NUTRITION & WOUND HEALING

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The Importance of Nutrition for Wound Healing

- Nutrients are the building blocks of healing. When developing a pressure ulcer prevention or wound management protocol, nutrition is too often overlooked. This is a serious omission.
- Nutrition plays a role in virtually every phase of wound healing.
- An appropriate diet, combined with outstanding routine care, can prevent many pressure ulcers and speed the healing of existing wounds.

The Importance of Nutrition for Wound Healing

- Malnutrition Effects:
  - A diet lacking in critical nutrients places individuals at a higher risk of pressure ulcer development, infection and impaired healing.

- Critical Nutrients:
  - Certain nutrients play an important role in the wound management process. It is important for healthcare professionals to learn more about these critical nutrients and their healing properties.

The Importance of Nutrition for Wound Healing

- Nutritional Guidelines:
  - Adequate amounts of calories and critical nutrients help to speed the healing process.
- Healing & Protein:
  - Research shows that very-high-protein diets stimulate healing.

The Primary Goals of Nutritional Support

- Patients are given adequate nutrients to reduce the risk of developing pressure ulcers and to support healing.[1,2]

- To achieve this, nutritional support is designed to prevent or correct nutritional deficits, maintain or achieve positive nitrogen balance, and restore or maintain serum albumin levels.

1. Bergstrom N, Bennett MA, Carlson CE, et al. (1994).
2. Panel for the Prediction and Prevention of Pressure Ulcers in Adults. *Pressure Ulcers in Adults: Prediction and Prevention. Clinical Practice Guideline.* Number 3. Rockville, MD: U.S. Department of Health and Human Services, Public Health Service, Agency for Health Care Policy and Research; 1992. AHCPR Publication No. 92-0047.

Malnutrition Effects

- Diets including adequate protein, vitamins C and A, zinc and selenium can provide the needed building blocks for maintaining skin integrity and healing uncomplicated wounds.

- Diets that lack necessary nutrients, however, can seriously compromise healing.

Malnutrition Effects

- Increased likelihood of infection:
  - Because every phase of wound healing is influenced by malnutrition, the effects are seen throughout the entire process. Delayed wound healing leads to the increased risk of infection.

Malnutrition Effects

- Decreased or abnormal collagen accumulation:
  - The steps necessary for the cross-linking of collagen are disrupted, leading to a weaker framework.
- Reduced wound strength:
  - As collagen weakens or remodels ineffectively, the wound itself is weaker and may never attain 80 percent of the skin's previous strength. This puts the wound area at even higher risk of recurrence.

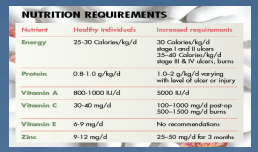
Malnutrition Effects

- Retarded epithelialisation:
  - The wound will never be able to fully close and form a mature scar if the appropriate nutrients are not available to sustain the formation and migration of epithelial cells over it.

Critical Nutrients

NUTRITION REQUIREMENTS

Nutrient	Healthy individuals	Increased requirements
Energy	25-30 Calories/kg/d	30 Calories/kg/d stage I and II ulcers 35–40 Calories/kg/d stage III & IV ulcers, burns
Protein	0.8-1.0 g/kg/d	1.0–2 g/kg/d varying with level of ulcer or injury
Vitamin A	800-1000 IU/d	5000 IU/d
Vitamin C	30-40 mg/d	100–1000 mg/d post-op 500–1500 mg/d burns
Vitamin E	6-9 mg/d	No recommendations
Zinc	9-12 mg/d	25–50 mg/d for 3 months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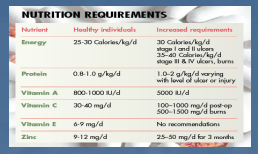
Critical Nutrients

- Much research has been done on the value individual nutrients play in the management of healing wounds.

- The following nutrients are considered important to the healing process:
  - Proteins
  - Lipids
  - Vitamins A, C & K
  - Zinc
  - Arginine
  - Manganese
  - Glutamine
  - Selenium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Critical Nutrients
Proteins

- Healing wounds make the body catabolic, and even short-term, moderate protein deprivation may affect the repair process.
- Without sufficient amino acids, protein synthesis is reduced.
- In the face of insufficient protein stores, even the immune system is weakened through decreased B-cells and T-cells.
- Wound contraction is reduced as a result of decreased collagen remodelling.

