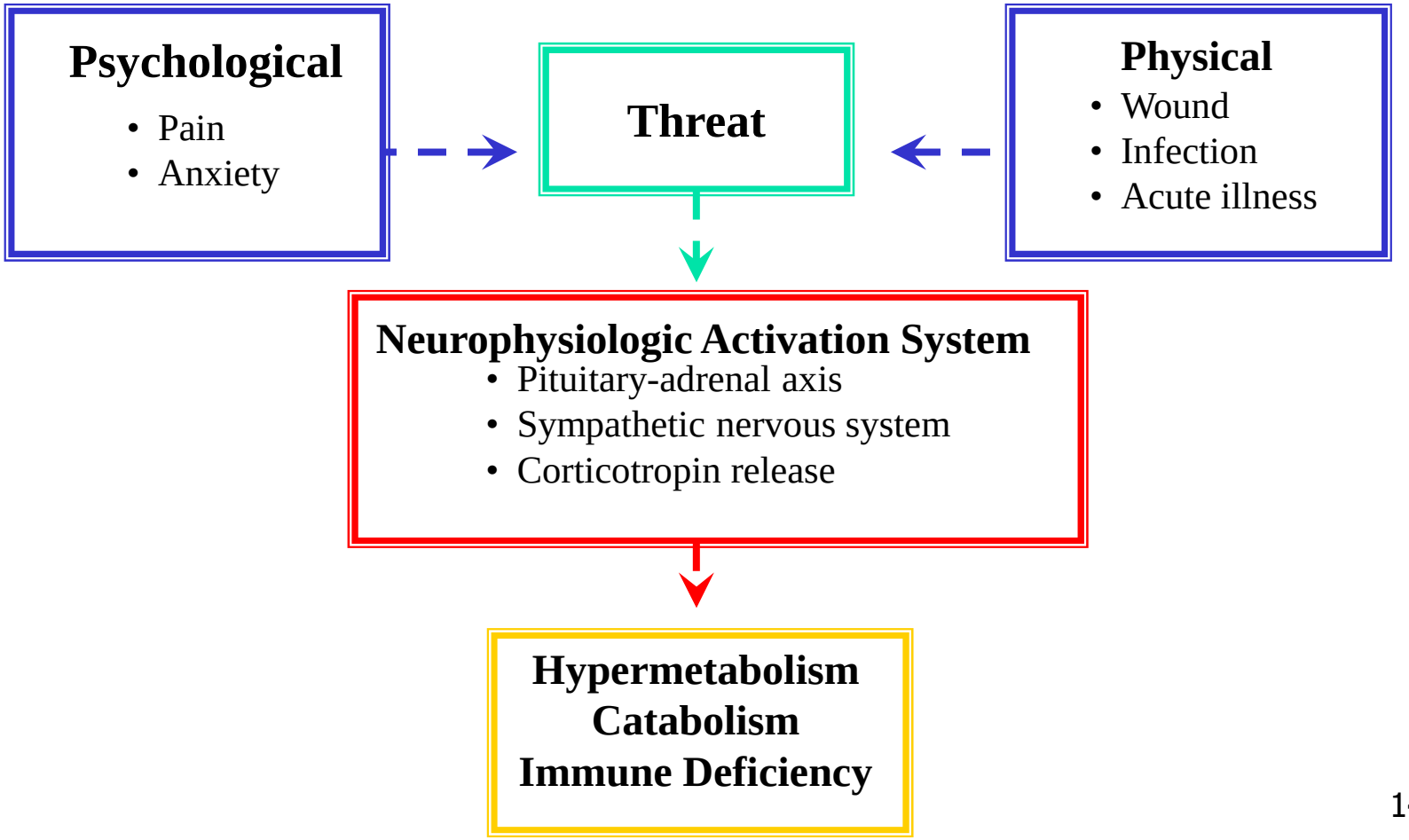
- Accounts for more than 50% of the serum proteins
- Slow to reflect changes because of the large serum pool and long half-life
- Reflects prolonged protein depletion
- Increases slowly with good refeeding

Prealbumin and Degrees of Malnutrition

- Most reliable indicator to evaluate nutritional status
- Prealbumin (mg/100 mL):
  - Normal: 16-30
  - Mild depletion: 10-15
  - Moderate depletion: 5-9
  - Severe depletion: <5

NOTE: Albumin is used most frequently, but prealbumin is more reliable.

