

TEXAS CHILDREN'S HOSPITAL
EVIDENCE-BASED OUTCOMES CENTER
Management of Acute and Chronic Wounds
Evidence-Based Guideline

Definition: A wound is an injury to the skin. Wounds can be classified as acute or chronic. Acute wounds follow a systematic approach to healing. ⁽¹⁾ These steps include hemostasis, inflammation, formation of granulation tissue, and scar remodeling. ^(2,3) The progression of wound healing in chronic wounds is delayed or impaired. ^(1,2) Chronic wounds can be classified as vascular injuries (such as venous or arterial ulcers), pressure ulcers or diabetic wounds. Characteristics of chronic wounds include prolonged inflammation of the wound bed and delayed healing. ⁽³⁾

Pathophysiology: The initial stages of wound healing include hemostasis and inflammation. In the hemostasis phase, platelets and other clotting factors are activated to control bleeding at the site of the wound. Once the clot is formed, leukocytes, fibroblasts, keratinocytes and endothelial cells migrate to the wound site. The release of clotting factors and leukocytes help to initiate the inflammatory phase. Cells that migrate to the wound during the inflammatory phase help to rid the site of debris and harmful bacteria. The proliferative phase consists of the formation of granulation tissue and restoration of the vascular system. ⁽³⁾ The work of fibroblasts result in the production of new connective tissue which forms a matrix for the wound. ⁽⁴⁾ During the scar formation phase, remodeling of the wound matrix leads to contraction of the area. Scar formation results from the apoptosis of fibroblastic cells. ⁽³⁾

There are three different types of wound healing. Healing by primary intention occurs most often in surgical wounds. The wound edges in this type of healing are closed by sutures, staples or glue which results in less granulation tissue and scar formation. Healing by secondary intention results when wound edges are not approximated. Granulation tissue fills the wound which results in healing. This type of healing occurs in chronic wounds such as pressure ulcers. Wounds healing by tertiary intention have a purposefully delayed primary closure due to complications. ⁽⁴⁾

Etiology: Wounds can have many different etiologies. All wounds are considered acute at occurrence. Acute wounds can result from surgical incisions, accidents, burns, and trauma. Wounds become chronic when wound healing does not follow the expected stages and/or is prolonged. ⁽⁵⁾ It is imperative to determine the etiology of the wound in order to ensure proper healing. If able, causative agents should be removed. This is important not only for wound healing but to also to prevent recurrence. ⁽⁶⁾

Inclusion Criteria

- All TCH patients with acute and chronic wounds

Exclusion Criteria

- Major Burns

Diagnostic Evaluation

A comprehensive initial assessment including a detailed health, medical and social history should be completed. ⁽⁷⁾

History: Assess

- Etiology of wound

Physical Examination:

A focused physical examination should include assessment for/of: ⁽⁷⁾

- Wound characteristics including measurement and volume
- Impairments in perfusion or sensation
- Systemic infection
- Vascular impairment if the wound is located on an extremity
- Nutritional deficits
- Pain related to wound
- Risk of developing additional wounds

Prevention

Pressure Ulcers

- All patients should have a pressure injury risk assessment completed.
 - The Braden scale should be used in adults greater than or equal to 21 years of age.
 - The Braden QD scale should be used in infants and children from 3 weeks to 21 years of age.
 - The Neonatal Skin Condition Scale should be used in neonates up to 43 weeks gestational age.
- Individuals at high risk for pressure injury development include: ⁽⁷⁾
 - Patients with a history of trauma
 - Patients with spinal cord injuries
 - Patients with congenital acquired mobility and sensation impairments such as spina bifida, cerebral palsy and multiple sclerosis
 - Patients with a fractured hip
 - Acutely ill patients
 - Patients with diabetes
 - Patients in critical care
 - Patients with surgical operative time greater than four hours
 - Patients with a history of pressure injury
- Utilize a support surface that redistributes pressure and reduces shear for prevention of pressure ulcers. ⁽⁷⁾

Bed Support Surface

- Beds with low-air-loss features can be used for prevention in a high risk patients and treatment in patients with Category/Stage III and IV pressure ulcers.
- Mattresses and overlays with alternating pressure features can be used for prevention in low risk patients or for treatment in patients with Stage I or II pressure ulcers.