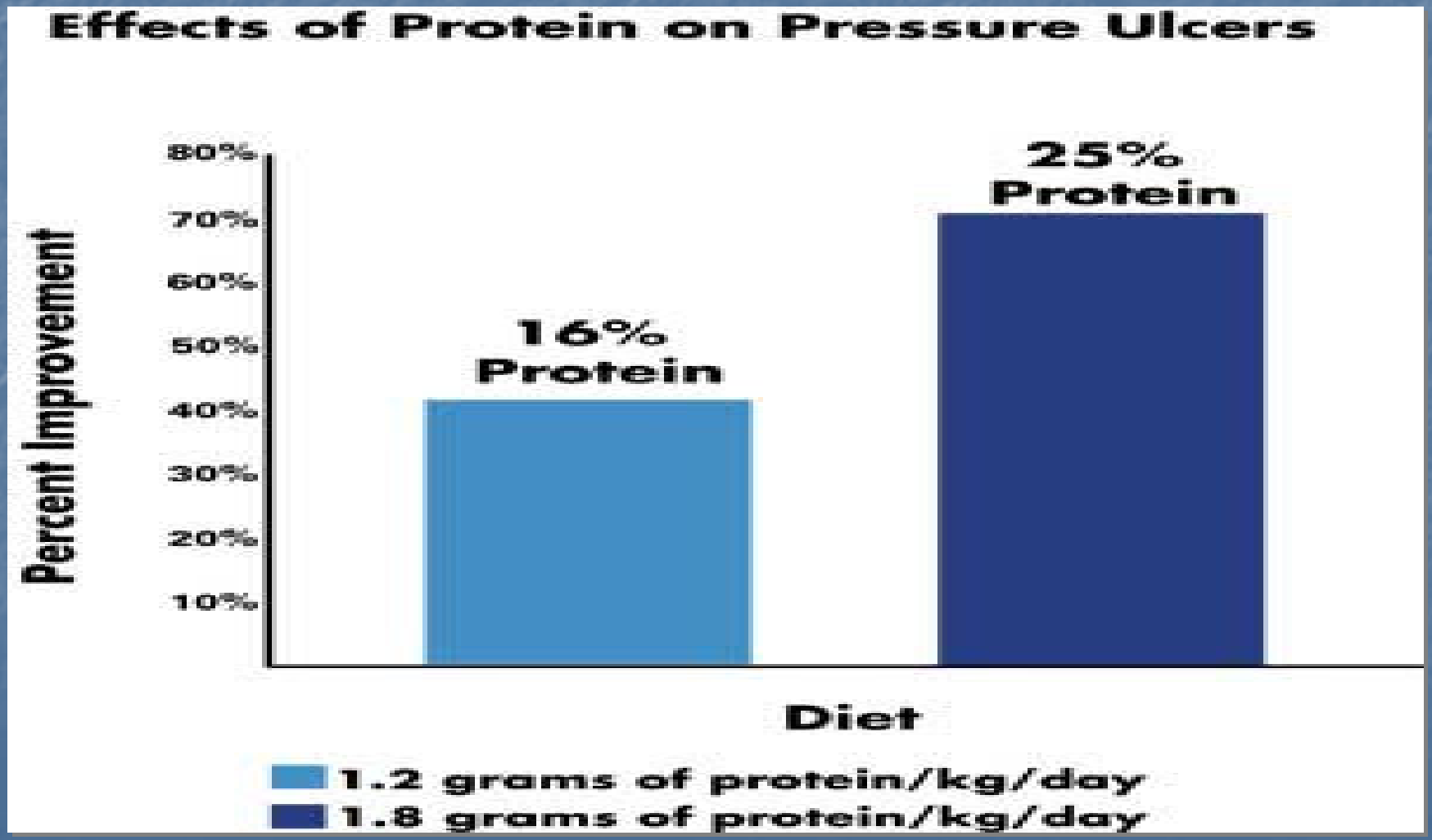
Healing & Protein

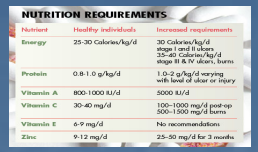
- Studies have demonstrated the value of protein in wound healing.
- As the following bar chart shows, very-high-protein diets can have a profound effect on the speed of recovery.