The Stress Response to Injury



Effect of Cytokines on Nutrition

- Anorexia
- Muscle wasting
- Decreased nitrogen retention
- Decreased albumin synthesis
- Decreased circulating levels of albumin and cholesterol

The Catabolic State

- A progressive loss of lean body mass in response to any significant insult, physiologic or psychologic

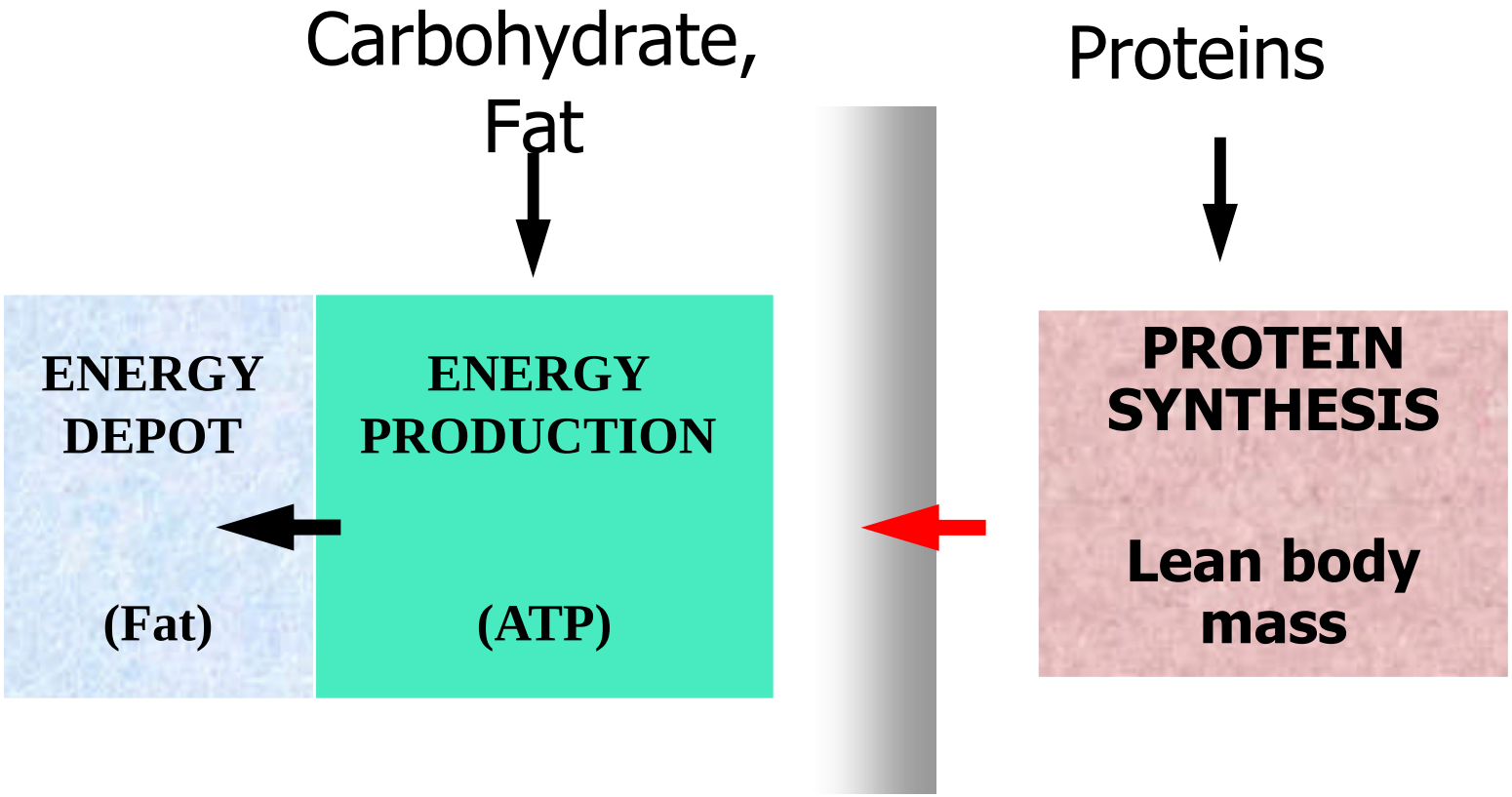
The Hypermetabolic State

- An increase in energy demands that accompanies any significant physiologic and/or psychologic insult