Seating Support Surface

- To determine the most appropriate seating support surface, consult a seating specialist if sitting is unavoidable.
 - Consider a seating cushion that redistributes pressure away from ulcer.
 - Careful selection is necessary when evaluating the use of alternating pressure seating devices. The benefit of off-loading pressure should be weighed against the risk of shear and instability when sitting for the patient.
- Consider a nutritional assessment by a dietician in the high risk population or patients with nonhealing wounds. Correct any identified nutritional deficiencies if appropriate for overall care.

Critical Points of Evidence*

Evidence Supports

- Continue the use of the Braden Scale for pressure injury risk assessment in adults greater than or equal to 21 years of age. (7-20) – Strong recommendation, low quality evidence
- Utilize the Braden QD scale for pressure ulcer risk assessment in infants and children from 3 weeks to 21 years of age. (7-20) – Strong recommendation, low quality evidence
- Utilize the Neonatal Skin Condition Score to assess pressure injury risk in neonates up to 43 weeks gestational age. (7-20) – Strong recommendation, low quality evidence
- Consider the use of negative pressure wound therapy in patients with wounds healing by secondary intention with the following clinical concerns. (7,19,21-41) – Weak recommendation, low quality evidence
 - Large painful wound with a copious amount of exudate
 - Failed treatment with traditional dressings
 - Contraindication to treatment with traditional dressings
 - Need for a bridge to surgical wound closure
- Consider iodine dressings for wounds with stable eschar and/or wounds requiring dry wound healing. (7,20,36-38,42-46) – Weak recommendation, low quality evidence
- Consider the continued use of silver-based products for infected wounds and wounds suspected of infection. (7,19,36-38,42,44,47-55) – Weak recommendation, low quality evidence
- Use honey in patients with necrotic wounds and burns. (2,7,36,37,43,56-58) – Strong recommendation, moderate quality evidence
- Patients should be followed up for wound care by a trained multidisciplinary group of experts in wound and ostomy care. (59-61) – Strong recommendation, very low quality evidence

Remarks - The content expert team places a high value on multidisciplinary care by experts in the pediatric setting to increase the quality of wound healing and provide early intervention for concerns.

- Tissue biopsy cultures is the preferred method for diagnosing and identifying an organism of an infected wound. A swab culture utilizing the Levine technique may also be used for diagnosing an organism in an infected wound (7,19,37,62-69) – Strong recommendation, low quality evidence
- Surgical debridement should be utilized for infected wounds and/or wounds with a large amount of necrotic tissue. (7,19,36,37,70-78) – Strong recommendation, low quality evidence
- Autolytic debridement with appropriate dressings should be used for wounds without an urgent need for removal of devitalized tissue or infection. (7,19,36,37,70-78) – Strong recommendation, low quality evidence
- Wet-to-moist dressings may only be considered temporarily as the initial dressing choice for patients with newly recognized wounds until an individualized wound care plan is established. (2,7,19,36-38,42,55,74-76,79-84) – Weak recommendation, moderate quality evidence

Remarks: Wet-to-moist dressings should be changed every 6 – 8 hours and moistened prior to removal from skin to decrease pain and removal of vitalized tissue.

- Obtain a plastic surgery consult for patients with stage III, stage IV or unstageable pressure ulcers as well as non-healing wounds or wounds that prompt concerns for disfigurement. (7,19,37) – Strong recommendation, very low quality evidence

Remarks: Content from national guidelines was adopted for this recommendation. Non-healing wounds show no evidence of healing after 2 – 4 weeks of treatment. Practitioner should assess wound volume, dimensions, exudate and tissue type.

