Nutrition Management of Wounds v3.0: Phase I

Approval & Citation | Summary of Version Changes | Explanation of Evidence Ratings

Inclusion Criteria

- Surgical incisions with delayed healing (dehisced, deteriorating, stalled healing, infected)
- Open full thickness wounds
- Severe skin breakdown (i.e. Stevens-Johnson Syndrome, GVHD, epidermolysis bulosa, necrotizing fasciitis, ulcerative diaper dermatitis, radiation burns, staph scalded skin)
- Wound Vac for large, complex wounds
- Pressure ulcers (stage III and IV)

Exclusion Criteria

- At risk for pressure ulcer (if low Braden per hospital nutrition risk screening)
- Normal healing surgical incisions (please refer to service specific coverage plans)
- Pressure ulcers stage I and II

Order Nutrition Management of Wounds Powerplan
(Includes automatic Nutrition Consult)

RD to Complete Nutrition Assessment

Nutrition Status
- Assess for presence of malnutrition
- Estimate nutritional needs

Physical
- Obtain description of wound type, size, and location (review documentation and/or discuss with care providers)

Diet History
- Assess adequacy of intake
- Assess ability to eat
- Assess for gastrointestinal symptoms (diarrhea, emesis, nausea)

Ensure Adequate Intake of All Nutrients

- Initiate protein intake minimum of 1.5-2 X RDA (or per disease specific condition)
- If eating, provide education and handout on nutrition for wound healing (PE2115)
- Start Multivitamin-Mineral Supplement (MVMS) if not on TPN or receiving adequate intake from enteral nutrition (EN)
- Order Calorie Counts and offer oral supplements if patient is taking PO
- Liberalize diet restrictions as appropriate and involve diet technician for plan to improve intake
- If unable to meet >75% estimated needs with oral intake, initiate EN or TPN per SCH guidelines
- If feasible, order Indirect Calorimetry / Metabolic Cart study for patients in the ICU or with a diagnosis of malnutrition

Dietitian to Re-assess Wound Status in 5-7 Days

- Determine wound healing progress per discussion with practitioners involved in patient's wound care or per review of written documentation
- Assess adequacy of nutrient intake (i.e., I/O, calorie counts)
- Monitor adequacy and tolerance of protein per BUN, creatinine levels and ratio
- Assess anthropometrics (i.e., weight trends, BMI, weight/length)

Wound is healing appropriately

Wound is not healing appropriately despite adequate intake

Continue Current Nutritional Intervention
- Dietitian to continue to reassess wound healing status every 5-7 days
- Discontinue above nutrition intervention once wound is healed

Discharge Instructions:
- Help coordinate ambulatory nutrition follow-up plan with medical team

Go to Phase II

For questions concerning this pathway contact nutritioninwoundmanagement@seattlechildrens.org

Last Updated: March 2020
Next Expected Review: March 2025

Nutrition Management of Wounds v3.0: Phase II

Approval & Citation | Summary of Version Changes | Explanation of Evidence Ratings

Nutritional Intervention

- Increase protein starting at a minimum of 20-25% > current dose unless already maximized. Consider Nitrogen Balance study to assess protein adequacy. See Special Considerations.
- Consider specialized protein supplement
- Check serum vitamin C and zinc levels and start empiric supplementation as outlined below while awaiting levels. **Continue supplementation ONLY if a deficiency is confirmed.**
- Order Indirect Calorimetry / Metabolic Cart study if feasible to better assess energy needs.
- Discuss with team other factors causing delayed wound healing (i.e., poor dressings, inadequate turning)

!!
Special considerations for protein, vitamin C and zinc

Continue Current Intervention

- Dietitian to continue to reassess wound healing status every 5-7 days.
- For vitamin C and zinc deficiencies, recheck levels every 2 weeks until replete. Discontinue supplementation once levels are replete.
- Discontinue above nutrition intervention once wound is healed

Discharge Instructions:

- Assess need for vitamin/ mineral supplementation after discharge and develop plan
- Help coordinate ambulatory nutrition follow-up plan with medical team

Supplement Vitamin C & Zinc (See Special Considerations)

- Supplementation is in **ADDITION** to what patient is already receiving from diet, EN, PN, and MVMS.
- Follow SCH formulary for vitamin C and zinc clinical indications and dosing.