Anorexia of Aging

- Decreased food intake
  - Decreased sense of taste and smell
  - Dental problems
  - Alterations in GI function
- Decreased activity and resting metabolic rate (RMR)
- Results in sarcopenia (decline in LBM)
- Often seen in conjunction with cachexia

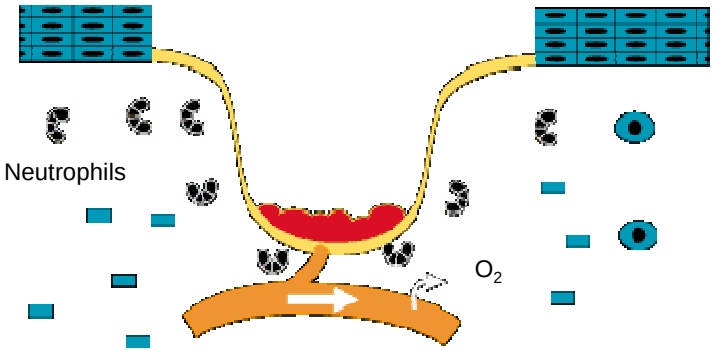
Defects in Nutrient Partitioning



Courtesy of RH Demling, MD

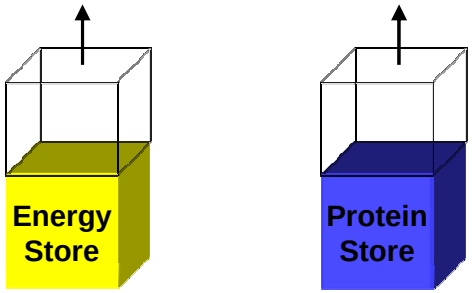
The Nonhealing Chronic Wound
Failure to Heal by 12 Weeks

The Nonhealing Wound



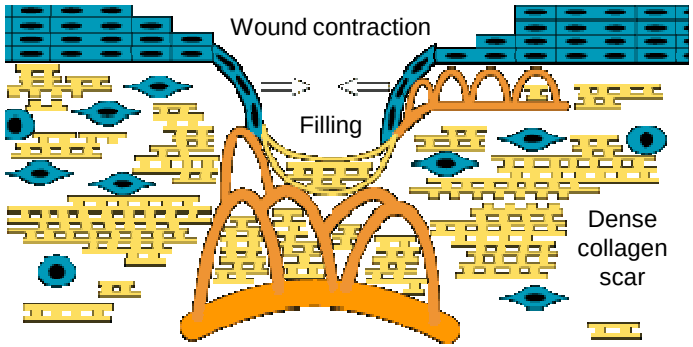
↑ **Catabolism** ↓ Anabolism

Energy | Protein Synthesis



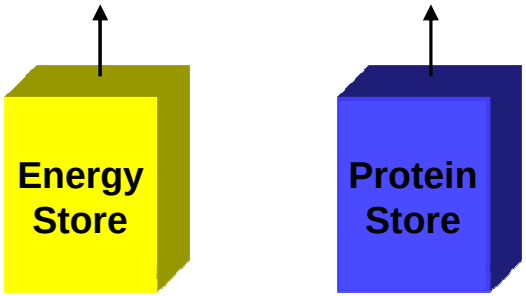
↑ **Macronutrients** ↑

The Healing Wound



↑ **Anabolism** ↓ Catabolism

Energy | Protein Synthesis



↑ **Macronutrients** ↑

Courtesy of RH Demling, MD

Nutrient Needs Assessment

Calories	**kcal/kg/day**
Normal	25 - 30
Protein calorie malnutrition (PCM)*	30 - 35
Critically ill or injured*	35 - 40

