

An Overview of Neonatal and Pediatric Wound Care Knowledge and Considerations

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Despite significant technological advances in the care of premature neonates and chronically ill children, the knowledge and evidence base for the management of this population's wound care lag far behind its adult counterpart. Updating antiquated care regimens is an uphill battle. This review of the literature seeks to illuminate key anatomical/structural differences in neonatal skin with particular attention paid to percutaneous absorption and tolerance of adhesives. The article also presents anatomically and physiologically based recommendations for the selection of prevention and treatment modalities, including specific dressing types, appropriate dressing change and securement procedures, and pain management. Commonly encountered wound types (epidermal stripping; surgical wounds; extravasation and thermal injuries; chemical burns; pressure ulcers; diaper dermatitis; and wounds secondary to congenital conditions) are discussed. Opportunities for research abound and are considered.

KEYWORDS: neonatal/pediatric wound care, extravasation injuries, pressure ulcers, diaper dermatitis, epidermolysis bullosa

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A paucity of pediatric wound care research is available upon which to guide practice; few wound care products have been studied in this population.¹⁻³ This problem is compounded further by the ethical and litigious issues involved in carrying out research in this vulnerable population, leaving clinicians without an evidence base from which to render care. In fact, it is not unusual for skin care regimens to be based on individual or institutional preference and routine.⁴ Most papers on wound care in neonates and children are anecdotal or are discussions of wound healing principles and clinical practice guidelines for adults.¹ Research data regarding the safety and clinical efficacy of wound care dressings, drugs, and adjunctive treatments in neonates and children are needed.^{3,5}

Although they follow the same wound healing trajectory as adults, wounds in neonates and children typically exhibit faster rates of closure.⁶⁻⁸ Fibroblasts are present in greater numbers, collagen and elastin are more rapidly produced, and granulation tissue forms more quickly compared to adults.^{8,9} In fact, rapid, uncomplicated wound healing requiring limited healthcare professional intervention is the “normative expectation” in pediatrics.¹⁰ This expectation of rapid, uneventful healing and innate age-related integumentary resiliency has, in part, resulted in the lack of wound care knowledge transfer to the pediatric population.¹⁰ Pieper et al's¹ recent study of 13 home care agencies found that while children represented 3% of all visits and 17% of children had wounds, basic

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principles of wound care were not implemented into practice. Pressure ulcers and open surgical wounds among this pediatric population often were cleansed with hydrogen peroxide, household soap, or povidone-iodine — 44% were treated with dry gauze and 19% with normal saline dampened gauze.¹ Yet, more than 90% of the home care nurses interviewed for this study described the pediatric wound care as appropriate.¹ Similarly, a survey¹¹ among 104 neonatal intensive care units (NICUs) in the US found that less than 25% had wound care protocols in place. A survey of 13 NICUs in the UK reported wound care practices to be wide and varied with neither written policy nor guidelines for staff.¹² In fact, 32% of wounds were either left open to air or covered with dry dressings, with the prevailing view of staff participating in the study that plastic surgery would cure the wound at a later time.¹² Although eight of the units surveyed had access to wound specialists, only one unit reported use of this specialty.¹² Baker et al's¹³ US survey of 305 NICUs also reported a lack of consensus on skin care practices, with less than 30% of those interviewed agreeing on how to treat skin breakdown in micro-preemies. As a result, wounds were treated with hydrogen peroxide, exposed to air, or "allowed to heal" without intervention.¹

The purpose of this overview is to illuminate key anatomical/structural differences in neonatal skin as it pertains to percutaneous absorption, and tolerance of adhesives to foster anatomically/physiologically based inquiry when selecting prevention and treatment modalities; and to review the evidence for commonly encountered wound types.

Factors Affecting Wound Healing in Neonates and Children

The normally rapid wound healing response of neonates and children is often compromised by protein-calorie malnutrition, hypotension requiring inotropic therapy, edema, infection, and physiological instability that prevents safe redistribution of pressure.^{7,9} Possessing minimal to no antigen exposure, neonates are at especially high risk for overwhelming life-threatening sepsis secondary to bacterial proliferation and overgrowth within the wound bed.^{14,15} Their decreased epidermal-to-dermal cohesion, deficient



Figure 1. Premature neonate of 24 weeks' gestation. Photo courtesy of P. Palmer, RN, BSN.

stratum corneum, impaired thermoregulation, body surface/weight ratio nearly five times greater than the adult, and immature immune system — as well as hepatic and renal function — places neonates at increased risk for epidermal stripping, infection, increased transepidermal water loss with resultant heat loss, and toxicity from percutaneous absorption.^{12,14,16}

Integumentary Milestones: Summarizing Current Knowledge

At 24 weeks gestation, premature neonates have little stratum corneum and attenuated rete ridges. Their skin is red, wrinkled, translucent, and gelatinous in appearance (see Figure 1). They lack subcutaneous tissue; therefore, their dermis is lying directly over the muscle.¹⁷ Consequently, skin stripping secondary to adhesive dressing and/or tape removals can result in full-thickness tissue loss. Between 26 and 29 weeks' gestation, subcutaneous fat deposition begins and skin wrinkling lessens. However, the barrier function of the skin remains poor and at 26 weeks gestation as much as 110 mL of water can be lost in 24 hours.¹⁸

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KEY POINTS

- Despite increased wound healing knowledge and unprecedented advances in neonatal care, the evidence base of pediatric skin and wound care protocols remains limited.
- The author reviews current knowledge about neonatal and pediatric skin, skin problems, and currently recommended skin protection and wound care measures.



Figure 2. Premature neonate of 30 weeks' gestation.
Photo courtesy of P. Palmer, RN, BSN.



Figure 3. Premature neonate of 36 weeks' gestation.
Photo courtesy of P. Palmer, RN, BSN.

At 30 weeks, subcutaneous tissue is evident and the stratum corneum is two to three cell layers thick, compared to 40 weeks when it is 30 layers thick¹⁷ (see Figure 2). Functional integumentary maturity occurs at 33 weeks. The epidermis is fully keratinized and the dermal/epidermal junction is stronger but remains fragile and easily damaged. At 36 weeks (full term), the skin is structurally similar to the adult but the epidermal and dermal layers are up to 60% as thick as an adult¹⁸ (see Figure 3).

