American Journal of Pediatrics
2025, Vol. 11, No. 4, pp. 237–243
https://doi.org/10.11648/j.ajp.20251104.16

Review Article

Pediatric Wound Dressings Overview and Considerations for Management

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Abstract

Clinical decision-making in pediatric wound care has unique challenges due to limited research, complex terminology, and the large number of available wound products. These challenges are particularly evident in the neonatal and infant populations, whose skin physiology differs considerably from that of adults. These physiological differences include less cohesiveness at epidermal-dermal junction and overall structural immaturity, resulting in increased permeability, an increased susceptibility to mechanical injury, along with being thinner as compared to adult skin. The common practice of adopting adult wound care practice standards to serve pediatric patients with wounds remains evident and the need for product evaluation and evidence-based guidelines specific to these populations is clear. This review aims to support clinicians making safer, age-appropriate dressing decisions by addressing this paucity of pediatric-specific standards by examining some current wound care dressings and products used in the pediatric and neonatal populations, while also providing clinical expertise that emphasizes the importance of developmental considerations for dressing selection. This review will also explore some current research on products that are used for treatment on common pediatric injuries such as burns, diaper dermatitis, extravasation injuries, and pressure injuries from medical devices. This overview reinforces the need for more specific research, product review, and evidence-based guidelines to support safe, effective, and developmentally appropriate wound care products for neonatal and pediatric patients.

Keywords

Pediatric, Neonatal, Wound, Skin, Dressings, Infant, and Child

1. Introduction

Clinical decision making related to the application of a wound dressing can have multiple challenges. These challenges may include limited experience with skin healing, confusing language, and the current number of wound dressings that are available. These challenges may be further increased when treating a child that has a wound or an integumentary issue. Review and evaluation of the effectiveness of wound products in the pediatric population is an understudied and often underreported area of practice [1]. Suggested usage of pediatric wound dressings and products are attained through research in adults, and then simply applied or adopted to the pediatric and neonatal populations as the standard of care. [2] This process is inadequate for this special population and creates confusion related to pediatric and neonatal wound evaluation and treatment. The work of King and colleagues in 2014, outlined the need for the creation and implementation of evidence-based guidelines for treatment of wounds in neonatal and pediatric populations and provided a review of

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Received: 13 November 2025; **Accepted:** 25 November 2025; **Published:** 17 December 2025

commonly used wound care products. [2] Therefore, the purpose of this overview is to provide a review of current evidenced-based wound care products for the pediatric and neonatal population with clinical expertise in dressing selection and application of products.

To ensure clarity throughout this overview, the authors will define the terminology used to describe different age groups in the context of pediatric wound care. The authors defined Neonatal (0-28 Days), Infant (1 month - 1 year), Toddler (13 months - 3 years), Early Childhood (3- 5 years), School-Aged (6-12 years), and Adolescent (13-17 years) of age. [3] Prepubescent can be defined as 3 years to around 11 to 12 years old based on gender. [4] However, after puberty, skin tends to become more adult like. The term "pediatric" will be considered as a person from the age of birth to younger than 17 years based on the definition by the Food & Drug Administration (FDA). [5] By defining these age ranges, the authors hope to minimize confusion and provide clear foundation for discussing wound products and dressings for various age groups within the pediatric population.

1.1. Translational Relevance

This overview is by no means exhaustive but intended to provide guidance for the use of current wound care dressings and products that are available to use by any clinician who may be treating a pediatric wound. It is also meant to provide a summary for clinicians regarding the current research on interventions for treating pediatric and neonatal wounds. For clinicians to be successful, it is always recommended that a thorough assessment be conducted, provide individualistic care, review the components of the wound dressings, and use a comprehensive team approach when addressing specific needs of any population. [4]

1.2. Clinical Relevance

Wound clinicians must consider multiple factors when deciding what dressing to apply that will best assist in the wound healing process. Clinical decision making related to wound management can often be a challenge based on patient characteristics which may include different skin types, healing rates, reaction to a dressings or product, and comorbidities. Additionally, when considering a dressing, a clinician must also consider accessibility, cost, and the appropriateness of the dressing for a particular patient population along with the attributes that the specific dressing provides.