Evidence Against

- Iodine based dressings should not be used in neonates. (36) – Strong recommendation, low quality evidence
- Whirlpool should not be routinely used for debridement of wounds. (7,19,36,37,70-78) – Strong recommendation, very low quality evidence

Evidence Lacking/Inconclusive

- Consider the use of home health services for wound care in patients with the following criteria. – Consensus recommendation
 - Severe wound requiring negative pressure wound therapy or complicated treatment methods
 - Psychosocial concerns
 - Concerns related to access to follow-up including supplies
 - Need for DME care coordination
- Outpatient treatment is preferred for wound care however, inpatient treatment can be considered if there are concerns about availability of supplies needed for wound care in the home environment. Patients should be discharged with the best options for wound care covered by financial provider. – Consensus recommendation

*NOTE: The references cited represent the entire body of evidence reviewed to make each recommendation.

Condition-Specific Elements of Clinical Management

General: Outpatient treatment is preferred for wound care. Inpatient care may be needed depending on individual patient acuity, and access to supplies in the home environment.

Treatment Recommendations:

Initial Assessment and Care ⁽⁷⁾

- Assess wound and document characteristics
- Cleanse wound with sterile saline.
- Redistribute pressure if necessary.

Detailed Assessment by Trained Wound Care Provider ⁽⁷⁾

- Document characteristics of wound including wound measurement and volume
- Assess for pain with and without treatment, signs of infection and percent of devitalized tissue
- Determine etiology of wound
- Initiate appropriate consults
- Ensure nutritional assessment complete and initiate plan to correct any nutritional deficiencies

Wound Bed Preparation – Debridement ^(7,19,36,37,70-78)

- Necrotic tissue should be debrided using appropriate methods.
- Dry gangrene and eschar should be left in place until tissue is revitalized
- Surgical debridement should be utilized for infected wounds and/or wounds with a large amount of necrotic tissue.
- Autolytic debridement with appropriate dressings should be used should for wounds without an urgent need for removal of devitalized tissue or infection.
- Whirlpool debridement is discouraged in most cases.

Infection

- Suspect wound infection when the following signs are noted. ⁽⁷⁾
 - Lack of sign of healing for two weeks
 - Friable granulation tissue
 - Increased pain, redness, heat or exudate
 - Infectious change in exudate characteristic (eg. foul odor, purulent)
 - Increase in the amount of necrotic tissue
 - Pocketing and/or bridging in the granulation tissue.
- If infection is suspected, a tissue biopsy is the preferred method for obtaining a culture. If a tissue biopsy is not available or appropriate, utilize the Levine technique to culture the wound. ^(7,19,37,62-69)
 - Levine Wound Culture Technique – ^(63,85)
 - Cleanse the wound with sterile saline
 - Rotate the end of the swab over a 1cm² area for 5 seconds with enough pressure to extract exudate from wound tissue.
- If osteomyelitis is suspected, obtain an x-ray of the affected area. If additional imaging is needed, obtain a MRI.

Dressing Selection

There are many different dressings available for wound care. See Wound Care Product Glossary (page 4) for suggested dressings based upon wound characteristics.

- Select the dressing that promotes a moist wound healing environment, controls exudate and protects peri-wound skin.
- If patient has pain with treatment, select a dressing that requires less frequent changes.
- For infected wounds, select a dressing that also decreases bacterial load.
- Details for use of negative pressure wound therapy including pressure settings are outlined in policy for this intervention - [Negative Pressure Wound Therapy](#).

Admission Criteria

- Further medical evaluation needed
- Treatment and/or care requiring increased monitoring

Discharge Criteria

Patients should be discharged with a wound care plan outlining the best available options covered by their financial provider. The plan of care should detail the frequency of dressing changes, necessary supplies, caregiver providing the care, and location/service for follow up. Criteria to consider when discharging a patient are listed below.

- Overall patient condition
- Wound severity
- Patient care environment

Consults/Referrals

- Wound Ostomy Continence Nurses
- Plastic Surgery for stage III, stage IV or unstageable pressure ulcers as well as non-healing wounds and wounds that prompt concern for disfigurement. ^(7,19,37)
- Appropriate Surgical Service for surgical wounds
- Infectious Disease for infected wounds
- Nutrition Services
- Physical Therapy

Follow-Up Care

- A trained multidisciplinary group of experts should follow-up on patients.
- Home health services should be considered in patients with the following criteria
 - Severe wounds requiring negative pressure wound therapy or complicated treatment methods
 - Psychological concerns
 - Concerns related to access to follow-up including supplies
 - Need for DME care coordination