Common Wound Etiologies among Neonates and Children

Epidemiological studies and empirical evidence suggest that the most commonly encountered wound types among hospitalized neonates and children include epidermal stripping, extravasation injuries,

surgical wounds, incontinence-associated dermatitis, chemical and thermal injuries, wounds secondary to congenital abnormalities, and pressure ulcers in variable rates of prevalence.^{1,6,9,19-23}

Epidermal stripping. Epidermal stripping secondary to tape and adhesive dressing removal is most common in neonates born before 27 weeks' gestation and is the primary cause of skin breakdown in the NICU.^{3,24} Given the neonate's attenuated rete ridges, adhesive products typically bond more aggressively to the epidermis than the epidermis does to the dermis.²⁵ Epidermal stripping is not only a source of discomfort, but also can lead to other morbidity in very low birthweight neonates and those who are immunocompromised.¹⁶ Interventions to help prevent epidermal stripping include using an alcohol-free liquid skin barrier on the skin under adhesive dressings in neonates >30 days of age and clear film dressings to secure intravenous sites.^{16,26-28} Using pad splints and padded Velcro™ straps over splints rather than tape^{26,29} and using soft silicone dressings to treat areas of denudation secured with tubular latex-free stretchy gauze netting can offset the stripping phenomenon.^{24,29} Staff should be taught to remove adhesives gently using the horizontal stretch method³⁰ and to avoid use of adhesive removers and bonding agents in the neonatal population because these products can potentiate the risk of epidermal stripping and result in toxic percutaneous absorption. Neonates and those with edematous skin should be handled with extreme care.²⁶ Mepitac® or Mepiform (Molnlycke Health Care, Inc, Norcross, Ga), soft silicone dressing can be used as a tape in those with blistering disorders (eg, epidermolysis bullosa).²⁶

Extravasation injuries. Extravasation injuries occur as a result of inadvertent leakage of vesicant fluid from a vein/cannula into the surrounding soft tissue^{29,31,32} (see Figure 4). The reported incidence of extravasation injury in neonates and children is 0.1% to 15%^{23,33} and occurs most frequently in neonates of <26 weeks' gestation given the fragility and small caliber of the peripheral veins.³² Staging of infiltrates/extravasation is described in Table 1.³⁴

To prevent and manage this type of skin injury, experts recommend using sterile transparent dressings to secure intravenous lines to allow for at least hourly



Figure 4. Extravasation injury in a 3.5-week-old newborn.

site inspections.^{25,29} Although there is no consensus on best practice for extravasation wound treatment, experts recommend application of hydrogels covered with silicone dressings, applying a hydrogel-filled glove or boot to the affected site or using a hydrofiber covered by a thin hydrocolloid.^{21,30-32,35} Potential problems with using the hydrogel-filled glove or boot include periwound maceration, the infant's inability to move the affected extremity secondary to the gel weight, and trauma when removing securement tapes/film dressing.³⁰ The periwound skin can be protected against maceration through use of an alcohol-free liquid skin barrier in neonates >30 days of age.^{27,28} If necrotic tissue is present, surgical consultation should be obtained, coupled with use of autolytic debridement.

Surgical wounds. In a 2005 prevalence audit (n = 252),²² 43% of hospitalized children were noted to have an open surgical wound and/or closed incision, 71% required daily nursing observations, 22% received twice daily dressings, 5% received complex dressing care, and 2% received negative pressure wound therapy (see Figure 5).

Care protocols should include frequent monitoring for signs and symptoms of infection. While antimicrobial dressings containing cadexomer iodine and sustained-release silver have been successfully utilized in adult populations to manage wound malodor and reduce bacterial load, similar neonatal and pediatric data are lacking.⁹ Reports of a case series of burn wounds and a dehisced surgical wound managed with silver dressings suggest these products may be safe and effective alternatives to traditional dressings.^{14,36} Simon et al³⁷ similarly reported positive clinical outcomes

over a 3 year period during which Manuka Medihoney™ (Derma Sciences, Princeton, NJ) was used on dehisced surgical wounds and infected port-explantation sites in pediatric patients receiving chemotherapy.

In full-thickness wounds with large amounts of drainage, ostomy pouches, wound drainage collectors, and negative pressure wound therapy (NPWT) may be appropriate. Hydrogel, hydrofiber, foams, and soft silicone dressing use in the management of non-infected open surgical wounds has been reported anecdotally⁹; experts suggest that the periwound skin of children and neonates >30 days of age should be protected with a liquid barrier film.^{27,28}

TABLE 1
STAGING OF IV
INFILTRATES/EXTRAVASATION³⁴

Stage	Characteristic
0	Absence of redness, warmth, pain, swelling, blanching, mottling, tenderness or drainage Flushes with ease
1	Absence of redness, swelling Flushes with difficulty Pain at site
2	Slight swelling at site Presence of redness Pain at site Good pulse at site 1- to 2-second capillary refill below site
3	Moderate swelling above or below site Blanching Pain at site Good pulse below infiltration site 1- to 2-second capillary refill below infiltration site Skin cool to touch
4	Severe swelling above or below site Blanching Pain at site Decreased or absent pulse Capillary refill >4 seconds Skin cool to touch Skin breakdown or necrosis



Figure 5. Dehisced surgical wound in a 13 year old.

Incontinence-associated dermatitis (diaper dermatitis). The prevalence of diaper dermatitis among hospitalized neonates and children has been reported to be between 16% and 42%.^{22,23} In fact, diaper dermatitis is one of the most common dermatological conditions encountered among neonates and children who are diapered.²² Diaper dermatitis can be staged according to the integrity of the epidermis and the presence/absence of *Candida albicans* skin infection²² (see Table 2).

Interventions to prevent and manage this condition include diaper changes at least every 3 to 4 hours or sooner if needed and use of diapers containing absorptive gels.²⁴

It is generally recommended that commercial diaper wipes be avoided in neonates and that a petrolatum-based ointments and/or zinc oxide based barrier product be used to protect the skin.²⁴ In the presence of *C. albicans*, an antifungal ointment should be applied. The use of powders and products containing dyes and fragrances should be avoided in the nursery.²⁴ Cavilon™ No-Sting Barrier (3M, St. Paul, Minn) is approved for use in infants >30 days of age.^{27,28}

TABLE 2
TYPES OF DIAPER DERMATITIS²²

- Type 1:** Epidermis intact and no candidal infection present
- Type 2:** Epidermis intact and candidal infection present
- Type 3:** Epidermis not intact and no candidal infection present
- Type 4:** Epidermis not intact and candidal infection present

