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## EDUCATIONAL SERIES

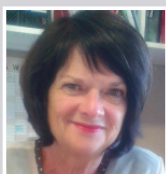
### Newborn and Infant Skin Care

#### About the Reviewers



**Dr Diana Purvis**  
 MBChB (Otago),  
 MRCPCH (London),  
 FRACP (Paediatrics) and  
 (Dermatology)

Diana is both a paediatrician and a dermatologist, with experience in adolescent health, neonatology, allergy and rheumatology. She trained in New Zealand and at Great Ormond Street Children's Hospital in London. Diana is a dermatologist at Starship Children's Hospital and is currently a lead in the development of National Network for the Treatment of Childhood Eczema.



**Pauline Brown**  
 Clinical Nurse Specialist  
 RN (Canada), BHScNsg (Akl),  
 PGDip Advanced Nsg Practice  
 (Akl),  
 Allergy Nsg Cert (Adelaide),  
 MHealthPrac (Akl)

Pauline is a paediatric clinical nurse specialist currently working for the Northland DHB in the field of allergy and eczema. She trained in eastern Canada and has been nursing in NZ since 1990 with most of this time working at Starship Children's Health in ICU, oncology and immunology/allergy. She is a member of the Clinical Reference Group of the National Network for the Treatment of Childhood Eczema.

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This review of skin care in newborns and infants is an educational resource for paediatric healthcare professionals and caregivers. It discusses the importance of maintaining skin barrier function with appropriate cleansing and moisturising practices, as well as the importance of sun protection. The review concludes with an Expert Commentary from Dr Diana Purvis (Auckland) and Pauline Brown (Northland) who highlight the most essential aspects of newborn and infant skin care.

#### Introduction

The skin fulfils many vital functions, including physical and immunological protection from harmful environmental elements.<sup>1-3</sup> Infant skin is not fully matured at birth,<sup>3,4</sup> potentially leaving it vulnerable to environmental insult. The use of appropriate evidence-based skin care practices in infants is therefore important.<sup>3</sup>

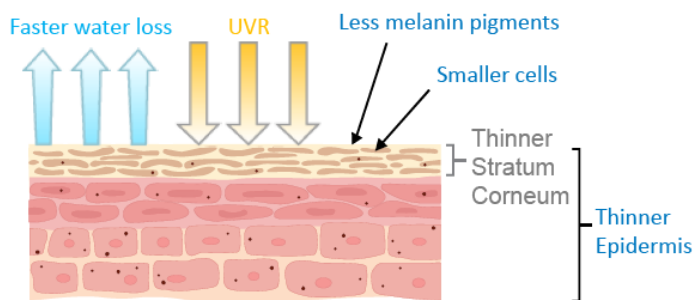
The basics of infant skin care are:

1. Cleanse – to remove, irritants, allergens, pathogens and other noxious environmental substances
2. Moisturise – to reduce the drying effects of low ambient humidity and other environmental factors.
3. Protect – the skin from sun damage by using sunscreens and protective clothing.<sup>5</sup>

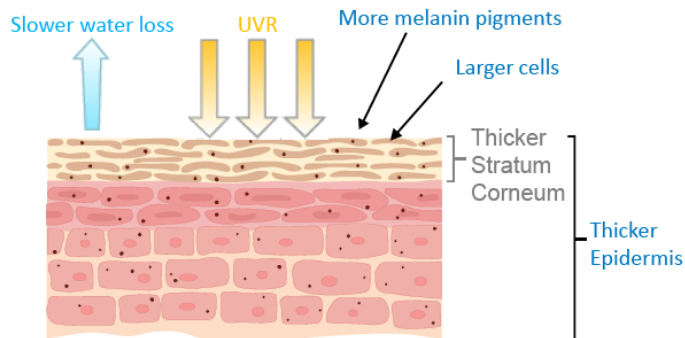
#### Skin Barrier Function

Skin barrier function resides primarily within the stratum corneum, the top layer of the epidermis (**Figure 1**). Although very thin, the stratum corneum plays a vital role in forming a protective barrier to help prevent percutaneous entry of irritants, allergens, micro-organisms, and ultraviolet radiation. In addition to serving as a physical barrier, the stratum corneum is also involved in the maintenance of hydration and contributes to innate immunity.<sup>1-3</sup>