*Nutrient supplementation required

Protein	**g/kg/day**
RDA	0.8
PCM	1.5
Critically ill or injured*	1.5-2.0

*Nutrient supplementation required

Fat < **30% kcals**

Fluid Needs Assessment

- Method 1: 30 mL/kg body weight
- Method 2: 1 mL/kcal
- Any item that is liquid at room temperature is considered a fluid
- Examples: gelatin, ice cream, fruit ices

Using Food to Meet Needs

- Increase caloric density of meals
- Provide favorite and culturally appropriate foods
- Assist as needed
- Variety is important—avoid flavor fatigue
- Consider adding protein module
- Try varied forms including juices, puddings, bars, shakes, cookies, ice creams

Other Factors

- Assistance at meals
- Dining environment
- Proper positioning
- QUIZ: How long does it take to feed a patient?

Micronutrients Required for Wound Healing

- **Multivitamins**

  Administer daily to provide 100% RDA/RDI

- **Vitamins**

  Vitamin C – helps collagen synthesis and tensile strength
  Vitamin A – helps epithelialization and fibroblast stimulation

- **Minerals**

  Zinc – protein synthesis
  Copper – collagen production and cross-linking
  Manganese – collagen and ground substance

Amino Acids: Arginine

- Conditionally essential amino acid
- Improves muscle integrity
- Precursor to proline
- Helps support immune function
- Increases nitric oxide production
  - Activates macrophages
  - Improves vasodilation
  - Increases collagen formation

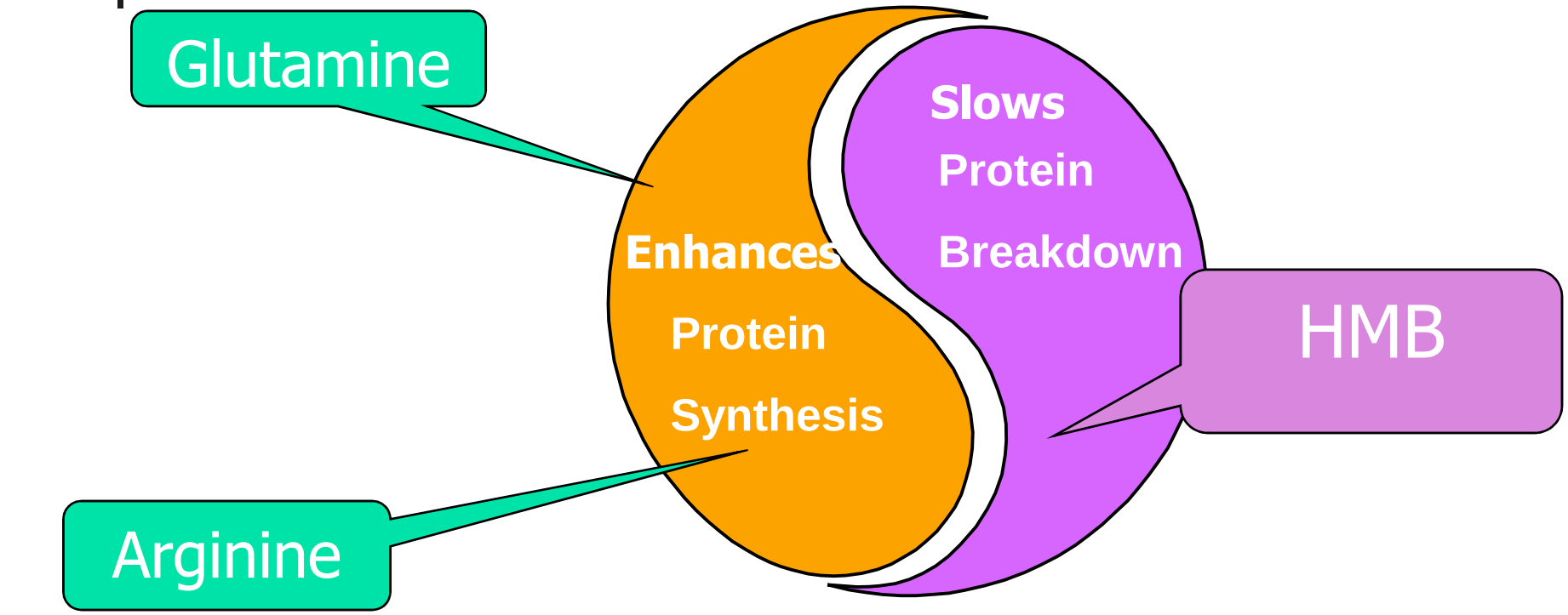
Amino Acids: Glutamine

- Conditionally essential amino acid
- Improves muscle integrity
  - Improves protein synthesis
  - Reduces protein breakdown
  - Acts as a precursor to cell growth and replication
- Improves immune function
- Maintains gut integrity
- Helps support protein/collagen synthesis