Chemical burns. Experts suggest that chemical injuries may occur secondary to the application of adhesive removers, bonding agents, betadine, and alcohol-based prep solutions.^{25,29} If betadine or alcohol-based prep agents are used before insertion of lines or drains or procedures, the amount used should be limited and rinsed immediately with sterile water.²⁹ The undersides of patients always should be checked to ensure they are not lying on linens soaked in prep solution. It is best to totally avoid the use of these agents and instead use aqueous-based skin preparations.²⁹ In pre-term neonates, percutaneous toxicity from alcohol and betadine-based solutions is an additional concern.³⁸

Thermal injuries. In neonates, thermal injuries may be secondary to heat from monitoring electrodes or less commonly from use of cold light for identifying veins and arteries for line insertions.^{25,29} The most common cause of community acquired thermal injuries in children is associated with fire.³⁹ To prevent neonatal burns from heat, temperatures of monitoring devices should be reduced and application time should be limited as is feasible.²⁹ To prevent neonatal burns from cold light, exposure time should be minimized and a protective guard used.²⁹ A literature review⁴⁰ on the use of Biobrane (Bertek Pharmaceutical Inc., Research Triangle, NC), a biosynthetic dressing consisting of a layer of peptides derived from porcine dermal collagen incorporated into silicone and nylon, has demonstrated clinical efficacy over conservative treatment in terms of pain control, wound healing, and hospital length of stay in children with partial-thickness burns. Further randomized controlled trials are required to examine the incidence of hypertrophic scarring and to compare clinical outcomes to other skin substitutes.⁴⁰

When Mepitel® (Molnlycke), a silicone dressing, was compared to silver sulfadiazine in a prospective, randomized study of 63 children with partial-thickness scald burns, wounds of children treated with the silicone dressing healed faster, were less painful, exhibited less eschar formation, and required fewer dressing changes.⁴¹ As a result, the silicone treatment group required fewer analgesics and had lower hospital charges.⁴¹ As with all wounds, the selection of an age-appropriate wound cleansing agent and dressing to address wound needs is needed (see “Best Practices in Wound Care Principles”).

Wounds secondary to congenital conditions.

Aplasia cutis congenita. Aplasia cutis congenita, which occurs in 0.03% of births, is a defect of the skin manifested by absent areas of epidermis and subcutaneous tissue.^{9,42} Wounds are partial- or full-thickness; 80% occur on the scalp.³⁰ Life-threatening bleeding and infection have been reported in the literature.^{9,43,44} Lesions of the skull require imaging to assess the depth of involvement.^{9,43} Small partial-thickness areas (<1 cm²) usually reepithelialize well with the use of atraumatic moisture-retaining dressings and topical antibiotics but larger or full-thickness wounds require dermatology, plastic surgery, and neurosurgical intervention.^{9,43}

Epidemolysis bullosa. Epidemolysis bullosa (EB) is a heterogeneous, genetic group of mechano-bullous disorders characterized by skin and mucosal blistering in response to minor friction or trauma.^{9,45} Inherited EB is grouped into three major types based on the depth of blister formation: simplex, junctional, or dystrophic.⁴⁵

Commonly suggested interventions based on expert opinions include using gentle handling techniques to minimize friction and shear forces to the skin³⁰ and avoiding adhesives and tapes. Instead, dressings can be secured by stretchy non-latex tubular gauze netting.⁹ Only flat-seamed clothing or clothing turned inside out should be used³⁰ and tight clothing and non-padded shoes should be avoided.⁴⁵ Each finger and toe should be wrapped individually with non-adherent dressings to prevent digitary fusion.⁴⁵

Cardiac monitoring and pulse oximetry devices must be secured with non-adhesive products. Exposure to humidity and heat should be decreased — they can increase blistering.³⁰ Cloth diapers should

be used; the elastic edges of disposable diapers should be cut out because they can cause blistering.⁴⁵ Using non-adherent dressings, tailoring use of absorptive dressings when exudate is high, and providing for moisture when drainage is minimal are other strategies.⁹ Soft silicone dressings provide an excellent atraumatic dressing option. Large blisters must be lanced or aspirated with a sterile hypodermic needle without removing the roof.⁹

In one open-label, uncontrolled study⁴⁶ of 15 patients with 78 wounds, Apligraf™ (Organogenesis Inc, Canton, Mass) was found to induce rapid healing in children with acute and chronic wounds secondary to EB without side effects. Large controlled studies with longer follow-up are needed before greater widespread use is advocated.

A case report⁴⁷ demonstrated the success of Integra™ Bilayer Matrix Dressing (Integra Lifespan Corp, Plainsboro, NJ) to cover the wound followed by Apligraf™ for epidermal coverage after surgical correction of pseudosyndactyly (mitten deformity of the hand). Further controlled studies are needed.

Pressure ulcers. Pressure ulcer rates as high as 27% in pediatric intensive care units, 23% in neonatal intensive care units, and 20% to 43% among outpatients with spina bifida have been reported.⁴⁸⁻⁵¹ Lack of pressure redistribution measures and the presence of friction/shear-related forces result in micro-vascular soft tissue damage and resultant partial- to full-thickness pressure ulcers. Stage I to Stage IV ulcers, unstageable ulcers, and suspected deep tissue injuries should be documented in accordance with the National Pressure Ulcer Advisory Panel's (NPUAP) updated definitions⁵² (see Table 3). In children, unlike adults, more than 50% of pressure ulcers are related to sustained pressure from equipment and devices⁵¹ (see Figure 6).

Experts recommend performing risk assessments at least daily utilizing an age-appropriate valid and reliable pressure ulcer risk assessment scale.^{9,24} Preventive skin care practices such as those outlined by Lund^{16,21,25,27,29,30}; the Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN)²⁴; Baharestani and Ratliff, Curley and Quigley, and Irving^{3,5,12}; Malloy^{4,20}; Garvin⁷; and Baharestani and Pope⁹ must be provided and frequent skin assessments

TABLE 3 PRESSURE ULCER STAGING SYSTEM⁵²

Suspected Deep Tissue Injury (DTI): Purple or maroon localized area of discolored skin due to damage of underlying soft tissue as a result of ischemia from pressure and/or shear. This area initially presents as intact skin or a blood-filled blister and may rapidly evolve to expose additional layers of tissue even with optimal treatment. Variations in skin pigmentation may change visual presentation and thus early deep tissue injury may be difficult to discern. Other characteristics of the area may include pain, firmness, softness, or a difference in temperature as compared to adjacent tissue

Stage I: Persistent redness of a localized area of intact skin usually over a bony prominence. Other characteristics of the area may include delayed capillary refill, pain, firmness, softness, or a difference in temperature as compared to adjacent tissue. Usually a minor and resolvable condition. Variations in skin pigmentation may change visual presentation