*Note- Above recommendations exclude current supplementation for disease specific conditions (i.e., BMT, GI losses, iron therapy)

For questions concerning this pathway contact nutritioninwoundmanagement@seattlechildrens.org

Last Updated: March 2020
Next Expected Review: March 2025

Malnutrition Diagnosis Criteria

Primary Indicators*	Mild Malnutrition	Moderate Malnutrition	Severe Malnutrition
Weight for height z score	-1 to -1.9 z score	-2 to -2.9 z score	-3 or greater z score
BMI [a] for age z score	-1 to -1.9 z score	-2 to -2.9 z score	-3 or greater z score
Length/height z score	No data	No data	-3 or greater z score
Mid-upper arm circumference (MUAC)	-1 to -1.9 z score	-2 to -2.9 z score	-3 or greater z score
Weight gain velocity (<2 years of age)	<75% of the norm [b] for expected weight gain	<50% of the norm [b] for expected weight gain	<25% of the norm [b] for expected weight gain
Weight loss (2 to 20 years of age)	≥5% usual body weight	≥7.5% usual body weight	≥10% usual body weight
Deceleration in weight for length/height z score	Decline of 1 z score	Decline of 2 z score	Decline of 3 z score
Inadequate nutrient intake	51 to 75% estimated energy/protein need	26 to 50% estimated energy/ protein need	≤ 25% estimated energy/protein need

*Only one primary indicator is needed to diagnose malnutrition. However, the more indicators used, the stronger the diagnosis.

[a]Body Mass Index
[b]World Health Organization data for patients younger than 2 y old

Becker PJ, et al. *J Acad Nutr Diet*. 2014; 114:1988-2000.

Return to Home

Indirect Calorimetry

Definitions	• **Indirect calorimetry** (IC) uses measures of the oxygen (O2) a patient consumes and the carbon dioxide (C02) produced to calculate energy expenditure (EE) and the respiratory quotient (RQ). • A **Metabolic Cart** is a machine or device that uses IC to measure EE. A **metabolic cart study** is ordered when you want to use IC to measure a patient's energy expenditure to determine energy needs. Metabolic Cart studies usually take 15-30 minutes to complete. • **Respiratory Quotient** is the volume of CO2 produced divided by the volume of O2 consumed. In the hospital setting, it is used primarily to judge the validity of the EE result. If the RQ is between 0.7 to 1.0 – 1.1, the EE result should be considered valid. If the RQ is outside this range, the literature says the EE result should be questioned. However, sometimes perfectly believable EE results are reported with RQ's outside the recommended range. In this case, consider using it, and recheck in 1-2 weeks. The literature also states that an RQ>1 may indicate overfeeding.
Which patients should be considered for IC?	• Underweight (BMI < 5th) or Overweight/Obese (BMI >95th) • Children with >10% weight loss or gain during hospital stay • Failure to wean from or need to escalate respiratory support • Need for muscle relaxants (e.g. vecuronium) for > 7 days • Neurologic trauma/hypoxia with evidence of dysautonomia • Oncologic diagnoses (including BMT) • Children with thermal injuries • Children requiring mechanical ventilation > 7 days • Children suspected to be severely hypermetabolic (status epilepticus, hyperthermia, SIRS, dysautonomic storming) or hypometabolic (hypothermia, pentobarbital coma) • Any patient with ICU length of stay > 4 weeks • Patients on Nutrition Management of Wounds pathway
Prerequisites for IC	• Inpatient (can be on room air or on mechanical ventilation). Patients on room air must be big enough to fit the face mask and be willing to keep the mask on for the duration of the test. • Weight >= 7 kg • FiO2 should be <50% • Hemodynamic and temperature stability
Conditions That Disqualify Patients for IC (see also prerequisites)	• Need for supplemental oxygen via HFNC, BiPAP and CPAP • ECMO (extra corporeal mechanical oxygenation) • Need for Nitric oxide or anesthetic gas therapy • Agitation, pain, fevers, seizures during the test • Large air leak in the circuit (e.g. leaking chest tubes)