Healing & Protein

- The study group included 12 patients receiving tube feedings who were monitored for eight weeks to assess tolerance and ulcer healing. Both groups did show healing, but as seen in the bar graph, the very-high-protein group showed more healing in the same time frame. In this group, four out of six patients had complete healing of their ulcers.
  - Source: Chernoff RS, JADA, 1990:90(9): A–130

Healing & Protein





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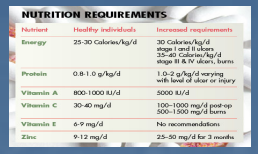
Critical Nutrients
Lipids

- Fat provides the overall source of energy for cells during the healing process.
- Essential fatty acids are critical components of all cell membranes (as phospholipid and triglycerides).



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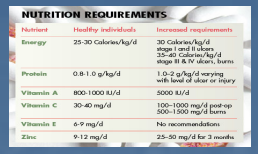
Critical Nutrients
Lipids

- Linoleic (n6) and Linolenic (n3) ratios are important in minimizing inflammation and down regulation of the immune response. (High n6 diets promote inflammation).

- The recommended target for n6:n3 ratios is 4:1 or less.



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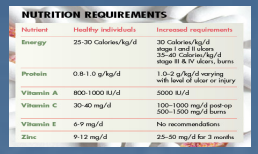
Critical Nutrients
Energy

- Adequate calories are needed to spare protein and allow for increased cellular needs due to infection.
- Glucose is the body's preferred substrate for repair. Without exogenous glucose, amino acids will be oxidized for energy.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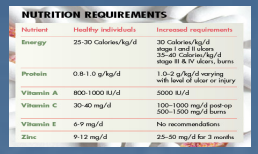
Critical Nutrients
Energy

- The recommended breakdown of nutrients to attain the calories needed for optimal wound healing is:
  - fat around 30%,
  - protein around 20-25% and
  - carbohydrates between 45-50% of total calories.



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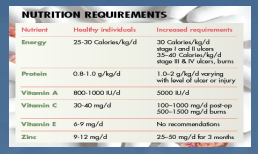
Critical Nutrients
Vitamin A

- Vitamin A is a fat-soluble vitamin that helps reduce inappropriate cross-linking of collagen fibres.

- Patients who have malabsorption problems or are on steroids may need supplementation with Vitamin A.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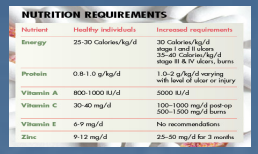
Critical Nutrients
Vitamin A

- The recommended Vitamin A supplementation is 25,000 IU/day for 10 days for those patients who are deficient.

- Caution must be used, as Vitamin A can be toxic at 30 times the RDA for many days .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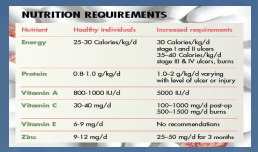
Critical Nutrients
Vitamin C

- Vitamin C is a water-soluble vitamin and is needed for the hydroxylation of proline, which is a nonessential amino acid necessary for wound healing. A deficiency in Vitamin C will likely cause a delay in wound healing.

- Vitamin C is commonly supplemented at 1,000-2,000 mg/day for patients who are deficient, and 100-200 mg/day for patients who need extra vitamin C to promote wound healing.

- Vitamin C is unlikely to become toxic because it is water soluble.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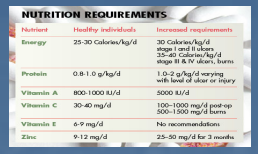
Critical Nutrients
Vitamin K

- Vitamin K is a fat-soluble vitamin that is necessary for normal coagulation. This is the primary activity in the first phase of wound healing. Deficiency may result in prolonged healing times and haematoma formation.
- Vitamin K deficiencies may develop in patients who have malabsorption problems or from drug interactions.



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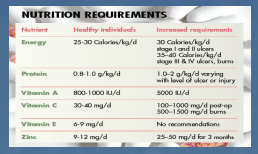
Critical Nutrients
Zinc

- Zinc is a mineral that is involved in over 100 enzymatic reactions in the body. It is a key factor in the process of wound healing. Zinc is a cofactor in collagen synthesis. Deficiencies result in delayed wound healing.