Stage II: Partial-thickness loss of epidermis or dermis presenting as a shallow open ulcer without slough. May present as an intact or open/ruptured serum-filled blister

Stage III: Full-thickness tissue loss. Subcutaneous fat may be visible but bone, tendon, or muscle are not exposed. Slough may be present, but does not obscure the depth of tissue loss. Other characteristics may include undermining and tunneling. Rolled edge of dermis may be seen

Stage IV: Full-thickness tissue loss with exposed bone, tendon, or muscle. Slough or eschar may be present on some parts of the wound bed. Other characteristics often include undermining and tunneling

Unstageable: Full-thickness tissue loss in which actual depth of the ulcer is completely obscured by slough (yellow, tan, gray, green, or brown) and/or eschar (tan, brown, or black) in the wound bed. Blood blisters are not débrided and therefore placed in the DTI group



Figure 6. Pressure ulcer in an 8-year-old secondary to a plaster cast.

performed, particularly under blood pressure cuffs, pulse oximetry devices, tracheostomy plates, oral and nasal gastric tubes, nasal prongs and masks of continuous positive airway pressure (CPAP) devices, arm boards, traction boots, and plaster cast edges.⁵³ Protective padding (eg, hydrocolloids, thicker silicone

dressings, or foam dressings) is needed under devices as feasible^{9,54} and pressure redistributed by using only support surfaces on cribs, isolettes, incubators, and beds that are age- and weight-appropriate. Patients should be turned and repositioned at least every 2 hours as is medically feasible. Unique to the neonatal and infant population, being held by healthcare professionals and parents also offloads pressure. Tapes and clothing should be loosened in the presence of edema and friction and shear forces should be minimized.²⁶ If an ulcer develops, the wound should be cleansed as needed (refer to “Best Practice in Wound Care Principles”), necrotic tissue débrided, bacterial colonization and infection managed, nutritional status maximized as is consistent with overall goals of care, and appropriate local wound care modalities selected. Maintaining a quality monitoring program will ensure standardized ongoing assessments of staff education, guidelines, and the effectiveness of care delivery processes as measured by the occurrence and management of facility-acquired skin breakdown.

The persistence of Apligraf cells on the wound and the safety of this device in venous ulcer patients beyond 1 year and diabetic foot patients beyond 6 months have not been evaluated. Apligraf is indicated for use with standard therapeutic compression for the treatment of noninfected partial- and full-thickness skin ulcers due to venous insufficiency of duration greater than 1 month that have not adequately responded to conventional therapy. Apligraf is also indicated for use with standard diabetic foot ulcer care for the treatment of full thickness neuropathic diabetic foot ulcers of greater than 3 weeks' duration that have not adequately responded to conventional ulcer therapy and that extend through the dermis, but without tendon, muscle, capsule, or bone exposure. Apligraf should not be used on infected wounds or on patients with hypersensitivity to any components of Apligraf or the shipping medium. Please consult complete prescribing information for a description of epidermal and dermal elements contained in Apligraf.

Apligraf® Essential Prescribing Information Numbers in parentheses () refer to sections in the main part of the product labeling. **Device Description:** Apligraf is supplied as a living, bi-layered skin substitute manufactured using neonatal foreskin keratinocytes and fibroblasts with bovine Type I collagen. (1) **Intended Use/Indications:** Apligraf is indicated for use with standard therapeutic compression in the treatment of uninfected partial and/or full-thickness skin loss ulcers due to venous insufficiency of greater than 1 month duration and which have not adequately responded to conventional ulcer therapy. Apligraf is indicated for use with standard diabetic foot ulcer care for the treatment of full-thickness foot ulcers of neuropathic etiology of at least three weeks duration, which have not adequately responded to conventional ulcer therapy and extend through the dermis but without tendon, muscle, capsule or bone exposure. (2) **Contraindications:** Apligraf is contraindicated for use on clinically infected wounds and in patients with known allergies to bovine collagen or hypersensitivity to the components of the shipping medium. (3, 4, 5, 8) **Warnings and Precautions:** If the expiration date or product pH (6.8-7.7) is not within the acceptable range DO NOT OPEN AND DO NOT USE the product. A clinical determination of wound infection should be made based on all of the signs and symptoms of infection. (4, 5) **Adverse Events:** All reported adverse events, which occurred at an incidence of greater than 1% in the clinical studies are listed in Table 1, Table 2, and Table 3. These tables list adverse events both attributed and not attributed to treatment. (6) **Maintaining Device Effectiveness:** Apligraf has been processed under aseptic conditions and should be handled observing sterile technique. It should be kept in its tray on the medium in the sealed bag under controlled temperature 68°F - 73°F (20°C - 23°C) until ready for use. Apligraf should be placed on the wound bed within 15 minutes of opening the package. Handling before application to the wound site should be minimal. If there is any question that Apligraf may be contaminated or compromised, it should not be used. Apligraf should not be used beyond the listed expiration date. (9) **Use in Specific Populations:** The safety and effectiveness of Apligraf have not been established in pregnant women, acute wounds, burns and ulcers caused by pressure. **Patient Counseling Information:** VLU patients should be counseled regarding the importance of complying with compression therapy or other treatment, which may be prescribed in conjunction with Apligraf. DFU patients should be counseled that Apligraf is used in combination with good ulcer care including a non-weight bearing regimen and optimal metabolic control and nutrition. Once an ulcer has healed, ulcer prevention practices should be implemented including regular visits to appropriate medical providers. **Treatment of Diabetes:** Apligraf does not address the underlying pathophysiology of neuropathic diabetic foot ulcers. Management of the patient's diabetes should be according to standard medical practice. **How Supplied:** Apligraf is supplied sealed in a heavy gauge polyethylene bag with a 10% CO₂/air atmosphere and agnise nutrient medium, ready for single use. To maintain cell viability, Apligraf should be kept in the sealed bag at 68°F - 73°F (20°C - 23°C) until use. Apligraf is supplied as a circular disk approximately 75 mm in diameter and 0.75 mm thick. (8) **Patent Numbers:** 4,485,096; 5,106,549; 5,536,656

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Integral to this process is the initiation and maintenance of continuous feed-back loops.