Return to Home

Continue to pg 2

Indirect Calorimetry

How do you order a Metabolic Cart Study?	• Direct the ordering physician to enter "Metabolic Cart Study" in the Orders tab. Once ordered, it will appear under the "Diagnostic Tests" order tab. • E-mail the pulmonary lab at PulmonaryLab@seattlechildrens.org. Tell them who you want tested and why. They can e-mail you the results; or they can let you know why they were unable to do the study.
What to do with the results once you get them.	• Look for the "REE (Kcal/day)" result on the mid-upper left side of the results print-out. Next to it (to the right) is the software's "Predicted" REE based on the patient's height, weight, gender and age. • Look at the RQ just below the REE. If RQ > 1.1, the results may not be valid (use your judgement—do the results make sense?). • Consider padding the REE result by 5-15% to account for energy expenditure due to regular nursing care and some minor movement when patient is awake. If the patient is agitated or moves quite a bit, you may need to pad results more. • If the result is significantly higher than is reasonable to expect, talk with the Respiratory Therapist who did the study and see if it can be repeated.
Other miscellaneous information.	• Metabolic Cart studies can be done when patients are on continuous drip feeds or when they are fasting (5 hr fast is ideal). Since patients should be completely at rest during the study, IC should not be done during or just following a meal. • There is some evidence that IC can be done with patients on Continuous Renal Replacement Therapy (CRRT) or intermittent dialysis, though traditionally, IC has been discouraged during dialysis therapy due to the effect dialysis has on acid/base balance. • Metabolic Cart studies may be available to outpatients in the Pulmonary Function Lab in the future. The logistics for this (scheduling, billing insurance, reporting results) need to be worked out.
References	1. Fraipont, V. (2013, November). Energy Estimation and Measurement in Critically Ill Patients. JPEN, 37 (6), pp. 705-713. 2. Mehta, N. (2009, May-June). A.S.P.E.N. Clinical Guidelines: Nutrition Support of the Critically Ill Child. JPEN, 33 (3), pp. 260-276. 3. Mehta, N. (2009, May-June). Cumulative Energy Imbalance in the Pediatric Intensive Care Unit: Role of Targeted Indirect Calorimetry. JPEN, 33 (3), pp. 336-344. 4. Doley, J. (2011, June). Nutrition Management for the Patient Requiring Prolonged Mechanical Ventilation. Nutrition in Clinical Practice, 26 (3), pp. 232-241. 5. Kyle, U. (2012, March). Is Indirect Calorimetry a Necessity of Luxury in the Pediatric Intensve Care Unit? JPEN, 36 (2), pp. 177-182. 6. Haugen, H. (2007, August). Indirect Calorimetry: A Practical Guide for Clinicians. Nutrition in Clinical Practice, 22 (4), pp. 377-388. 7. Krenitsky, J. (July 22, 2011). Nutrition Support Blog: Indirect Calorimetry as the "Gold Standard"? www.healthsystem.Virginia.edu/pub/dietitian/inpatient/dh/nutrition-support-team-blog. 8. Scheinkestel, C.D. (2003). Prospective Randomized Trial to Assess Caloric and Protein Needs of Critically Ill, Anuric, Ventilated Patients Requiring Continuous Renal Replacement Therapy. Nutrition, 19 (11/12), pp. 909-916

Return to Home

Vitamin C, Zinc and Protein Requirements

Vitamin C			Zinc		Protein		
Age	RDA (mg)	Upper Limit (mg)	RDA	Upper Limit (mg)	Age	RDA g/day	Upper Limit
Infants 0-6 mo	40	ND	2	4	Infants 0-6 mo	1.52g/kg	
Infants7-12 mo	50	ND	3	5	Infants 7-12 mo	1.2g/kg	
Children 1-3 y	15	400	3	7	Children 1-3 y	1.05g/kg	
Children 4-8 y	25	650	5	12	Children 4-13 y	0.95g/kg	
Males 9-13 y	45	1200	8	23	Adol 14-18 y	0.85g/kg	
Males 14-18 y	75	1800	11	34	Adults >18 y	0.8g/kg	
Males 19-30 y	90	2000	11	40			
Females 9-13 y	45	1200	8	23			
Females 14-18 y	65	1800	9	34			
Females 19-30 y	75	2000	8	40			