- Zinc is primarily excreted in the stool so patients with large ostomy outputs or diarrhea often may be deficient in zinc. Also, malabsorption and chronic steroid use may lead to zinc deficiency.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Critical Nutrients
Zinc

- The elderly are commonly zinc deficient, as their intake ranges between 7-11 mg/day, but the RDA is between 12-15 mg.
- Oral zinc sulfate has been shown to improve wound healing for decubitus ulcers and burns by supplementation with 220 mg of zinc sulfate, three times a day, for a two-week period.
- Caution must be used when supplementing zinc because increased serum zinc can impair immune function and also interfere with copper absorption.

Critical Nutrients
Arginine

- Arginine is a conditionally essential amino acid that may become depleted during times of stress. It may improve wound healing by enhancing collagen deposition.

- Arginine stimulates the release of anabolic hormones vital to wound healing:
  - growth hormone and
  - insulin.

Critical Nutrients
Arginine

- Arginine's role as substrate for enzymes integral to wound healing may shift along the time course of the healing process.
- A deficit or excess of Arginine may be suboptimal for wound healing.

Critical Nutrients
Manganese

- Manganese is a mineral found in whole grains and green leafy vegetables and is necessary for wound healing.

Critical Nutrients
Glutamine

- Glutamine is a conditionally essential amino acid that may become depleted during periods of stress.

- Glutamine is the major component of muscle tissue and may aid in the process of wound healing.

The Role of Nutrients in Wound Healing - Summary

- Protein
  - Tissue formation
  - Collagen synthesis
  - Wound remodelling
  - Immune support

The Role of Nutrients in Wound Healing - Summary

- Vitamin A
  - Collagen synthesis
  - Epithelialisation
  - Immune support

The Role of Nutrients in Wound Healing - Summary

- Vitamin C
  - Collagen synthesis
  - Antioxidant
  - Immune support
  - Capillary integrity

The Role of Nutrients in Wound Healing - Summary

- Vitamin E
  - Antioxidant

The Role of Nutrients in Wound Healing - Summary

- Zinc
  - Collagen synthesis
  - Protein synthesis

Critical Nutrients
Selenium

- Selenium is a key mineral in the wound-healing process, involved in decreasing antibody response and protecting against immuno-suppression.

- It is also a cofactor with Vitamin E in protecting against lipid membrane damage.

Nutritional Guidelines

- Based on the conclusions of leading researchers, intake guidelines for effective wound management are the following:

Nutritional Guidelines
Protein

- 1.25-2.0 g/kg/d:
  - For a healthy individual, protein requirements are approximately 0.8 g/kg per day. Patients with wounds may need as much as 2.5 g/kg per day. This provides enough protein so it is available for healing instead of being used for energy.

Nutritional Guidelines
Fluid

- 30-40 cc/kg/d:
  - With an increase in protein, a patient's diet should also have increased fluid intake to allow for the extra protein and help maintain kidney health.

Nutritional Guidelines
Energy

- 30-40 kcal/kg/d
  - Because wounds and infection increase metabolic rates, the calorie needs of patients with wounds would be slightly higher than normal.

Nutritional Guidelines
Vitamin A

- 20,000-25,000 IU/d
  - Recommendation is between 20,000-25,000 IU/day for 10 days.
  - Use caution, however. Due to the fat solubility, high levels for extended periods of time may become toxic.

Nutritional Guidelines
Vitamin C

- 1,000-2,000 mg/d:
  - For those patients who are deficient, 1,000-2,000 mg/day are recommended.
  - In addition, supplementation with 100-200 mg/day for those patients with wounds is often used.

Nutritional Guidelines
Zinc

- 50 mg/d (220 mg $ZnSO_4$):
  - Recommendation for zinc supplementation is 150 mg of elemental zinc for deficient patients. This equates to 220 mg of zinc sulfate, three times a day, to provide that amount of elemental zinc.
  - Because zinc can become toxic and can interfere with copper absorption, it is recommended that supplementation be limited to 2-3 weeks for those at risk of zinc deficiency.

Thank you!