Measures

Structure

- Availability of a framework for consistent documentation

Process

- Percentage of multidisciplinary conferences for patients with chronic wounds (more than three months)
- Percentage of complete wound assessments documented at each dressing change

Outcome

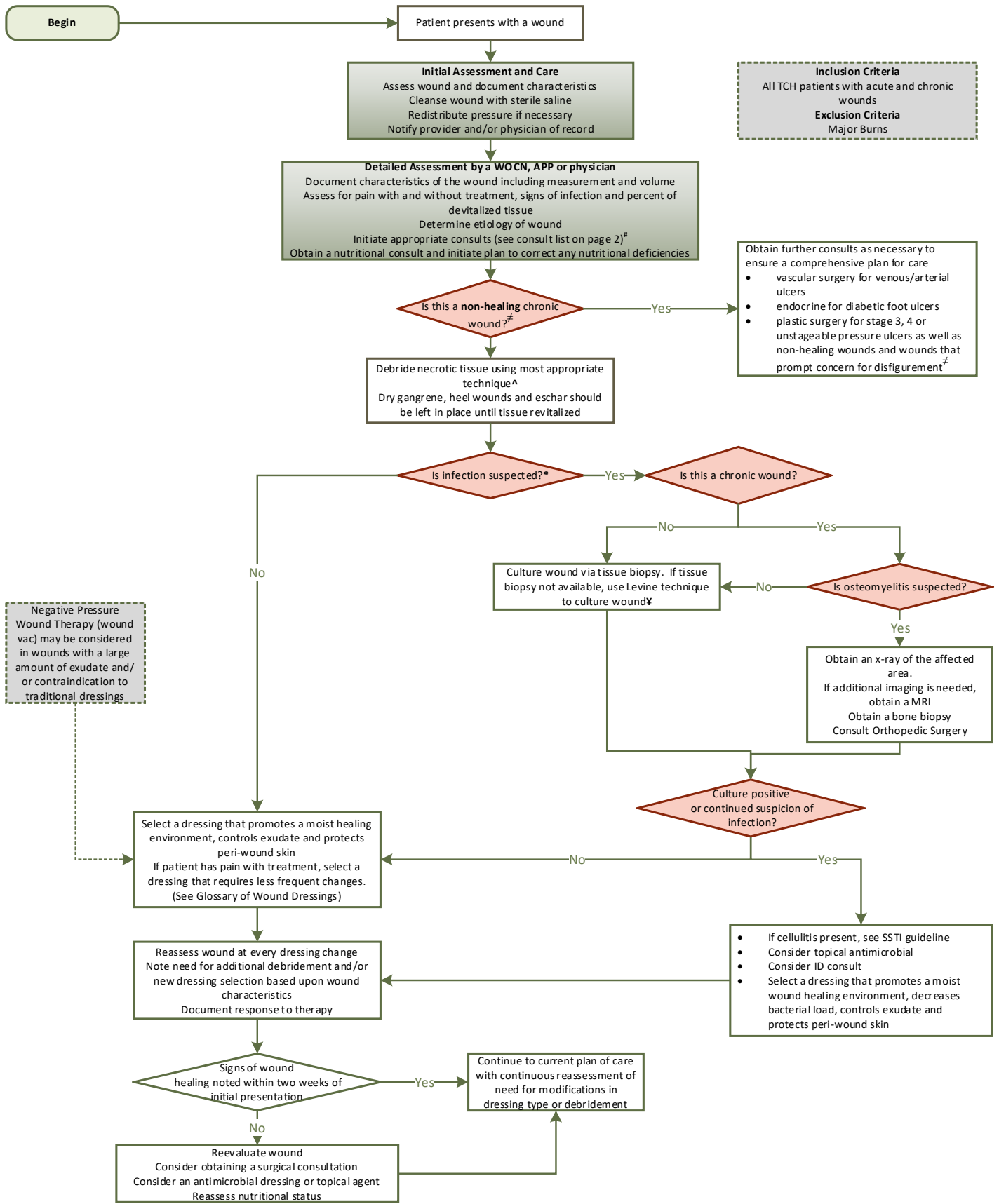
- Percentage of patients with wounds classified as improving
- Percentage of patients with wounds classified as stalled
- Percentage of patients with wounds classified as deteriorating