Best Practice in Neonatal and Pediatric Wound Care: Examining the Principles

When selecting a wound care dressing, drug, or adjunctive therapy for use in neonatal and pediatric populations, it is important to consider the goals of therapy, the practice environment, resource availability, patient age/degree of integumentary maturity, skin condition, product concentration and adherence, potential for skin sensitization, impact of product absorption, and need for avoidance of products containing dyes, fragrances, and preservatives.^{4,55,56} Knowledge of product safety and manufacturer's recommended use data in the neonatal/pediatric population are essential.⁵⁵

Patient assessment. As with adults, a thorough assessment should include but is not limited to the following⁹: current medical issues, clinical stability, age, medical history, surgical history, allergies and skin sensitivities, medication history, review of laboratory results and diagnostic tests, height and weight, social history, family support systems, pain status (using a tool validated for use within the patient's age group),⁵⁷ nutritional history, history of previous wounds, treatment and healing outcomes, pressure ulcer risk assessment score (using a valid and reliable tool such as: Braden Q, Braden, or Glamorgan)⁵⁵ and a targeted physical examination. Examples of validated pediatric pain assessment tools are listed in Table 4.

Dressing selection criteria. Ideally, a dressing should protect the wound, facilitate atraumatic removal and application, not require frequent changes, remain in place in a humidified environment, and be the correct size or have the capability to be cut to fit the area.²⁹ In addition, cultural and religious sensitivity is important when selecting dressings. For example, some dressings contain animal-derived products. While a complete review of dressing safety and effectiveness is beyond the scope of this publication, clinicians need to ascertain that the products selected have been shown to be safe and effective for the intended indication and population.

Commonly used products include soft silicone dressings, liquid barrier films, hydrocolloid dressings.

**TABLE 4
VALIDATED NEONATAL PAIN ASSESSMENT TOOLS**

Tool	Age Tested
PIPP (Premature Infant Pain Profile)	28 to 40 weeks
CRIBS (Crying, Requires Oxygen Saturation, Increased Vital Signs, Expression, Sleeplessness)	32 to 36 weeks
NIPS (Neonatal/Infant Pain Scale)	28 days to <1 year old
N-PASS (Neonatal Pain Agitation and Sedation Scale)	0 to 100 days
NFCS (Neonatal Facing Coding System)	Preterm and term neonates, infants at 4 months of age
PAT (Pain Assessment Tool)	Neonates
SUN (Scale for use in Newborns)	Neonates
EDIN (Neonatal Pain and Discomfort Scale)	25 to 36 weeks (preterm)
BPSN (Bernese Pain Scale for Neonates)	Term and preterm neonates
Oucher	3 to 12 years old
FLACC (Face, Legs, Activity, Crying, Consolability Scale)	2 months to 7 years old
CHEOPS (Children's Hospital of Eastern Ontario)	1 to 7 years old
Wong-Baker Faces Scale	3 to 7 years old
Bieri-Modified	Children >3 years old
CHIPPS (Children and Infants Postoperative Pain Scale)	Children up to 4 years old

(Adapted from: The American Academy of Pediatrics and the Canadian Paediatric Society)

Silicone dressings. Silicone dressings are available as contact layers, absorbents, antimicrobials, exudate transferrants, gel sheets for scar management, and as fixation tapes. They are commonly used in neonatal and pediatric wound management because they are versatile and lack adhesives. Their use should be avoided in patients with known silicone allergy.

Non-alcohol-based liquid barrier films. Non-alcohol-based liquid barrier films are applied to the skin to prevent epidermal stripping secondary to adhesive removal and to protect against chemical erosion from wound fluid.^{9,27,28} Cavilon™ No-Sting Barrier film (3M, St. Paul, Minn) is approved for neonates >30 days of age to prevent skin stripping from adhesive removal.^{24,27,28}

Hydrocolloids. The neonatal and pediatric literature^{24,25,58-62} contains multiple references to the successful use of hydrocolloids in maintaining wound bed moisture, providing autolytic debridement, and providing a waterproof and bacterial barrier, as well as a barrier for other adhesives.

Specific benefits provided by thin hydrocolloids in the treatment of neonatal and pediatric wounds include prevention of tissue damage, reduction of

epidermal water loss, allowance of full limb range-of-motion, easy application to small body surfaces, sterile dressing delivery, suitability for use in incubators/humidified environments, and provision of a barrier to viral and bacterial transmission.⁶³

Hydrogels. Hydrogels are available in two basic forms: solid sheet and amorphous gels. The primary components are cross-linked polymers and water.⁹ Neonatal and pediatric case studies describe use of hydrogels in the management of toxic epidermal necrolysis, wound dehiscence, extravasation injuries, pressure ulcers, fungating lesions, and burns.^{35,36,63-65}

Foam dressings. Foam dressings are polymeric materials with hydrophilic contact layers and hydrophobic outer layers. These dressings vary in thickness and may be impregnated with surfactants, glycerine, charcoal, or silver. Anecdotal pediatric case studies document successful use of these products.⁹

Composite dressings. Composite dressings are multilayered superabsorbent dressings designed for the management of moderate to heavily draining wounds. Successful use of composite dressings was reported anecdotally in the management of an extravasation injury in a 27-week gestational age neonate.⁶⁶

Semipermeable films. Semipermeable films are versatile, transparent, thin, polyurethane moisture-vapor permeable dressings designed to maintain a moist environment. These dressings facilitate epithelialization of minimally exuding partial-thickness wounds and provide autolysis of non-infected wounds. Film dressings also can be used to secure primary dressings while promoting a moist environment.

Hydrofiber dressings. Hydrofiber dressings are composed of carboxymethylcellulose hydrofibers. Highly absorbent, these dressings transform into solid sheet gels once in contact with fluid. Anecdotal success has been reported in pediatric case studies.⁹

Negative pressure wound therapy. Negative pressure wound therapy involves application of sterile hydrophobic, open-pore reticulated polyurethane foam or hydrophilic, polyvinyl alcohol foam dressings (KCI, San Antonio, Tex) cut to the appropriate wound geometry, covered with a transparent film drape, and fitted with a T.R.A.C.[®] Pad (KCI) attached to a computerized, calibrated microprocessor unit to deliver controlled NPWT. Patient age, exposed structures within the wound, bacterial load, and treatment goals influence selection of dressing type, pressure setting, dressing change frequency, and use of interposing layer(s). A clinical series of 51 children with acute and chronic wounds successfully treated with NPWT was reported by Caniano et al.⁶⁷

Alginates. Alginates are seaweed-based dressings designed for the management of moderately draining wounds. In adults, these dressings usually are used to control light bleeding; this has not been studied in the pediatric patient population.⁹ Calcium alginates are not recommended for use in neonates secondary to calcium absorption concerns.^{19,30}