β-Hydroxy- β-methylbutyrate (HMB)

- Metabolite of amino acid leucine
- Reduces muscle protein breakdown
- Helps maintain muscle membrane integrity
- Enhances muscle function
- Helps support immune function
- Supplemental HMB serves as a precursor for the manufacturing of cholesterol thus preserving muscle cell integrity and slowing muscle tissue breakdown

Synergistic Effect



Clinical Study

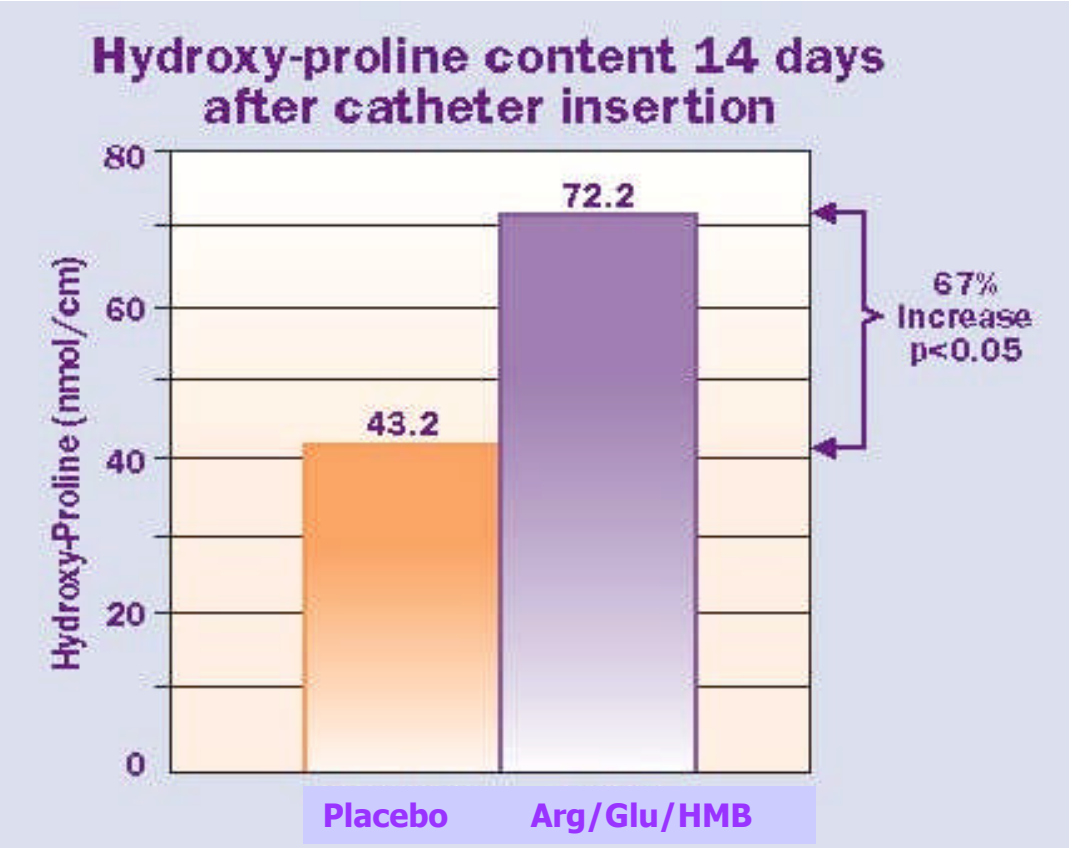
- Effect of a specialized amino acid mixture on human collagen deposition Williams et al
  - Ann Surg 2002
  - Objective: effect of HMB, arginine, and glutamine supplementation on wound collagen accumulation
  - Study Design: randomized, double-blind, placebo controlled

Study Design

- 35 healthy, non-smoking, aged 70+
- Surgical implantation of 2 small PTFE tubes into deltoid region
- 2 servings glu/arg/HMB mixture or isocaloric isonitrogenous control per day
- Catheters removed at 7 and 14 days post-implantation
  - Hydroxyproline (marker or collagen accumulation)

Williams JZ, Abumrad N, Barbul A: Effect of a specialized amino acid mixture on human collagen deposition. *Ann Surg* 2002;236:369-375.