Wound Care Product Glossary

Dressing Class	Adhesion	Indication	Function	Precaution	Examples
Transparent Polyurethane Film	May contain adhesive	Skin tears Superficial wounds with little to no exudate Secondary dressing Secure devices to skin	Prevents wound contamination Provides moist wound healing	Semi-permanent; not intended for frequent dressing changes May result in epidermal stripping (if adhesive present)	Tegaderm Opsite
Contact Layer	Some contain soft-silicone adhesive	Superficial tears Superficial wounds with little to no exudate First- and second-degree burns Minimal to moderate exudative wounds Pressure ulcers Partial and full-thickness wounds	Prevents wound contamination Provides moist wound healing Allows transfer of exudate into absorbent dressing Nonabsorptive	Requires secondary dressing	Mepitel Mepitel-One N-TERFACE Restore Contact Restore Contact Silver Versatel Adaptic Xeroform Conformant Wound Veil
Hydrocolloid	May contain adhesive	Minimal to moderate exudative wounds Pressure ulcers Partial and full-thickness wounds Promotes autolytic debridement	Prevents wound contamination Promotes autolytic debridement Minimal absorption Ease of use	Caution in infected wounds May cause maceration of periwound May result in epidermal stripping (if adhesive present)	Duoderm Tegasorb Medihoney
Polyurethane foam and composite	May contain adhesive	Moderate to heavy exudative wounds Partial and full-thickness wounds Peristomal Pressure redistribution Infected Wounds	Ease of removal (only if nonadherent or containing soft silicone adhesive) Ease of use Moderate absorption Pressure redistribution Comfortable	Not for use in dry wounds Requires a secondary dressing (unless composite)	Polymem Allewyn Lyof foam Mepilex Mepilex-Ag Hydrosorb
Hydrogel	Nonadherent	Minimal exudate or dry wounds Partial and full-thickness wounds Burns	Reduce pain Promotes autolytic debridement Promotes epithelialization Adds moisture Minimal to moderate absorption Fills dead space Ease of removal	May over-hydrate wound May macerate periwound; consider applying skin sealant first as protection Requires secondary dressing	Sheet: Vigilon Elastogel Amorphous: Solosite Intrasite Normgel Hypergel Carrasyn wound gel
Hydrofiber	None	Moderate to heavy exudative wounds Partial and full-thickness wounds Wound dehiscence Infected Wounds Wounds requiring packing	Promotes autolytic debridement Moderate to marked absorption Ease of removal	Requires secondary dressing	Aquacel Aquacel-Ag
Alginate	None	Moderate to heavy exudative wounds Partial and full-thickness wounds Infected Wounds Wounds requiring packing	Promotes autolytic debridement Moderate to marked absorption Ease of removal	Requires secondary dressing	Kaltostat Medihoney Maxorb extra Maxorb extra-Ag
Barrier	None	Diaper dermatitis Peristomal	Protects against moisture-associated skin damage Protects against epidermal stripping Protects against irritation from adhesives	May be difficult to assess wound with opaque preparations Residual cream or ointment should not be removed prior to reapplication	Stomahesive wafer Stomahesive powder Coloplast wafer Sensicare cream Criticaid ointment White petrolatum Zinc oxide ointment Cavilon No-Sting barrier Marathon

Table Reference: King, A., Stellar, J., Blevins, A., & Shah, K. (2014). Dressings and products in pediatric wound care. *Advances in Wound Care*, 3(4), 324-334. ⁽⁸⁶⁾

TCH Evidence-Based Outcomes Center Clinical Algorithm for Care of Acute and Chronic Wounds



Negative Pressure Wound Therapy (wound vac) may be considered in wounds with a large amount of exudate and/or contraindication to traditional dressings

Inclusion Criteria
All TCH patients with acute and chronic wounds
Exclusion Criteria
Major Burns

Obtain further consults as necessary to ensure a comprehensive plan for care

- vascular surgery for venous/arterial ulcers
- endocrine for diabetic foot ulcers
- plastic surgery for stage 3, 4 or unstageable pressure ulcers as well as non-healing wounds and wounds that prompt concern for disfigurement*

Clinical standards are developed for 80% of the patient population with a particular disease. Each practitioner must use his/her clinical judgment in the management of any specific patient.