#### Infant skin



#### Adult skin



**Figure 1.** An infant's skin is thinner than an adult's skin, including the protective stratum corneum layer. Infant skin is also more prone to losing water and dryness.<sup>2,3,6</sup>



Although the skin barrier is competent at birth in healthy full-term infants, infant skin is different from adult skin in structure, function, and composition (**Table 1**), and continues to develop during the first years of life.<sup>3,4,6</sup>

Skin barrier function depends on the structure and hydration level of the stratum corneum, among other factors. The relatively smaller corneocytes and thinner stratum corneum of infants indicate a weaker skin barrier compared to adults.<sup>2</sup> Adequate hydration of the stratum corneum is essential for maintaining the structural integrity and functionality of the stratum corneum.<sup>3</sup> Skin water content also influences skin barrier function via its effects on the activity of hydrolytic enzymes, which are involved in stratum corneum maturation and corneocyte shedding and renewal.<sup>3</sup>

However, because its water-handling properties are not fully developed before the end of the first year the infant stratum corneum loses water at a higher rate than adult stratum corneum, despite being more hydrated than adult skin (**Figure 1 and Table 1**).<sup>2,3</sup> Infant skin's greater water loss, combined with lower levels of sebum production, increase its risk of desiccation. Hence, infants have a higher tendency to develop dry skin, potentially leaving it susceptible to infection and irritant contact dermatitis.<sup>1</sup> The maintenance of skin hydration, and therefore barrier function, can be facilitated by regular use of emollients.<sup>1</sup>

	Infant skin	Adult skin
<b>Structural differences:</b>		
• Corneocytes	Smaller	Larger
• Granular cells	Smaller	Larger
• Stratum corneum and epidermis	Thinner	Thicker
• Pigmentation (melanin)	Less	More
<b>Compositional differences:</b>		
• Natural moisturising factor concentration	Lower	Higher
• pH	Higher (neonates only)	Lower
• Sebum	Lower (7-12 months)	Higher
• Stratum corneum water content	Higher	Lower
<b>Functional differences:</b>		
• Rate of water absorption	Higher	Lower
• Rate of water desorption	Higher	Lower
• Skin barrier function	Competent	Competent
• Transdermal water loss	Higher	Lower

**Table 1.** Comparison of the differences and similarities of infant and adult skin.<sup>3</sup>

Skin acidity is also important to skin barrier function. The pH of fully mature skin is maintained between 4.5–6.7, which creates an 'acid mantle'.<sup>1,2</sup> The acid mantle serves as a defence against infection and facilitates the biological activities of the enzymes in the stratum corneum, which are optimised to function at pH 5.6.<sup>1</sup> The formation of an acidic stratum corneum is also required for skin barrier maturation and repair processes. Neonatal skin has a higher pH (6.6–7.5) than older infant skin and that of adults, becoming more acidic by 5–6 weeks and remaining stable thereafter.<sup>1,3</sup> This feature of infant skin biology favours the use of skin care products that cause minimal changes to the skin's natural pH.

## Importance of Infant Skin Cleansing

Skin hygiene plays an important role in overall infant health and wellness. There are functional benefits, including proper skin cleansing through the removal of irritants and the promotion of normal exfoliation and skin rejuvenation.<sup>3,7,8</sup> There are also emotional benefits such as the reinforcement of parent-infant bonding through touch.<sup>8,9</sup>

## Skin cleansing considerations

Because development of the skin barrier continues after birth and infant skin is thinner than adult skin, care should be taken when cleansing and bathing an infant's skin. Bathing is generally considered superior to washing.<sup>8</sup> Furthermore, cleansing products should be clearly indicated for infant use, pH neutral (pH 7.0, i.e. neither acidic nor alkaline), and have a record of safety.<sup>10</sup>

Infants require cleansing that takes into consideration the specific needs of their skin as well as their activity levels and immediate environment (**Table 2**).<sup>6,8,11-14</sup> In particular, because their skin is thinner and has lower levels of natural moisturising factor than adult skin, it absorbs and loses water more quickly.<sup>6,14</sup> Infants also have an immune system that is still developing.<sup>15</sup> These factors have implications for infant cleansing, including the timing, frequency and duration of bathing, and highlight the importance of using a mild, pH-neutral cleanser that has less potential to alter skin barrier structure and function (**Table 2**).<sup>6,8,11-14</sup>