With these challenges, and the considerable number of wound products available today, there is no single product that can be considered ideal to treat every wound effectively. [6] Clinicians agree that a dressing should possess key properties to promote optimal wound healing. The first of these properties is the ability to remove excessive fluid without dehydrating the wound bed. Second, the dressing should allow for the passage of oxygen and water vapor in and out of the wound. The product should provide insulation to facilitate temperature regulation in the wound bed. Next, a dressing should also be impermeable to microorganisms and minimize contamination from toxins. Finally, the dressing should be atraumatic upon removal and not adhere to or damage healing tissue. [7, 8] Different wounds will require specific combinations of these properties. Therefore, based on the wound's individual characteristics, a dressing should be selected and applied that will best support healing using the properties mentioned above.

This overview does not aim to cover every dressing and product available but will focus on considerations specific to the neonatal and pediatric population. Traditional dressings recognized by CMS (Centers for Medicare & Medicaid Services) include five categories: foams, hydrogels, hydrocolloids, alginates, and gauze. [9] Other products that are commonly used in the pediatric and neonatal populations, such as transparent films, composites, hydroactive dressings, and honey will also be discussed. Table S1 reviews recent research and is organized by the type of products used based on various type of reviews which may include any of the following: randomized control studies, retrospective reviews, systematic reviews, case studies, prospective studies, comparative studies, and case series. The summation of information in tables two and three also include the same type of reviews. Table S2 compiles research based on common injuries seen in the pediatric and neonatal populations such as burns, diaper dermatitis, extravasation injuries, and pressure injuries related to medical devices. Table S3 summarizes research related to the neonatal population and addresses wound dressing for the use on diaper dermatitis, extravasation injuries, and negative pressure wound therapy (NPWT).

2. Topical Products and Dressings

2.1. Foam Dressings

Foam dressings, which are generally made from polyurethane, are appropriate to use in the neonate and pediatric populations due to their versatility, forgiving adhesive properties, and soft construction. These dressings are semi-occlusive, which means they allow for exchange of gas and water vapor, which is critical for maintaining a healthy, moisture-balanced wound environment. [10] Foams are also highly absorptive and assist with exudate management along with providing insulation. This insulation attribute assists in protecting the periwound area and maintaining thermal regulation of the wound bed. [10] In foam border dressings, the silicone properties of the border combined with the soft polyurethane create an ideal dressing to apply to the pediatric patient. These dressings are easy to use when applying and they conform well to skin contours without causing pain or irritation during a dressing change. Randomized control trials that evaluate the performance of foam dressings within the pediatric population are limited. A recent retrospective study

by Odom et al. in 2020 (N=93) found that foam and foam plus filler assisted with healing tracheostomy wounds, but recommended the foam and wound filler combination may be most beneficial for healing in the first 14 days of wound care. [11] Foam dressings can potentially be used in pediatric patients with epidermal stripping, pressure injuries, extravasation injuries, over surgical sites, and on burns because of their ease of use, absorbency, and ability to protect damaged skin. [4]

2.2. Hydrogels

Hydrogel dressings are composed of complex, organic hydrophilic polymers with a water content between 30% and up to 90%. [12] The primary application of this dressing is to provide moisture to a dry wound bed to promote cell migration and facilitate the formation of granulation tissue and epithelialization. [12] In general, hydrogels can absorb some fluid and fill spaces and cracks in a dry wound bed which is beneficial for pediatric patients with burns, abrasions, or are in the inflammatory phase of healing. Beneficial effects of hydrogel dressings can include pain control, conformability, assistance with promoting gentle debridement of necrotic tissue which is advantageous when working with neonatal and pediatric populations. [12] When using a hydrogel, maceration of periwound skin can be a concern if not used appropriately. Generally, these dressings require a secondary dressing, which could increase additional risks to neonates and pediatric patients base on the adhesive nature of the secondary dressing. For example, if using a hydrogel with an adhesive border, the patient may be at risk for epidermal stripping. However, when used appropriately, hydrogel sheet dressings are an appropriate option when treating patients with extravasation injuries [4] Despite the recognized benefits of hydrogel dressings, concerns remain for clinicians due to the limited amount of published research regarding efficacy for use in the pediatric population.