Topical enzymes. While the safety and efficacy of topical enzymes in the pediatric population has not been studied, successful use in the management of pediatric burns and extravasation injuries has been anecdotally reported.^{39,68} Although not specifically contraindicated, topical enzyme preparations have not been tested for safety or efficacy in the neonatal and pediatric populations. The manufacturer's recommended use of these drugs is only for persons >18 years of age.⁹

Dressing change procedure and securement. Although manufacturer guidelines for dressing changes must be followed, some dressing change procedures are unique to the pediatric population. For neonates and small children, it is ideal to have two people present (one to provide comfort and one to change the dressing).²⁹ As appropriate, family members can be involved, assisting with dressing changes and observing or cuddling/holding their child.²⁹ Patient distraction techniques can be used; when appropriate, a Child Life Specialist can be involved. Stress can be tempered by decreasing noise, bright lights, and excessive handling.²⁹ Dressing changes should be kept to a minimum consistent with the

needs of the wound, the need for monitoring, and manufacturer recommendations. Preparing dressings before uncovering the wound can help limit wound exposure time and resultant thermoregulatory stress and pain receptor exposure.²⁹

As feasible, the use of tape on premature infant's skin should be avoided. When needed, dressings can be secured with latex-free stretchy tubular gauze netting materials. When a wound is over a joint, proper positioning should be ensured to prevent contracture development during wound healing.¹⁰

Also, collaborative treatment goals and wound healing outcomes should be established (eg, higher incidence of hypertrophic or keloid formation in those with darkly pigmented skin).¹⁰

Irrigation procedures. Because cold irrigants will increase patient stress and decrease wound bed temperature (thereby, ceasing polymorphic and macrophagic activity until restoration of normothermia occurs), only warm fluids should be used.²⁹ Aseptic techniques should be maintained.²⁹ Sterile water and normal saline are the most commonly recommended cleansing agents for pediatric wounds⁶⁸; sterile water is preferred for neonates.²⁴ Among neonates, cleansers should be warmed to body temperature and normal saline diluted 1:1 with sterile water.^{24,60} A 20-mL syringe with a blunt needle or a polytetrafluoroethylene (Teflon[™]) catheter should be used to gently flush away wound exudate.²⁴ Antiseptics should be avoided given their potential for tissue damage and absorption.^{24,60}

Pain assessment and management. Pain assessment should be integral to every wound assessment.⁶⁹⁻⁷² Behavioral characteristics (crying, facial expressions, motor response, restlessness, or undue quietness) should be considered.⁶⁹⁻⁷² A valid and reliable pain assessment scale (eg, CRIES, CHIPPS, NIPS) can be used in conjunction with patient assessment.^{29,57,70-72} (see Table 4). Institutional pain management guidelines should be followed.²⁹ Soft silicone-based dressings, hydrocolloid pastes, hydrocellular foams, and hydrogels coupled with analgesics, distraction, and guided imagery may be beneficial in pain management.⁹ Where clinically appropriate, autolytic debridement can be facilitated through the use of hydrogels, hydrocolloids, foams, and pre-activated polyacrylate

with Ringer's solution dressings.² Securement devices such as tubular stretchy latex-free gauze netting can securely maintain dressing placement while allowing for atraumatic non-adhesive dressing removal.²

Education. Integral to education in pediatrics is recognition of each child's uniqueness, the developmental characteristics of each age group, and the psychological and psychosocial factors children face.⁷⁰ These young patients should be involved as feasible in care and allowed to make choices (eg, what they want to eat, selection of special stickers on their dressings). Peer-related activities should be encouraged as feasible and play therapy as age/developmentally appropriate.⁷⁰ If the child is of school age and returning to class, resources, education, and contact information should be provided to teachers and the school nurse.⁵⁵ Communication techniques/language used should be age-appropriate for the learner. For example, education of teenagers is best provided on a one-to-one basis with respect for their privacy. Educational materials that are concise and focused are best received.⁷⁰ The clinician needs to assess how much the patient and/or parent(s)/caregivers want to know and involve the family as feasible and when consistent with their wishes and that of their child. The patient and/or parent(s)/caregiver's level of understanding, expectations, coping skills, and access to sources of support should be assessed.⁷⁰ The patient and family's possible feelings of guilt associated with the cause of the wound and level of anxiety require consideration.²⁹

Wound assessment. Wound assessment documentation in children generally follows those established for adults⁹ and includes etiology, phase of healing, wound type (acute or chronic), location/distribution, dimensions (length, width, depth) measured in centimeters, presence of tunneling, undermining, sinus tracts measured in centimeters, tissue types (granulation, slough, eschar, epithelialization), exudate (amount, color, consistency, odor) and the presence of infection. The status of surrounding skin (intact, erythematous, hyperkeratotic, indurated, fluctuant, crepitant, candidal overgrowth, denudation secondary to adhesive stripping), level of pain, overall goals of care, patient/family goals of care, and previous treatments and outcomes also must be assessed and documented.

Conclusion

Adult-based wound care practices provide a rudimentary foundation for neonatal and pediatric wound care but do not negate the need for developmentally specific evidence-based guidelines.⁹ Most currently available guidelines and information are based on expert opinions and case studies. However, given the wide variation in percutaneous toxicity potential and developmental and integumentary maturity spanning from the very low birth weight premature infant through adolescence, clinicians desperately need age-appropriate, safe, and effective products, educational tools and research based guidelines from which to deliver safe and effective wound care practice.⁹ - OWM