Clinical Study
Data collected at 2 weeks



Pharmaceuticals

- Appetite stimulants
  - Megestrol acetate
  - Dronabinol
  - Cyproheptadine
  - Eldertonic®
  - Mirtazapine
- Anabolic agents
  - Oxandrolone
  - Recombinant human growth hormone (hGHr)

Appetite Stimulants

- Loss of appetite (anorexia) results in very low caloric intake
- Pharmaceuticals may result in improved appetite
- Allow time for drug to reach therapeutic level
- Improved appetite may result in weight gain
- Monitor diabetic patients closely

Anabolic Agents

- Synthetic derivatives of testosterone
- Stimulate protein building (anabolic activity) in skeletal muscle, bone, and kidneys
- Anti-catabolic — prevents protein breakdown
- Anabolic — increases protein synthesis
- Allow optimal use of nutrients
  - Permit repletion of LBM
- Result in positive nitrogen balance

Nutrition Support

- Must ascertain patient and family wishes early
- Must document that all choices have been explained and understood
- Do not have to infuse around the clock
- Enteral = if the gut works, use it
- Parenteral = for nonfunctional GI system

Wound-Specific Tube Feeding Formulas

- 20% to 25% of calories from protein whereas a standard formula has between 15% and 18% of calories from protein
- Vitamin and mineral profile aimed at wound healing

Wound-Specific TF Formulas

- Principle active ingredients
  - Arginine
  - Fish oil
  - FOS
  - Dietary nucleotides
- May reduce risk of wound infections by improving immune defenses

Visit wounds411.com and RD411.com

- FREE peer reviewed information on wound care
  - Forms
  - Patient handouts
  - Nutrition information
  - Slides
  - Patient/family discussion strategies
  - Regulatory and QI information
  - And more!

Summary

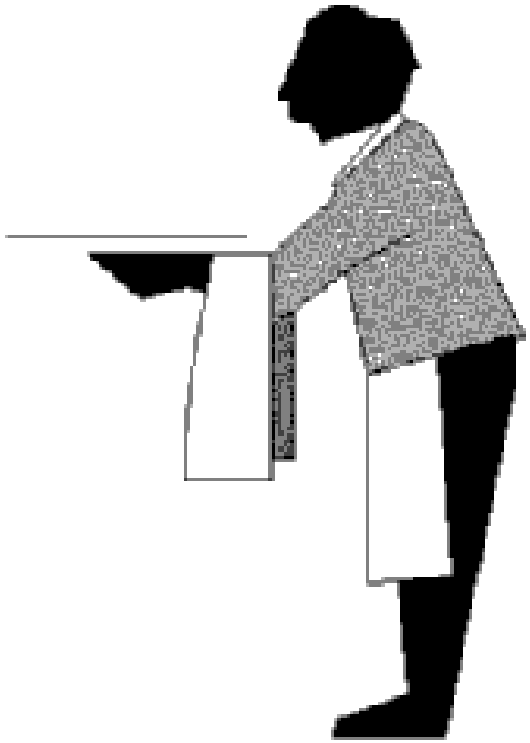
- MNT must be timely and advance along the expected continuum
- Goal is to maintain optimal body composition, replete LBM and meet elevated nutrient needs
- Many new advances in MNT, with products to meet every patient's unique preferences

The Team Approach

We must all work together to communicate the nutrition message!

Final Thought….

The very best nursing and medical care will not heal wounds if there is inadequate nutritional substrate from which to build new tissue.