2.3. Hydrocolloids

Hydrocolloids are dressings that are formed by the combination of gel-forming polymers with adhesives that are held in a fine suspension on a backing of polyurethane film or a foam pad. [13] When placed on a wound with exudate, the polymers combine with wound fluid to form a gel-like mass. [13] Hydrocolloids may also be used in a prophylactic capacity for skin protection because of the ability to provide a moist environment, durability, and reliable skin adherence in areas prone to frequent trauma and friction. This preventative use can be valuable in pediatric care where skin is more delicate and susceptible to damage from pressure or repeated friction from a medical device such as catheters or tracheostomy tubes. In a study by Xie, hydrocolloid dressings were used on the nasal nares of preterm infants (n=65) to reduce skin trauma caused by continuous positive airway pressure (CPAP) and nasal devices. [14] Xie's study also suggested that hydrocolloid dressings significantly decreased the incidence and severity of nasal injuries. [14]

Clinicians should manage precautions associated with using hydrocolloids with neonatal and pediatric patients. Risks include covering infected wounds, maceration of the periwound, and the high risk of epidermal stripping associated with increased levels of adhesive used in hydrocolloid dressings. [13, 15] A clinician would need to consider using some form of barrier spray or skin protectant prior to application to reduce skin stripping. Hydrocolloid dressings could be a potential option for use in pediatric patients with superficial skin damage related to pressure injuries, extravasation injuries, or to reduce skin trauma. [4]

2.4. Alginates/Hydrofibers®

Alginate is a product that is derived from seaweed, processed with calcium and sodium ions, and then formed into flexible fibers or sheets for use in wound treatment. The action of this dressing is the result of interaction of the sodium and calcium ions contacting wound exudate, which forms a hydrophilic gel. [12] The alginate gel provides an environment for moist wound healing and can be highly absorptive. Hydrofibers® are synthetic dressings constructed of woven sodium carboxymethylcellulose fibers that essentially provide the same action as alginates. [16] Alginates and Hydrofibers® can also be embedded with properties that assist with bacterial control. A drawback to the use of alginate and Hydrofiber® dressings is that these dressings require a moist environment to form a gel and thus, should not be placed in dry wounds. [12]

Alginate and Hydrofiber® dressings are staple dressings used by wound clinicians to assist with wound healing and they work well with foam dressings to manage heavily exudating wounds. Calcium alginate dressings use on neonates should be avoided due to the potential for calcium to be absorbed by the body. [15] A study in 2016, conducted by Lau et al., found that hydrofibers containing silver appeared to promote early burn wound healing and decrease hypertrophic scar formation in pediatric patients. [17] Oquendo et al. completed a study in 2015 examining the use of silver-impregnated hydrofiber dressings for the management of giant omphaloceles. [18] Oquendo and colleagues concluded that this type of dressing mediated epithelization of giant omphaloceles followed by delayed surgical closure was safe for infants. [18] Lastly, Brenner et al. conducted a prospective randomized control trial comparing the effectiveness of three previously mentioned dressings on pediatric burn donor sites which included Hydrofibers®, foam, and calcium alginate. [19] The results showed no statistical difference in leakage of exudate, pain scores, or infection rates between the three products. Calcium alginate was found to be the optimal dressing for pediatric donor site healing in this trial. [19] Another consideration when using a hydrofiber treated with

silver on the neonatal and infant populations would be the patients age, risk of absorption, and the lack of evidence to support the use on the pediatric populations. [4]

2.5. Gauze

Gauze, once considered to be the standard of care for wound treatment in the 20th century, is a product that is often still used today based upon its cost effectiveness, reliability, and high absorbency. [20] This dressing is not, however, generally considered for maintaining a moist wound environment that promotes wound healing. [13] Gauze comes in woven and nonwoven forms and can be fabricated from cotton or synthetic fibers into multiple shapes and sizes and are commonly used in a wet-to-dry application for debridement. Gauze dressings are simple to use but are often seen as labor intensive and lacking the ability to provide an adequate healing environment. [13] Gauze products have a place in wound care; however, concerns regarding this dressing remain. Gauze tends to deposit lint material into the wound bed, often requires a secondary dressing, traumatizes the wound bed with non-selective debridement with removal, and is permeable to bacteria, which leads to an environment of accelerated growth. [7, 21]