**TCH Evidence-Based Outcomes Center
Clinical Algorithm for Care of Acute and Chronic Wounds**

Acute Wounds

- Follow a systematic approach to healing.

Chronic Wounds

- Classified as vascular injuries (such as venous or arterial ulcers), pressure ulcers or diabetic wounds.
- Characteristics include prolonged inflammation of the wound bed and delayed healing.

Non-Healing Wounds[‡]

- Classified as wounds that show no evidence of healing after 2 – 4 weeks of treatment. Practitioner should assess wound volume, dimensions, exudate and tissue type.

High Risk Population[ⓧ]

- Patients with a history of trauma
- Patients with spinal cord injuries
- Patients with a fractured hip
- Acutely ill patients
- Patients with diabetes
- Patients in critical care
- Patients with surgical operative time greater than four hours

Consultations[#]

- Wound Ostomy Continence Nurse
- Plastic Surgery for stage 3, stage 4 or unstageable pressure ulcers as well as non-healing wounds and wounds that prompt concern for disfigurement.
- Appropriate surgical service for surgical wounds
- Infectious Disease for infected wounds
- Nutrition Services
- Physical Therapy
- Orthopedic Surgery for suspected Osteomyelitis
- For bone biopsy, consult Orthopedic Surgery or IR

Wound Assessment Documentation

- Wound bed characteristics including percentage of granulation tissue and devitalized Tissue
- Wound Measurement

Debridement[^]

- Utilize surgical debridement for infected wounds and/or wounds with a large amount of necrotic tissue.
- Autolytic debridement with appropriate dressings should be used for wounds without an urgent need for removal of devitalized tissue or infection.

Pressure Redistribution

- Consider using a dynamic or specialist support surface appropriate for size and development of child

Nutrition

- Consider a nutritional assessment by a dietician in the high risk population[ⓧ] or patients with nonhealing wounds. Correct any identified nutritional deficiencies if appropriate for overall care.

Signs of Wound Infection^{*}

- Lack of sign of healing for two weeks
- Friable granulation tissue
- Increased pain, redness, heat or exudate
- Infectious change in exudate characteristic (e.g. foul odor, purulent)
- Increase in the amount of necrotic tissue
- Pocketing, tunneling and/or bridging in the granulation tissue

Wound Culture / Biopsy[‡]**Levine Technique**

- Cleanse the wound with sterile saline
- Rotate the end of the swab over a 1cm² area for 5 seconds with enough pressure to extract exudate from wound tissue.

Biopsy

- Consultation with Orthopedic Surgery or Interventional Radiology needed for Bone Biopsy

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Clinical Standards Preparation

This clinical standard was prepared by the Evidence-Based Outcomes Center (EBOC) team in collaboration with content experts at Texas Children’s Hospital. Development of this clinical standard supports the TCH Quality and Patient Safety Program initiative to promote clinical standards and outcomes that build a culture of quality and safety within the organization.

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No relevant financial or intellectual conflicts to report.

Development Process

This clinical standard was developed using the process outlined in the EBOC Manual. The literature appraisal documents the following steps:

1. Review Preparation
 - PICO questions established
 - Evidence search confirmed with content experts
2. Review of Existing External Guidelines
 - Guideline for Prevention and Management of Pressure Ulcers, Wound, Ostomy and Continence Nurses Society, 2016; Neonatal Skin Care, Association of Women’s Health, Obstetric and Neonatal Nurses, 2013; Prevention and Treatment of Pressure Ulcers: Clinical Practice Guideline, National Pressure Ulcer Advisory Panel, 2014; Pressure Ulcers: Prevention and Management, National Institute for Health and Care Excellence, 2014; Wound Healing Society 2015 Update on Guidelines for Pressure Ulcers, Wound Healing Society, 2016; The burn/wound guidelines-2: Guidelines for the diagnosis and treatment of pressure ulcers, Japanese Dermatological Association, 2011; Evidence-based recommendations for the use of negative pressure wound therapy in chronic wounds: Steps towards an international consensus, International Expert Panel on Negative Pressure Wound Therapy, 2011; Guideline for the prevention of Surgical Site Infection, Centers for Disease Control and Prevention, 2017; Wound Healing Society 2015 Update on Guidelines for Diabetic Foot Ulcers, Wound Healing Society, 2016; Wound Healing Society 2015 Update on Guidelines for Venous Ulcers, Wound Healing Society, 2016; Wound Healing Society 2014 Update on Guidelines for Arterial