Seattle Children's
HOSPITAL • RESEARCH • FOUNDATION

Return to Home

Return to Phase II

Special Considerations

Protein	1) Patients with Chronic Kidney Disease* or Acute Kidney Injury**: a. Consider a more modest increase in protein ~10-15% if BUN or Creatinine levels are significantly elevated 2) Patients with Chronic Liver Failure: a. Monitor Ammonia levels 3) Patients with metabolic disorders, organic acidemia and inborn errors of amino acid metabolism: a. Discuss protein adjustments for wound healing with metabolic team
Vitamins	1) Patients who are prone to forming kidney stones or with renal insufficiency: a. Avoid intake of vitamin C from diet and/or supplementation greater than 2x RDA b. Substitute renal vitamin (Nephronex/Nephro-Vite) for standard Multi-vitamin Mineral Supplement to prevent vitamin A toxicity. Consider adding the RDA for zinc as renal vitamins do not contain zinc 2) Additional vitamin C may not be appropriate if Ferritin levels are elevated
Zinc	1) Monitor copper and iron levels in patients who have been on prolonged therapeutic zinc doses as there is a risk of deficiency due to reduced absorption of copper and iron 2) Note- Zinc supplementation can sometimes cause diarrhea or loose stools

**Chronic Kidney Disease (K/DOQI):*

- Defined as either kidney damage or GFR <60 for >3 months
- Disease stage 1-5 is assigned by level of kidney function using the GFR

***Acute Kidney Injury:*

- Not as easily defined
- Determined by decreases in either GFR or urine output, and/or increase in serum Creatinine

Return to Home

Return to Phase II

Evidence Ratings

This pathway was developed through local consensus based on published evidence and expert opinion as part of Clinical Standard Work at Seattle Children's. Pathway teams include representatives from Medical, Subspecialty, and/or Surgical Services, Nursing, Pharmacy, Clinical Effectiveness, and other services as appropriate.

When possible, we used the GRADE method of rating evidence quality. Evidence is first assessed as to whether it is from randomized trial or cohort studies. The rating is then adjusted in the following manner (from: Guyatt G et al. J Clin Epidemiol. 2011;4:383-94.):

Quality ratings are *downgraded* if studies:

- Have serious limitations
- Have inconsistent results
- If evidence does not directly address clinical questions
- If estimates are imprecise OR
- If it is felt that there is substantial publication bias

Quality ratings are *upgraded* if it is felt that:

- The effect size is large
- If studies are designed in a way that confounding would likely underreport the magnitude of the effect OR
- If a dose-response gradient is evident

Guideline – Recommendation is from a published guideline that used methodology deemed acceptable by the team.

Expert Opinion – Our expert opinion is based on available evidence that does not meet GRADE criteria (for example, case-control studies).

Quality of Evidence:

✪✪✪✪ High quality
✪✪✪○ Moderate quality
✪✪○○ Low quality
✪○○○ Very low quality
Guideline
Expert Opinion

Return to Home

Return to Phase II

Nutrition Management of Wounds Approval & Citation

Approved by the CSW Nutrition Management of Wounds team for March 17, 2020 go-live

CSW Nutrition Management of Wounds Team:

Clinical Nutrition, Owner	Kristen Thompson, MPH, RDCD
Clinical Dietitian II	Ashley Fuller, MS, RD, CD, CNSC
Nutritional Services, Director	Polly Lenssen, MS, RDN, CD, FAND
CNS, Surgical Unit	Ashley Van Drunen, MN, RN, PCNS-BC, CPN
Wound Nurse Specialist	Sharon Nielsen, BSN, RN, CWCN

Clinical Effectiveness Team:

Consultant:	Jean Popalisky, DNP
Project Manager:	Asa Herrman
CE Analyst:	Susan Stanford, MPH, MSW
CIS Informatician:	Michael Leu, MD, MS, MHA
Librarian:	Peggy Cruse, MLIS
Program Coordinator:	Kristyn Simmons

Clinical Effectiveness Leadership:

Medical Director:	Darren Migita, MD
Operations Director:	Karen Rancich Demmert, BS, MA

Retrieval Website: http://www.seattlechildrens.org/pdf/nutrition-management-of-wounds-pathway.pdf

Please cite as:
Seattle Children's Hospital, Thompson K, Fuller A, Herrman A, Lenssen P, Leu MG, Nielsen S, Popalisky J, Van Drunen A. 2020 March. Nutrition Management of Wounds Pathway. Available from: http://www.seattlechildrens.org/pdf/nutrition-management-of-wounds-pathway.pdf

Return to Home

Return to Phase II

Seattle Children's
HOSPITAL • RESEARCH • FOUNDATION

Summary of Version Changes

- **Version 1.0 (12/05/2011):** Go live
- **Version 2.0 (4/22/2015):** Periodic review; updated literature search and recommendations
- **Version 2.1 (5/7/2015)**: Correction to Proteinex page
- **Version 2.2 (7/30/2018):** Move "consider specialized protein supplement" from a yellow caution box to the nutritional intervention green box with current link
- **Version 2.3 (12/28/2018):**Updating language for Metabolic Cart Study
- **Version 3.0 (3/17/2020):** Periodic review; updated literature search and recommendations

Return to Home

Return to Phase II

Medical Disclaimer

Medicine is an ever-changing science. As new research and clinical experience broaden our knowledge, changes in treatment and drug therapy are required.