Research related to the effectiveness of gauze is often negative. Gauze is often used in comparison studies to show the superiority of another product. In a review by Zheng and Li in 2015, comparison between hydrocolloids and saline gauze on pressure injuries (n= 329) showed that hydrocolloid dressings increased the likelihood of complete healing by more than two-fold compared to saline gauze. [22] Research conducted by Lawrence in 1994, found that bacteria could pass through up to 64 layers of dry gauze. [23] Lawrence's research, which was supported by a study conducted by Hutchinson in 1989, showed gauze dressings had a higher infection rate as compared to use of transparent films and hydrocolloids. This research has become very impactful on how clinicians use gauze today. Clinicians should be judicious and consider the patient's age when applying gauze products to acute wounds in the pediatric population, especially those infused with antimicrobial substances that may not have been evaluated on infants or the neonate population. Data on these types of infused dressings lack evidence to support their use on these populations because of the greater risk for absorption of chemicals due to an immature epidermis. [4, 24]

2.6. Film Dressings

Transparent film dressings are commonly used in pediatric wound care. They are generally composed of a polyurethane film and are permeable to water vapor, oxygen, and carbon dioxide but impermeable to bacteria and water droplets. [10] This type of dressing can be used for waterproofing, securing devices to the skin, reducing contamination, or providing a barrier of protection from friction or trauma. When using films in the pediatric population, caution is necessary due to the occlusive, adhesive nature of these products, which can increase the risk for epidermal stripping. [4] Unfortunately, no research or product analysis using film dressings in wound care with pediatric patients is available. Much of the research on films has focused on adult patients and fabrication films out of various materials or incorporating drugs into the films to enhance wound healing. [25, 26] Despite the lack of evidence, transparent film is a popular dressing used in pediatric care because of the multiple benefits it provides. However, if a clinician chooses to use this dressing, consider using some form of barrier spray or skin protectant prior to application to reduce skin stripping. Also, consider using an adhesive remover when this dressing is being removed along with employing the "low and slow" method of dressing removal. [4]

2.7. Composites/Hydroactives

Composite dressings are the result of combining multiple properties of wound dressings into one simple dressing. Composite dressings often have three layers that provide a bottom layer of non-adherence, a second layer of absorption, and a third outer layer of protection. [7] Many, but not all, of these dressings are waterproof. These products are versatile, come in multiple sizes and shapes, and can be used as a primary or secondary dressing. Composite dressings are often a first choice when working with the pediatric population due to the ability of the dressing to be non-adherent, easy to use, and highly adaptable.

Hydroactive dressings are multilayer dressings, comparable to foams and composites, and are capable of absorbing moderate to heavy levels of exudate. [12] However, like hydrocolloids, hydroactive dressings act similarly by trapping wound fluid in a hydrophilic (water-attracting) polymer away from the wound bed instead of forming a gel-like mass. [12] This action assists in maintaining a moist environment and inhibits bacterial growth. Hydroactive dressings also come in a variety of sizes and shapes and can offer a top water-proof layer, a non-adherence layer, or an odor-trapping layer. Unfortunately, high-level evidence on the use of hydroactive dressings use within the pediatric population is unavailable. However, the beneficial effects and adaptability of these two types of products should be considered when working with the pediatric population. Similar to foam dressings, composites and hydroactives can be considered for use with epidermal stripping, pressure injuries, extravasation injuries, over surgical sites, and on burns. [4]

2.8. Honey

Honey has been used to treat wounds for thousands of years, and clinicians haves seen its use increase significantly over the last few years because of the many benefits it provides. [27] These benefits include an antibacterial component along with antioxidant benefits, anti-inflammatory properties, analgesic

properties, and the ability to debride effectively. [10, 28] Another benefit of honey is the physical environment that it creates, as it provides a moist environment which is optimal for wound healing. [10] Clinical evidence to support the use of honey in adult care is extensive, but there remains conflicting evidence as to where honey fits into best practice. [10] The evidence to support use of honey in pediatric populations is increasing as provided in Table S1, but the clinical significance for use within the pediatric population needs continued review. While honey is considered safe, precautions should be taken when using honey. Clinicians should only use honey-based products that have been properly manufactured through gamma radiation sterilization to reduce the possibility of allergic reaction or contamination by Clostridium spores.