	Biological and Environmental Factors	Cleansing Considerations
Neonate (0 to 4-8 weeks)	<ul style="list-style-type: none"> <li>• Skin barrier is immature and at risk of water and heat loss, and vulnerable to irritants and infection</li> <li>• Neonates are relatively inactive</li> <li>• Their environment is controlled</li> </ul>	<ul style="list-style-type: none"> <li>• Delay bathing 4-6 hours after birth to allow temperature to stabilise</li> <li>• Duration: ≤5 minutes</li> <li>• Immersion bathing is beneficial when feasible</li> <li>• Water or mild, pH-neutral cleansing</li> </ul>
Infant (4-8 weeks to 8 months)	<ul style="list-style-type: none"> <li>• Skin barrier is maturing and still subject to water loss</li> <li>• Infant is active (crawling)</li> <li>• Environment is less controlled: infant is coming into contact with impurities, irritants, and bacteria</li> </ul>	<ul style="list-style-type: none"> <li>• More frequent: 2- to 3-times per week until crawling</li> <li>• Longer bathing is possible</li> <li>• Immersion bathing is beneficial</li> <li>• Water or mild, pH-neutral cleansing</li> </ul>
Toddler (8 months to 4 years)	<ul style="list-style-type: none"> <li>• Skin barrier continues to mature</li> <li>• Infant is more active (crawling and walking)</li> <li>• Increased contact with impurities, irritants, and bacteria</li> </ul>	<ul style="list-style-type: none"> <li>• Regular and frequent bathing is needed</li> <li>• Immersion bathing is beneficial</li> <li>• Water or mild pH-neutral cleansing</li> </ul>

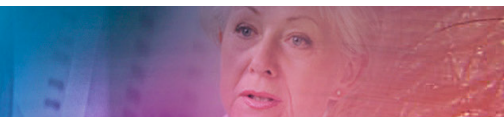
**Table 2.** Important biological and environmental considerations in infant cleansing.<sup>6,8,11-14</sup>

## Cleansers for infant skin?

Parents are often advised to use only water and a cloth to clean their infant.<sup>10</sup> Indeed, the UK's National Institute for Clinical Excellence (NICE) 2006 clinical guidelines on neonatal care recommended that cleansing agents should not be added to bath water and that lotions or medicated wipes should not be used, additionally advising that a mild non-perfumed soap is the only cleansing agent that should be used and used only when necessary.<sup>3</sup>

However, water by itself may be insufficient for infant cleansing, mainly because it is not capable of removing impurities that are oil-based,<sup>12,16</sup> and cleansing with water alone may even dry infant skin.<sup>17-19</sup> Furthermore, despite being an effective cleanser, soap can disrupt skin surface pH, alter skin lipids, and cause skin dryness and irritation.<sup>3</sup>

Formal guidelines published since the NICE guidelines recommend the use of cleansers for infant bathing. The second edition of the US-based Association



of Women's Health, Obstetric, and Neonatal Nurses (AWHONN) Neonatal Skin Care Evidence-Based Clinical Practice Guideline recommended that caregivers select mild cleansing bars or liquid cleansers that have a neutral pH (5.5–7.0) and are preservative-free or contain preservatives that have a demonstrated safety and tolerance profile.<sup>3</sup> Similarly, the European Roundtable meeting on 'Best Practice for Infant Cleansing' recommended that caregivers use liquid, pH-neutral, or mildly acidic, cleansers rather than traditional soaps for neonates and infants, although it departs slightly from the AWHONN guidelines in stating that liquid cleansers should contain adequate and appropriate preservatives.<sup>8</sup> However, there are few studies to guide this advice and much is based on expert opinion.

More recently, a randomised controlled study in healthy neonates demonstrated that use of a cleansing product was no worse than bathing with water alone in terms of skin water loss, pH, and clinical observations of dry skin, a finding that was consistent with that of other studies showing that wash products formulated for infants do not harm neonatal skin barrier function.<sup>20</sup> At the same time, a similar study conducted by the same researchers demonstrated that specially-formulated infant wipes for cleaning the nappy area of neonates have an equivalent effect on skin hydration when compared with cotton wool and water, with no adverse effects.<sup>21</sup>

### Skin cleanser selection

Most cleansers and soaps are suitable for adult skin cleansing. However, because infant skin continues to mature through the first years of life, cleansers for neonatal or infant skin should be formulated specifically for that population, i.e. they should not interfere with skin surface pH or disturb the skin barrier.<sup>3</sup> The properties of an appropriate infant cleanser are described in **Table 3**.