NUTRITION

The Power of Protein

NANCY COLLINS, PhD, RD, LD/N

Increase protein intake. These three simple words have been featured on nutritional care plans millions of times in nursing homes from New York to New Mexico. In fact, a real-life patient we will call Mrs. Stanley had a nutritional care plan addressing her unintended weight loss, which stated this very intervention. She also had a separate care plan dealing with her heel and sacral pressure ulcers, which reiterated the same three words—increase protein intake. A quick look at the dietitian's notes showed the dietitian concurred and had performed several calculations to back up the recommendation. The documentation stated the following: "115 lbs ÷ 2.2 kg/lb = 52.3 kg x 1.3 g protein/kg body weight = 67.99 g protein/day."

This medical record showed this facility had correctly identified the resident's protein needs and set an intervention in place to address it. So why, some years later, was an attorney staring into the eyes of the dietitian as a court reporter recorded, "Please tell me how you provided 67.99 g of protein to my client every day?" The dietitian did not have much of a recollection of Mrs. Stanley. After all, Mrs. Stanley passed away almost three years ago and was only in the facility for seven months. After a moment, the dietitian asked if she could see her notes. The chart, already open to the nutrition documentation, slid across the table. The dietitian's eyes darted across the few meager entries as she composed an answer. "We gave Mrs. Stanley Ensure® (Ross Products, Columbus, Ohio) three times a day." As the dietitian sighed in relief, the attorney had many more questions and wanted many more answers. How much protein was in each can of Ensure? Did three cans of a medical nutrition supplement provide all the protein she needed? How was the remainder of her protein needs met? Did Mrs. Stanley consume every can in its entirety every day? How often were her labs monitored? Could she possibly heal with her severely depleted albumin level? Were her needs adjusted when her sacral wound worsened to Stage 4? Did she require more protein after the surgical debridement? Could anything else have been done or tried to meet her protein needs?

The next time you review a care plan and it calls for increasing protein intake, consider the exact steps you are going to take to bring this approach to fruition. Knowing and documenting how you are going to achieve this goal is an important component of the care plan. This takes a general understanding of protein.

FUNCTIONS OF PROTEIN

Protein has many specific functions in the body, including helping to maintain fluid and acid-base balance, acting as transporters of certain materials, playing a role in the immune system, acting as hormones, and providing energy if there are insufficient glucose and fatty acids to keep the cells furnished adequately.[1] In the long-term care population, one of the most common functions of protein is growth and repair (eg, when a patient has a pressure ulcer). The body constantly deposits protein into new cells to replace those that have been lost. No new living tissue can be built without protein—so it follows that no wound can heal without adequate protein from which to build new tissue.

(above) To meet a person's protein needs, it may be necessary to supplement his or her meal intake with protein-rich items like milk.

Table 1. Classification of Amino Acids[2]

Indispensable	Dispensable	Conditionally Indispensable
Histidine	Alanine	Arginine
Isoleucine	Aspartic Acid	Cysteine
Leucine	Asparagine	Glutamine
Lysine	Glutamic Acid	Glycine
Methionine	Serine	Proline
Phenylalanine	Tyrosine	
Threonine		
Tryptophan		
Valine		

PROTEIN'S BUILDING BLOCKS

The primary function of dietary protein is to provide amino acids.[3] Protein is different than carbohydrates and fat because it contains nitrogen. Protein is approximately 16% nitrogen, and it is this nitrogen content that gives rise to the amino acids. Amino acids are classified as dispensable, indispensable, or conditionally indispensable.[2]

If your body cannot synthesize the amino acid in question, it is classified as indispensable. This category used to be called essential amino acids; while the name has changed, the meaning has not. If you cannot synthesize it, you must get it from dietary sources.

The dispensable amino acids can be made by the body if it is given sufficient building blocks to do so. These amino acids were formerly called non-essential, implying that you did not have to get them from your diet because the body would manufacture its own supply.

The final category is called conditionally indispensable, which was previously known as conditionally essential. This category includes amino acids that the body can synthesize, but in certain circumstances it may not be able to synthesize enough to keep up with demand. For example, if a patient is suffering from a disease or condition that triggers a physiological stress response with the resultant release of stress hormones, the need for certain amino acids may increase, and the body might not be able to meet the increased demand. Thus, this group is called conditionally indispensable because it requires certain conditions. (See Table 1 for the specific amino acids in each category.)