The authors have checked with sources believed to be reliable in their efforts to provide information that is complete and generally in accord with the standards accepted at the time of publication.

However, in view of the possibility of human error or changes in medical sciences, neither the authors nor Seattle Children's Healthcare System nor any other party who has been involved in the preparation or publication of this work warrants that the information contained herein is in every respect accurate or complete, and they are not responsible for any errors or omissions or for the results obtained from the use of such information.

Readers should confirm the information contained herein with other sources and are encouraged to consult with their health care provider before making any health care decision.

Return to Home

Bibliography

Literature Search Methods:

For this update, we revised the search strategies in line with current Library practices. Literature searches were conducted in June 2019. The search targeted synthesized literature on skin wounds or wound-healing and nutrition. Results were limited to 2014-current and English language. The search was executed in Ovid Medline, Embase, Cochrane Database of Systematic Review (CDSR), and Turning Research into Practice database (TRIP).

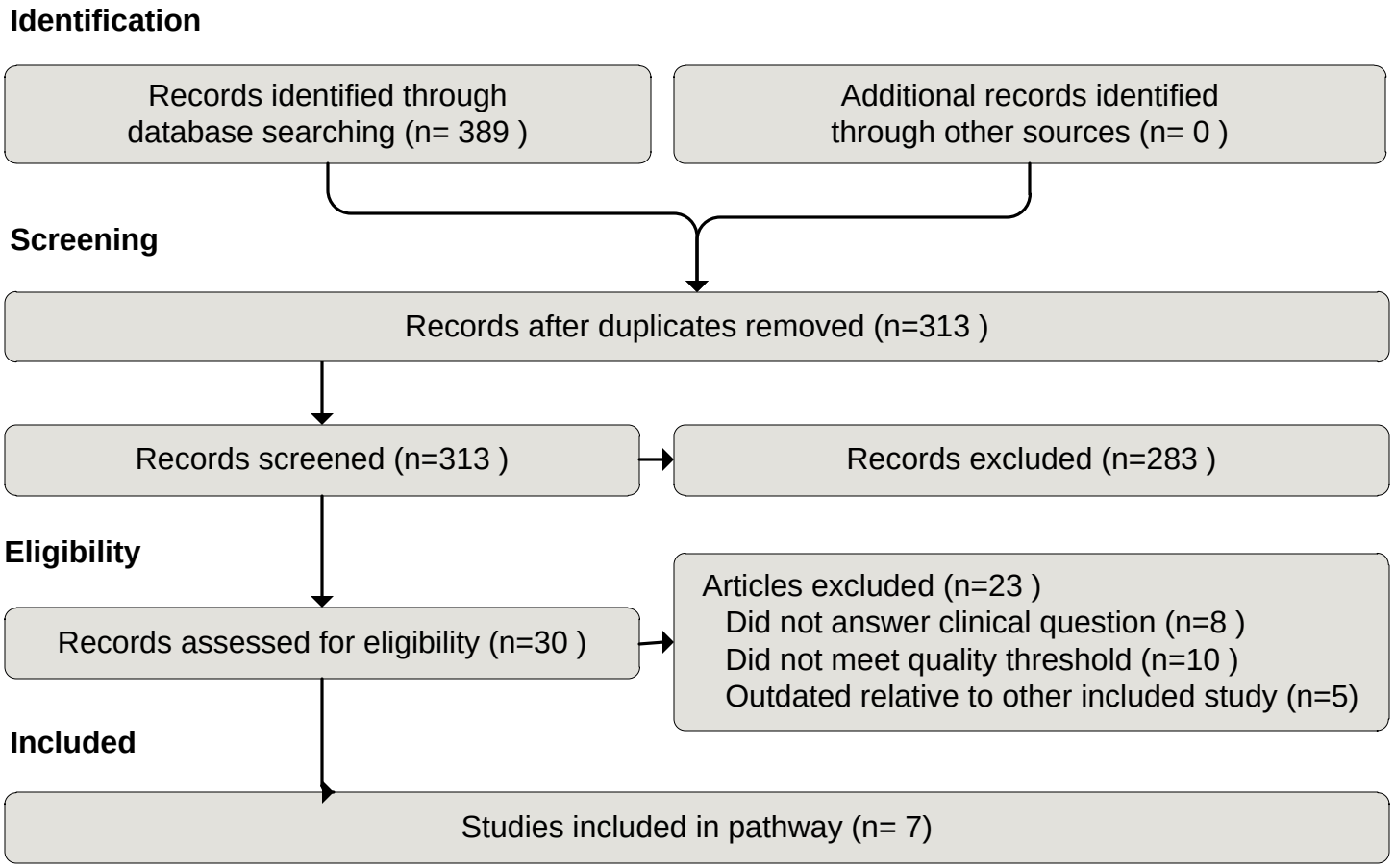
Screening and data extraction were completed using DistillerSR (Evidence Partners, Ottawa, Canada). Two reviewers independently screened abstracts and included [guidelines and systematic reviews] that addressed [optimal diagnosis, treatment, and prognosis of patients who meet pathway inclusion/exclusion criteria]. One reviewer screened full text and extracted data and a second reviewer quality checked the results. Differences were resolved by consensus.