Property	Traditional cleanser	Infant cleanser
Surfactant system	Amphoteric, anionic	Amphoteric, non-ionic, and ethoxylated anionic
Micelle diameter	Smaller	Larger
pH	Slightly acidic to neutral pH	pH should cause minimal changes to skin surface pH
Preservative system	Some claim preservative-free	Product should be 'microbiologically robust'
Fragrance (perfume)	Higher concentration level	Lower concentration level; restrictions on specific fragrance components; fragranced product clinically evaluated for irritation and sensitisation potential

**Table 3.** Ideal properties of an infant cleanser.<sup>3</sup>

Liquid cleansers should be formulated to remove impurities, including fats and oils, maintain skin pH and lipid content, and avoid irritation.<sup>8</sup> This is achieved in large part by selecting the right type of surfactant, by blending surfactants, or by blending hydrophobically-modified polymers with surfactants to increase product mildness.<sup>3</sup>

Surfactants are molecules with both hydrophilic and lipophilic properties.<sup>3</sup> When exposed to water, surfactants self-assemble into micelles, which reduce the surface tension of water and emulsify oils and other substances that are not water soluble into droplets that can be rinsed away without the need for excessive friction.<sup>22,23</sup>

Some parents look for cleansing products that say natural, preservative-free, or organic. However, preservative-free products are prone to contamination, especially in the bath setting.<sup>10</sup> Ensuring that cleansing products are effectively preserved is essential for their safety. The importance of an effective preservative system in preventing the bacterial contamination of personal care products, including topical creams, has been demonstrated in laboratory studies.<sup>24,25</sup>

### Emollients for Moisturising

Emollients have a long history of use for maintenance of skin barrier integrity and function,<sup>3</sup> including beneficial effects on the skin of preterm neonates.<sup>26-28</sup> The moisturising benefits of emollients, used during or after bathing, have also been demonstrated in healthy full-term neonates, including a reduction in trans-epidermal water loss without affecting skin surface pH or sebum production.<sup>17</sup>

Formulating an emollient with the right type of oil is an important contributor to its effectiveness. Natural oils are advocated and widely used in neonatal skin care because, when applied

regularly, they help to maintain skin integrity and create a mechanical barrier.<sup>10,29</sup> Petrolatum and mineral oil have a history of safe use in infants as emollients, reducing water loss from the skin and hydrating the stratum corneum.<sup>10,30</sup> However, not all natural oils are appropriate for use on infant skin. Some natural oils, such as vegetable, nut, and olive oils, contain oleic acid, which can disrupt skin barrier function.<sup>3,10</sup> For example, topical application of olive oil has been shown to compromise the integrity of the adult stratum corneum and induce mild skin irritation.<sup>29</sup> Topical olive oil, and other vegetable oils (mustard and soybean) have also been shown to delay skin barrier recovery in pre-term infants with a developmentally-compromised skin barrier.<sup>31</sup> In contrast to some vegetable oils, mineral oil is more stable and is not subject to degradation by oxidation and hydrolysis.<sup>3</sup> Colloidal oatmeal, a natural product derived from oat grains, has also been used extensively as an emollient for the relief of dry skin,<sup>32,33</sup> and has demonstrated benefits as an adjunctive product in infant atopic dermatitis.<sup>34</sup>

### Irritant Contact Dermatitis

Irritant contact dermatitis is the most common form of contact dermatitis,<sup>35</sup> and involves the disruption of multiple skin barrier functions.<sup>1</sup> Irritant contact dermatitis is caused by a direct insult to the stratum corneum, which results in immune cell activation and an acute inflammatory response. Nappy rash is the most common form of irritant contact dermatitis in early infancy.<sup>3</sup> Up to 50-60% of infants experience nappy rash during their nappy-wearing phase.<sup>36,37</sup> Nappy rash is an acute inflammatory reaction of the skin in the nappy area caused by irritation from exposure to urine and increased skin surface pH, the activity of faecal enzymes, and friction between the skin and nappy surface.<sup>3,38</sup> As the basis of nappy rash is skin barrier disruption, protection of the skin in the nappy area forms the foundation of prevention of nappy rash. The following steps can help to prevent nappy rash:

- Frequent nappy changes;
- Thorough cleansing;
- Thorough drying of the skin by patting dry or allowing to air dry;
- Applying barrier creams, such as zinc oxide or mineral oil (paraffinum liquidum), to moisturise and protect the skin of the nappy area.<sup>8,17,39</sup>

### Sun Protection

Infant skin has been demonstrated to have a lower concentration of melanin compared with adult skin in body sites typically exposed to the sun, which is of relevance because melanin functions as an ultraviolet (UV) filter that reduces the penetration of UV light through the epidermis.<sup>2</sup> A lower melanin concentration in combination with a thinner stratum corneum in infants may contribute to heightened sensitivity to the harmful effects of UV light.<sup>2,3</sup> Hence, sun protection is an important consideration in infants.

There is evidence of confusion among New Zealand mothers with young children, as well as healthcare practitioners, about vitamin D and sun exposure messages.<sup>40</sup> This was a factor in the development of consensus statements on vitamin D and sun exposure for the [general population](#) and in [pregnancy and infancy](#).<sup>40,41</sup> The guidelines state that sun protection is particularly important for infants; they should not be exposed to direct sunlight, especially between 10am and 4pm from September to April.<sup>41</sup> Shade, protective clothing, wide-brimmed hats, and sunglasses are recommended as first-line protection against sun exposure in infants and young children, with an SPF30+ broad-spectrum sunscreen considered safe for use when additional sun protection is required.<sup>41</sup> Once mobile, young children should follow the same sun prevention advice as for the general population, and sunburn should always be avoided.<sup>41</sup>

### Expert Commentary

This review demonstrates the paucity of evidence to support clinical practice in caring for the skin of new babies. The majority of practice is guided by cultural norms and personal experience and preference. The few studies that have looked at specific products have generally been small in participant numbers and funded by industry who have a vested interest in the increased use of such products. This is definitely an area where more research is needed to support clinicians and families in making good decisions. For those with an interest in the topic, two recent reviews: [Prevention of Diaper Dermatitis in Infants – a Literature Review\\*](#) and [Skin Care Practices for Newborns and Infants: Review of the Clinical Evidence for Best Practice\\*\\*](#)

Research suggests that mild cleansers may be as gentle as water and possibly more effective for cleaning the skin and that gentle baby wipes may be as safe as water and a cloth, and offer a convenient alternative for parents – especially when they are out and about. Emollients can also play a role in supporting the skin especially if it is dry and inflamed. However as professionals it is important that we consider the implications of our advice to children and families – if we advise them to use an expensive wash product or moisturiser then this can significantly impact the household budget at a time when finances are frequently tight. Where possible we need to recommend funded products for families to use, and then only when clinically necessary.

Sun protection is also an area with limited evidence to guide our recommendations. In fair-skinned people living in the tropics it is clear that there is benefit from sun protection for the prevention of skin cancer. However for those with darker skin or living or living further from the equator there can be benefit from sun exposure for formation of vitamin D. Advice needs to be individualised to take these factors

into account and weigh the risk of skin cancer versus vitamin D deficiency. Certainly sunburn is to be avoided and the mainstay of sun protection at all ages should be avoiding spending time in sun during the middle hours of the day (seeking shade) and wearing appropriate clothing (long sleeves, brimmed hats and sunglasses). Sunscreens can be used when necessary in infants and should be broad spectrum with a high SPF >30.

\* Blume-Peytavi U et al. *Pediatric Dermatology* 2014;31(4): 413-29

\*\* Blume-Peytavi U et al. *Pediatric Dermatology* 2012;29(1): 1-14

### Take-Home Messages

- Neonatal skin undergoes a 1- to 2-year period of maturation during which special care is recommended.
- Skin care in neonates and infants should focus on supporting barrier function, primarily through hydration.
- Gentle skin cleansing and emollient use are two simple strategies for maintenance of skin health.
- Water alone is not capable of dissolving oil-based substances.
- Mild cleansers and wipes are equivalent to water in terms of effect on skin barrier function.
- Emollients are effective moisturisers for neonatal and infant skin.
- Maintenance of skin barrier function may reduce the risk of irritant contact dermatitis.
- Sun protection is at least as important in infants as it is in adults.

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