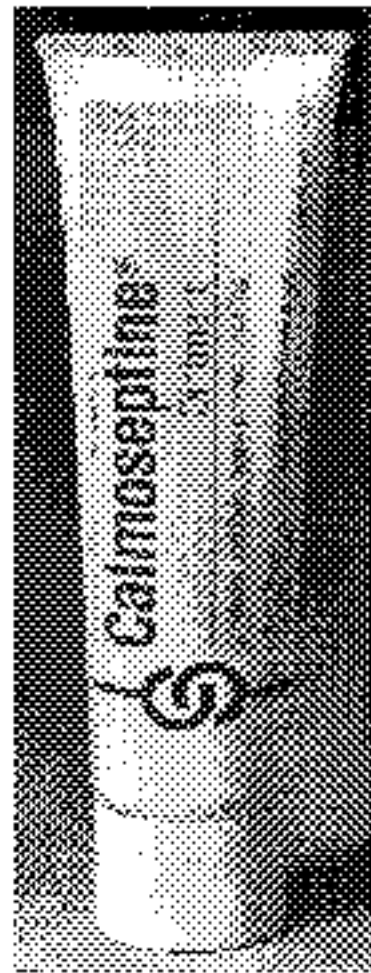
References

1. Pieper B, Templin T, Dobal M, Jacox A. Prevalence and types of wounds among children receiving care in the home. *Ostomy Wound Manage.* 2000;46(4):36–42.
2. Siegfried EC, Shah PY. Skin care practices in the neonatal nursery: a clinical survey. *J Perinatology.* 1999;19(1):31–39.
3. Irving V. Caring for and protecting the skin of pre-term neonates. *J Wound Care.* 2001;10(7):253–256.
4. Malloy-McDonald MB. Skin care for high risk neonates. *J WOCN.* 1995;22:177–182.
5. Irving V. Skin problems in the pre-term infant: avoiding ritualistic practice. *Professional Nurse.* 2001;17(1):63–66.
6. Bale S, Jones V. Caring for children with wounds. *J Wound Care.* 1996;5(4):177–180.
7. Garvin G. Wound healing in pediatrics. *Nurs Clin North Am.* 1990; 25:181–192.
8. Wysocki AB. Anatomy and physiology of skin and soft tissue. In: Bryant RA, ed. *Acute and Chronic Wounds: Nursing Management*, 2nd Edition. St. Louis, Mo: Mosby;2002.
9. The Tendra Academy®. Report from an independent multidisciplinary advisory group. Issues in paediatric wound care: minimizing trauma and pain. April 2004. Molnlycke Health Care, Inc., Norcross, Ga.
10. Baharestani MM, Pope E. Chronic wounds in neonates and children. In: Krasner D, Rodeheaver GT, Sibbald GT, eds. *Chronic Wound Care: A Clinical Source Book for Healthcare Professionals*, 4th Edition. Malvern, Pa: HMP Communications;2007:679–693.
11. Munson KA, Bare DE, Hoath SB, Visscher MO. A survey of skin care practices for premature low birth weight infants. *Neonatal Network.* 1999;18(3):25–31.
12. Irving V. Neonatal iatrogenic skin injuries: a nursing perspective. *J Neonatal Nurs.* 1999;5(5):10–13.
13. Baker SE, Smith BJ, Donohue PK, Gleason CA. Skin care management practices for premature infants. *J Perinatology.* 1999;19(6 Pt 1):426–431.
14. Rustogi R, Mill J, Fraser JF, Kimble RM. The use of

- Acticoat™ in neonatal burns. *Burns*. 2005;31(7):878–882.
15. Keener KE. The surgical neonate. In: Wise BV, McKenna C, Garvin G, Harmon BJ, eds. *Nursing Care of the General Pediatric Surgical Patient*. Gaithersburg, Md: Aspen Publishers, Inc;2000.
 16. Lund CH, Tucker JA. Adhesion and newborn skin. In: Hoath SB, Maibach, HI, eds. *Neonatal Skin Structure and Function*, 2nd edition. New York, NY: Marcel Dekker, Inc; 2003.
 17. Eichenfield L, Hardaway C. Neonatology dermatology. *Curr Opin Pediatr*. 1999;11(5):471–474.
 18. Campbell JM, Banta-Wright SA. Neonatal skin disorders: a review of selected dermatologic abnormalities. *J Perinat Neonat Nurs*. 2000;14(1):63–83.
 19. Garvin G. Wound and skin care in PICU. *Crit Care Nurs Q*. 1997;20(1):62–71.
 20. Malloy MB, Perez-Woods RC. Neonatal skin care: prevention of skin breakdown. *Pediatric Nurs*. 1991; 17(1):41–48.
 21. Kuller JM, Lund CH. Assessment and management of integumentary dysfunction. In: Kenner C, Brueggemeyer A, Gunderson LP, eds. *Comprehensive Neonatal Nursing: A Physiologic Perspective*. Philadelphia, Pa: WB Saunders;1993.
 22. Noonan C, Quigley S, Curley MAQ. Skin integrity in hospitalized infants and children — a prevalence survey. *J Ped Nurs*. 2006;21(6):445–453.
 23. McLane KM, Bookout K, McCord S, McCain J, Jefferson LS. The 2003 national pediatric pressure ulcer and skin breakdown prevalence survey: a multisite study. *J WOCN*. 2004;31(4):168–178.
 24. Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN). Neonatal skin care. Evidence-based clinical practice guideline. Washington, DC: Association of Women's Health, Obstetric and Neonatal Nurses (AWHONN); January 2001.
 25. Lund C. Prevention and management of infant skin breakdown. *Nurs Clin N Am*. 1999;34(4):907–920, vii.
 26. Report from an independent advisory group. Issues in neonatal wound care minimizing trauma and pain. The Tendra Academy®. June 2005. Molnlycke Health Care, Inc., Norcross, Ga.
 27. Irving V. Reducing the risk of epidermal stripping in the neonatal population: an evaluation of an alcohol free barrier film. *J Neonatal Nurs*. 2001;7:5–8.
 28. 3M Health Care. 3M Cavilon No-Sting Barrier Film (brochure). Saint Paul, MN;2000.
 29. Irving V, Bethell E, Burton F, on behalf of a Neonatal Advisory Group. Neonatal wound care: minimizing trauma and pain. *Wounds UK*. 2006;2(1):33–41.
 30. Irving V. Wound care for preterm neonates. *Infant*. 2006;2(3):102–106.
 31. McCullen KL, Pieper B. A retrospective chart review of risk factors for extravasation among neonates receiving peripheral intravascular fluids. *J WOCN*. 2006;33(2):133–139.
 32. Wilkins C, Emmerson A. Extravasation injuries on regional neonatal units. *Arch Dis Child Fetal Ed*. 2004;89:F274–F275.
 33. Shenaq SM, Abbase EH, Friedman JD. Soft-tissue reconstruction following extravasation of chemotherapeutic agents. *Surg Oncol Clin N Am*. 1996;5(4):825–845.
 34. Flemmer L, Chan J. A pediatric protocol for management of extravasation injuries. *Pediatr Nurs*. 1993;19(4):355–358,424.
 35. Thomas S, Rowe HN, Keats J, Morgan RJH. The management of extravasation injury in neonates. Available at: www.worldwidewounds.com. 1997. Accessed January 11, 2006.
 36. McCord S, Bookout K, McLane K, Helmuth M. Use of silver dressing with neonatal abdominal evisceration. Poster presented at the 36th Wound, Ostomy, Continence Nurses (WOCN) Annual Conference. Tampa, Fla. June 2004.
 37. Simon A, Sofka K, Wiszniwsky G, et al. Wound care with antibacterial honey (Medihoney) in pediatric haematology-oncology. *Support Care Cancer*. 2006;14(1):91–97.
 38. Linder N, Davidovitch N, Reichman B, et al. Topical iodine-containing antiseptics and subclinical hypothyroidism in preterm infants. *J Ped*. 1997;131(3):434–439.
 39. Hansbrough JF, Hansbrough W. Pediatric burns. *Pediatr Rev*. 1999;20(4):117–123.
 40. Mandal A. Paediatric partial-thickness scald burns — is Biobrane the best treatment available? *Int Wound J*. 2007;4(1):15–19.
 41. Gotschall CS, Morrison MI, Eichelberger MR. Prospective, randomized study of the efficacy of Mepitel® on children with partial-thickness scalds. *J Burn Care Rehab*. 1998;19(4):279–283.
 42. Frieden IJ. Aplasia cutis congenita: a clinical review and proposal for classification. *J Am Acad Dermatol*. 1986;14(4):646–660.
 43. Valencia IC, Falabella AF, Schachner LA. New developments in wound care for infants and children. *Pediatr Ann*. 2001;30(4):211–218.
 44. Sargent LA. Aplasia cutis congenita of the scalp. *J Pediatr Surg*. 1990;25:1211–1213.
 45. Bello YM, Falabella AF, Schachner LA. Epidermolysis bullosa and its treatment. *WOUNDS*. 2001;13(3):113–118.
 46. Falabella AF, Valencia IC, Eaglstein WH, Schachner LA. Tissue-engineered skin (Apligraf) in the healing of patients with epidermolysis bullosa wounds. *Arch Dermatol*. 2000;136:1225–1230.
 47. Rottnan SJ, Glat PM. The use of a biologic tissue matrix (Integra Bilayer Matrix Wound Dressing) in the treatment of recessive dystrophic epidermolysis bullosa pseudosyndactyly deformity. *WOUNDS*. 2006;18(11):315–321.
 48. Curley MAQ, Razmus IS, Roberts KE, Wypij D. Predicting pressure ulcer risk in pediatric patients — the Braden Q scale. *Nurs Res*. 2003;52(1):22–31.
 49. Baharestani M, Vertichio R, Higgins MB, Kurot M, May B. A neonatal and pediatric evidence-linked pressure ulcer and skin care performance improvement initiative. Poster abstract presented at the Symposium on