3. Wound Types

Numerous types of wounds may affect neonatal, infant, and pediatric populations that require a hospitalization, develop during a hospitalization, or treated in another clinical or home settings. Wound clinicians using the principles of wound treatment are often using similar or traditional methods in their approach for adults, pediatric, infant, and neonatal patient wound healing. These approaches should include assessment, reducing risk factors, potential debridement of non-viable tissue, reducing infections, promoting an ideal wound environment for recovery, and optimizing the factors that contribute to overall wound healing. However, the pediatric and neonatal population has additional challenges related to epidermal maturation, changes in structural immaturity, lack of a well-developed capillary plexus, transepidermal water loss, and changes in the acidic mantle. [4] Understanding that neonatal and infant skin is undergoing physiological changes and is not fully developed can enhance a clinician's ability to treat various wound types. Table S2 provides a review of recent studies based on the specific type of wound, and focuses on burn injuries, diaper dermatitis, extravasation, and pressure-injuries from medical devices.

Childhood burns have been identified by the World Health Organization (WHO) as the fifth most common cause of non-fatal childhood injuries in the world, and thus, the review of burn injuries in children is relevant to the clinician treating wounds in pediatric patients. [29] Extravasation injuries, which are created by vesicant fluid or medication that has leaked into surrounding tissue space from a peripheral IV causing tissue damage, need to be also considered due to reported incidence as high as 70% in the neonate population. [30, 31] Medical device-related pressure injuries in infants and children are also reviewed due to the high rate of occurrence in the pediatric population. [32]

Pediatric patients in the neonatal intensive care unit (NICU) are a separate and distinct subset of the population who have increased and unique challenges with treatments for the skin and wounds. Available and approved skin treatment products are limited for neonates establishing added challenges to working with this group. Table S3 provides an overview of research that have been conducted in the neonatal population and examines skin conditions and products that include extravasation injuries, diaper dermatitis, and the use of NPWT. Based on the authors clinical experience, the listed skin conditions are often a challenge and frequently seen while working in the NICU. While use of NPWT in neonates is sparse, evidence documenting NPWT use on the very young stresses the need for special consideration regarding size and weight in neonates. [33] There are many published studies documenting the successful use of NPWT in pediatric patients, however, the utilization of NPWT in the pediatric, infant, and neonatal population is currently outside the U.S. Food and Drug Association's indications. [33]

4. Conclusions

With the advancements of survivability of neonates and the medically complex pediatric patient, there is a growing need to advance skin and wound care practices to ensure safety for these populations. These populations have unique physiological characteristics which are significantly different from adults and may require a different strategy for wound care. However, with the limited research into wound healing products and absence of evidence-based guidelines for treatment in the pediatric and neonatal populations, clinicians may have to rely on traditional practices, institutional routine, and anecdotal care. To ensure optimal care is being delivered, there is a critical need for continued research to review wound care principles and resources as they apply to the pediatric and neonatal populations. This research would then provide and enhance clinicians with the best evidence-based wound strategies and guidelines to tailor fit their care to address specific pediatric wound care needs.

Abbreviations

CMS	Centers for Medicare and Medicaid Services
NPWT	Negative Pressure Wound Therapy
FDA	Food and Drug Administration
CPAP	Continuous Positive Airway Pressure
WHO	World Health Organization
NICU	Neonatal Intensive Care Unit

Supplementary Material

The supplementary material can be accessed at https://doi.org/10.11648/j.ajp.20251104.16

Author Contributions

Brian Heath Odom: Writing – original draft, Writing – review & editing

Charlotte Yates: Writing – original draft, Writing – review

& editing

Leah Lowe: Writing – review & editing

Conflicts of Interest

The authors declare no conflict of interest.

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Biography

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