Understanding the classification of amino acids is relevant because several of today's supplements consist of a single amino acid, such as glutamine or arginine. These amino acids fall into the category of conditionally indispensable. The thought behind this is that by providing extra amounts of certain amino acids, the gap between what the body can manufacture on its own and what the body needs will be narrowed.

PROTEIN REQUIREMENTS

The Recommended Dietary Allowance (RDA) for protein is 0.8 g per kilogram of body weight each day.[2] For example, based on the RDA, a 120-lb adult would require 43.6 g of protein per day (120 lbs ÷ 2.2 = 54.5 kg x 0.8). Most persons are not familiar with gram weights, so it is more practical to convert this to ounces. Generally, one ounce of protein is equivalent to seven grams. (See Table 2 for the protein content of various food groups.) Using the example, 43.6 g is approximately 6 oz per day. It is interesting to note that the typical American consumes almost twice that amount each day.

The RDA is based on the needs of healthy adults. Most patients, and especially those with wounds, would not fall into the category of "healthy adult." This raises the question of how far above the RDA we should estimate protein needs for the patient with multiple diagnoses, including a wound. Optimal protein intake has not been determined, and different sources state different amounts. Generally speaking, most clinicians estimate between 1.2 and 1.5 g protein/kg body weight for patients with a wound. Going back to the example, now the estimated daily needs are between 65.4 and 81.8 g of protein per day, or about 9–12 oz per day. That is quite a difference.

INCREASING PROTEIN INTAKE

To reach these increased levels, supplementation beyond the three standard meals per day will often be necessary. There are many ways to supplement. The most common way is by providing a canned beverage. There are many good products available with differing levels of both calories and protein. When reviewing products for cost effectiveness, it is helpful to remember that an 8-oz glass of whole milk provides 150 kcal and 8 g of protein.

The downside of this approach is that most patients tire quickly of the same supplement day after day. If a supplement is not consumed, it does no good and wastes money. Variety is key, and items, such as high-protein cookies, high-protein gelatins, nutrition bars, and enriched foods (eg, soups and mashed potatoes), can be used to add variety in both flavor and texture. There are many, many products available for purchase to add nutrient density to the meals, including protein powders and liquids. Protein powders are generally well accepted by patients and can be added to prepared foods. Most powders provide 4–5 g of protein per tablespoon. If one tablespoon was added to each meal, an additional 12–15 g would be provided daily. Some liquids are even more nutrient-dense and provide a large amount of protein in a small volume.

If budgetary constraints restrict the number of convenience products available, recipe modification and certain food preparation techniques can be utilized to provide higher amounts of calo-

Table 2. Protein Content of Food Groups[4]

Protein Source	Protein (Grams)
Meat, Poultry, Cheese, Eggs, Fish (1 oz)	7
Milk (1 cup)	8
Breads and Starches (1 slice or 1/2 cup)	3
Vegetables (1/2 cup)	0–2*
Fruits (1 piece or 1/2 cup)	(Trace)
Fats	0

*Beans and legumes have the highest protein content

ries and protein in common foods. Snacks may be as simple as a hard-boiled egg (80 kcal and 7 g of protein) or cheese sticks. Another technique for patients who consume at least 75% of most meals is to serve an extra ounce of the entrée at each meal, since it usually contains the protein. For milk drinkers, the consumption of additional milk or flavored milk can be encouraged. The best policy is to treat each patient as an individual and find out which foods would be accepted and preferred and document this in the medical record.

THE POWER OF PROTEIN

Mrs. Stanley's case was settled in her family's favor, as most cases of this type are. The documentation could not conclusively demonstrate that she was provided appropriate, individualized care to heal her wounds, maintain her weight, and promote her overall safety and well being. Incomplete meal records, untotaled intake and output records, sporadic wound care notes, and other inconsistencies all played a role in the outcome. The next time you look at a chart calling for increasing protein intake, examine it with a more critical eye—and put the documentation to the test. If you reviewed the medical record several years from now, would you be able to describe in detail the exact steps you were taking to meet the patient's need for more protein and whether those steps were successful? ■

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