Ulcers, Wound Healing Society, 2016; Guideline for Diagnosis and Treatment of Diabetic Foot Infections, Infectious Disease Society of America, 2012; The management of diabetic foot: A clinical practice guideline, Society of Vascular Surgery, American Podiatric Medical Association, The Society of Vascular Medicine, 2016; Management of venous leg ulcers: Clinical practice guidelines, Society of Vascular Surgery, American Venous Forum, 2014

3. Literature Review of Relevant Evidence
 - Searched: PubMed, Cinahl, Cochrane Library
4. Critically Analyze the Evidence
 - Twenty-two meta-analyses, twelve randomized controlled trials, and twenty-eight nonrandomized studies
5. Summarize the Evidence
 - Materials used in the development of the clinical standard, literature appraisal, and any order sets are maintained in a Wound Care evidence-based review electronic file.

Evaluating the Quality of the Evidence

Published clinical guidelines were evaluated for this review using the **AGREE II** criteria. The summary of these guidelines are included in the literature appraisal. AGREE II criteria evaluate Guideline Scope and Purpose, Stakeholder Involvement, Rigor of Development, Clarity and Presentation, Applicability, and Editorial Independence using a 4-point Likert scale. The higher the score, the more comprehensive the guideline.

This clinical standard specifically summarizes the evidence *in support of* or *against* specific interventions and identifies where evidence is *lacking/inconclusive*. The following categories describe how research findings provide support for treatment interventions. **“Evidence Supports”** provides evidence to support an intervention **“Evidence Against”** provides evidence against an intervention. **“Evidence Lacking/Inconclusive”** indicates there is insufficient evidence to support or refute an intervention and no conclusion can be drawn *from the evidence*.

The **GRADE** criteria were utilized to evaluate the body of evidence used to make practice recommendations. The table below defines how the quality of the evidence is rated and how a strong versus weak recommendation is established. The literature appraisal reflects the critical points of evidence.

Recommendation	
STRONG	Desirable effects clearly outweigh undesirable effects or vice versa
WEAK	Desirable effects closely balanced with undesirable effects
Quality	Type of Evidence
High	Consistent evidence from well-performed RCTs or exceptionally strong evidence from unbiased observational studies
Moderate	Evidence from RCTs with important limitations (e.g., inconsistent results, methodological flaws, indirect evidence, or imprecise results) or unusually strong evidence from unbiased observational studies
Low	Evidence for at least 1 critical outcome from observational studies, RCTs with serious flaws or indirect evidence
Very Low	Evidence for at least 1 critical outcome from unsystematic clinical observations or very indirect evidence

Recommendations

Practice recommendations were directed by the existing evidence and consensus amongst the content experts. Patient and family preferences were included when possible. The Content Expert Team and EBOC team remain aware of the controversies in the management of wounds. When evidence is lacking, options in care are provided in the clinical standard and the accompanying order sets (if applicable).

Approval Process

Clinical standards are reviewed and approved by hospital committees as deemed appropriate for its intended use. Clinical standards are reviewed as necessary within EBOC at Texas Children’s Hospital. Content Expert Teams are involved with every review and update.

Disclaimer

Practice recommendations are based upon the evidence available at the time the clinical standard was developed. Clinical standards (guidelines, summaries, or pathways) do not set out the standard of care and are not intended to be used to dictate a course of care. Each physician/practitioner must use his or her independent judgment in the management of any specific patient and is responsible, in consultation with the patient and/or the patient’s family, to make the ultimate judgment regarding care.

Version History

Date	Comments
June 2019	Originally completed