- Advanced Wound Care and Medical Research Forum on Wound Repair. April 21–24, 2005. San Diego, Calif.
50. Okamoto GN, Lamers JV, Shurtleff DB. Skin breakdown in patients with myelomeningocele. *Arch Phys Med Rehab.* 1983;64:20–23.
 51. Willock J, Hughes J, Tickle S, et al. Pressure sores in children — the acute hospital perspective. *Tissue Viabil Soc.* 2000;10(2):59–62.
 52. Black J, Baharestani MM, Cuddigan J, et al. National Pressure Ulcer Advisory Panel's updated staging system. *Adv Skin Wound Care.* 2007; In press.
 53. Baharestani MM, Ratliff C, and the National Pressure Ulcer Advisory Panel. Pressure ulcers in neonates and children: an NPUAP white paper. *Adv Skin Wound Care.* 2007;20(4):208–220.
 54. Smith ZK. Adapting a soft silicone dressing to enhance infant outcomes. *Ostomy Wound Manage.* 2006;52(4):30–32.
 55. Baharestani MM. Pressure ulcers in special populations: neonates and pediatrics. In: Baranoski S, Ayello E, eds. *Wound Care Essentials: Practice Principles*, 2nd Edition. Philadelphia, Pa: Lippincott Williams & Wilkins; 2007: In press.
 56. Hoath SB, Narendran V. Adhesives and emollients in the preterm infant. *Semin Neonatol.* 2000;5(4):289–296.
 57. Suraseranivongse S, Kaosaard R, Intakong P. A comparison of postoperative pain scales in neonates. *Br J Anaesth.* 2006;97(4):540–544.
 58. Quigley SM, Curly MAQ. Skin integrity in the pediatric population: preventing and managing pressure ulcers. *JSPN.* 1996;1(1):7–18.
 59. Darmstadt GL, DiNulos JG. Neonatal skin care. *Ped Clin NA.* 2000;47(4):757–782.
 60. Taquino LT. Promoting wound healing in the neonatal setting: process versus protocol. *J Perinat Nurs.* 2000;14(1):104–118.
 61. Hagelgans NA. Pediatric skin care issues for the home care nurse. *Pediatr Nurs.* 1993;19(5):499–507.
 62. Packard S, Douma C. Skin care. In: Cloherty JP, Eichwald EC, Stark AR, eds. *Manual of Neonatal Care*, 5th edition. Philadelphia, Pa: Lippincott Williams & Wilkins; 2004.
 63. Atkins J, Irving V, Young T. Development of a wound care policy for neonates. (Poster). Available from author.
 64. Harris Ah, Coker KL, Smith CG, Uitvlugt N, Doctor B. Case report of a pressure ulcer in an infant receiving extracorporeal life support: the use of a novel mattress surface for pressure reduction. *Adv Neonatal Care.* 2003;3(5):220–229.
 65. Moushley R, Meadows L. Burn care of children. In: Wise BV, McKenna C, Garvin G, Harmon BJ, eds. *Nursing Care of the General Pediatric Surgical Patient*. Gaithersburg, Md: Aspen Publishers, Inc; 2000
 66. Fell J. Versiva dressing in the management of a severe extravasation injury in a premature baby. (Poster) 2002. Available from author.
 67. Caniano DA, Ruth B, Teich S. Wound management with vacuum-assisted closure: experience in 51 pediatric patients. *J Ped Surg.* 2005;40:128–132.
 68. Spooner J. Use of a papain, urea enzymatic debriding ointment on a pediatric patient with an intravenous infiltrate burn. (Poster) Available from author.
 69. Samaniego I. Developing a skin care pathway for pediatrics. *Derm Nurs.* 2002;14(6):393–396.
 70. Hickey K, Vogel LC, Anderson CJ. Pressure ulcers in pediatric spinal cord injury. *Topics Spinal Cord Injury Rehabil.* 2000;6(Supp):85–90.
 71. Royal College of Nursing. Clinical practice guidelines: the recognition and assessment of acute pain in children: technical report. London, UK: RCN; 2002.
 72. American Academy of Pediatrics, Canadian Paediatric Society. Prevention and management of pain in the neonate: an update. *Pediatrics.* 2006;118(5):2231–2241.

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