Literature Search Results:

The searches of the 4 databases (see Electronic searches) retrieved 313 records. Our searches of other resources [insert sources e.g. hand searches] identified 0 additional studies that appeared to meet the inclusion criteria.

Once duplicates had been removed, we had a total of 313 records. We excluded 283 records based on titles and abstracts. We obtained the full text of the remaining 30 records and excluded 23.

We included 7 studies. The flow diagram summarizes the study selection process. Citations obtained outside the structured search parameters are listed under Additional References.



Flow diagram adapted from Moher D et al. BMJ 2009;339:bmj.b2535

To Bibliography, Pg 2

Return to Home

Bibliography

Cereda, E., Neyens, J. C. L., Caccialanza, R., Rondanelli, M., & Schols, J. (2017). Efficacy of a Disease-Specific Nutritional Support for Pressure Ulcer Healing: A Systematic Review and Meta-Analysis. Journal of Nutrition, Health & Aging, 21(6), 655-661. doi:https://dx.doi.org/10.1007/s12603-016-0822-y

Liu, P., Shen, W. Q., & Chen, H. L. (2017). Efficacy of arginine-enriched enteral formulas for the healing of pressure ulcers: a systematic review. Journal of Wound Care, 26(6), 319-323. doi:https://dx.doi.org/10.12968/jowc.2017.26.6.319

National Pressure Ulcer Advisory, P., European Pressure Ulcer Advisory, P., & Pan Pacific Pressure Injury, A. (2014). Prevention and Treatment of Pressure Ulcers: Clinical Practice Guideline. Emily Haesler (Ed.). Cambridge Media: Osborne Park, Western Australia.

Tachibana, T., Imafuku, S., Irisawa, R., Ohtsuka, M., Kadono, T., Fujiwara, H., . . . Burn Guidelines, C. (2016). The wound/burn guidelines - 2: Guidelines for the diagnosis and treatment for pressure ulcers. Journal of Dermatology, 43(5), 469-506. doi:https://dx.doi.org/10.1111/1346-8138.13274

Thompson, K. L., Leu, M. G., Drummond, K. L., Popalisky, J., Spencer, S. M., & Lenssen, P. M. (2014). Nutrition Interventions to Optimize Pediatric Wound Healing: An Evidence-Based Clinical Pathway. Nutrition in Clinical Practice, 29(4), 473-482.

Wilkinson, E. A. (2014). Oral zinc for arterial and venous leg ulcers. Cochrane Database of Systematic Reviews(9), CD001273. doi:https://dx.doi.org/10.1002/14651858.CD001273.pub3

Ye, J., & Mani, R. (2016). A Systematic Review and Meta-Analysis of Nutritional Supplementation in Chronic Lower Extremity Wounds. International Journal of Lower Extremity Wounds, 15(4), 296-302. doi:https://dx.doi.org/10.1177/1534734616674624

Return to Home