SOUTH AFRICAN NEONATAL SKIN CARE GUIDELINES

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ABOUT THE ASSOCIATIONS

Dermatology; NEA; NNASA; SOMSA

Dermatology

The Department of Paediatric Dermatology based at the Red Cross War Memorial Children's Hospital, the largest children's hospital in Sub-Sharan Africa. It provides all levels of multidisciplinary care at an international level whilst taking into account the limitations of being located in a resource poor country. Being the main referral centre, the division of paediatric dermatology sees patients from primary healthcare facilities to tertiary healthcare facilities and aims to provide superior paediatric dermatology care in a setting that offers care support, compassion and family design. The Department of Paediatric Dermatology unit at Red Cross War Children's Hospital strives to base its patient care and thus strongly supports research (evidence) base patient care.

NEA

The Nursing Education Association (NEA) establish in 1981 is a professional organisation for professional nurses with an interest in nursing education. Their vision is to lead excellence in nursing education to improve practice and the quality of healthcare for all through improving access to information and knowledge, strengthening scholarship of teaching and learning, stakeholder engagement, quality nursing education to improve practice, and visionary leadership.

NNASA

The Neonatal Nursing Association of Southern Africa (NNASA) formed in 2007 saw a need to improve the standard of neonatal care in the region by supporting and encouraging the nurses caring for these vulnerable babies. Their vision includes collaboration with other national and international organisations involved in the care of mothers and babies and support for nurses in neighbouring countries.

SOMSA

The Society of Midwives of South Africa is the professional association for midwives and is linked internationally to the International Confederation of Midwives. SOMSA envisions midwives being sensitive and empowered to deliver effective Midwifery services in SA. The mission is: to influence and engage with Midwifery structures and all relevant stakeholders regarding education, regulation and policies that impact on the Midwifery practice.

BACKGROUND

The aim of this skin care guideline is to provide evidence-based, contextualized guidelines for the care of full term, healthy neonatal skin. Complications in skin conditions and special populations, such as preterm and critically ill infants are outside the scope of this document.

This document is based on the third edition of the AWHONN Neonatal Skin Care Guidelines, however all sources and recommendations were checked by the working groups, updated and contextualized for the South African context. This was done with permission of AWHONN following a presentation by AWHONN representatives at a consultative meeting in April 2017 where the AWHONN Neonatal Skincare Guidelines were launched.

Statement: This edition of Neonatal Skin Care Guidelines has referred to some contents applicable to Chinese clinical care in the third edition of the AWHONN Neonatal Skin Care - Evidence-based Clinical Practice Guidelines. Some clinical operating guidelines which are derived from the third edition of the US AWHONN Neonatal Skin Care - Evidence-based Clinical Practice Guidelines are noted in relevant chapters.

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CONTENTS

OVERVIEW

This Evidence-Based Clinical Practice Guideline was developed for South African health professionals as an informational resource for practice. The Guideline does not define a standard of care, nor is it intended to dictate an exclusive course of management. It presents general methods and techniques of practice that the development team believes to be current and widely viewed as acceptable, based on current research and recognized authorities. Ultimately it is about the choices that is made within the resources available to provide the best care.

Proper care of individual patients may depend on many individual factors to be considered in clinical practice, including the resources available, as well as professional judgment in the techniques described herein. Variations and innovations that are consistent with law and that demonstrably improve the quality of patient care should be encouraged.

The drug classifications and selections set forth in this text are in accordance with current recommendations and practice at the time of publication. However, in view of ongoing research, changes in government regulations and policies, and the constant flow of information relating to drug therapy and drug reactions, the reader is urged to check information available in other published sources for each drug for potential changes in indications, dosages, warnings, and precautions. This is particularly important when a recommended agent is a new or infrequently employed drug. In addition, appropriate medication use may depend on unique factors such as individuals' health status, other medication use, and other factors that the professional must consider in clinical practice.

The information presented here is not designed to define standards of practice for employment, licensure, discipline, legal, or other purposes.

PURPOSE

The purpose of this neonatal skin care guideline is to provide healthcare professionals and healthcare workers with evidence-based guidelines to use to:

- Maintain skin integrity in healthy infants during the neonatal period,
- Formulate health communication messages for parents, carers and professionals

QUALITY OF EVIDENCE RATING GUIDE

Evidence-based practice and guidelines imply that the available evidence is critically evaluated to determine if it answers a selected clinical problem or aim. In addition, the evidence is rated to demonstrate the strength and quality of evidence. In this guideline the quality of evidence was determined by team consensus using the quality-of-evidence rating scale of the U.S. Preventive Services Task Force (1996). The evidence rating scale has three levels with sub-levels as depicted below.

Guide to Clinical Preventive Services quality-of-evidence rating scale:

I: Evidence obtained from at least one properly designed randomized, controlled trial or meta-analysis of randomized, controlled trials.

II-1: Evidence obtained from well-designed controlled trials without randomization.

II-2: Evidence obtained from well-designed cohort or case–control analytic studies, preferably from more than one centre or research group.

II-3: Evidence from multiple time series with or without the intervention. Dramatic results in uncontrolled experiments (such as the results of the introduction of penicillin treatment in the 1940s) could also be regarded as this type of evidence.

III: Opinions of respected authorities, based on clinical experience, descriptive studies, or reports of expert committees.

In text the evidence will be indicated as follows: Reference: level of evidence, e.g. Nikolovski et al., 2008:III. Where no studies specifically to full term babies were available, the closest evidence that could inform practice, such as evidence regarding adult or preterm infant skin, were included.

The next section of this document deals with the characteristics of neonatal skin. This will be followed by eight topics relevant to neonatal skincare. The topics included are: Vernix caseosa, New-born skin care, Cord care, Circumcision, Bathing, Diaper rash, Disinfectant, Emollients, and Medical adhesives. Each guideline is presented with clinical practice recommendations followed by the supporting evidence with the quality of evidence in brackets.

CHARACTERISTICS OF NEONATAL SKIN

The care of newborn skin is widely varied, influenced by individual training anecdotal experiences, regional customs, and individual patient's cultures. Yet the skin of all newborns experiences the same demands as it transitions from intrauterine to extra uterine existence. Developing skin care protocols that incorporate a better understanding of the anatomy and physiology of newborn skin and investigating outcomes in terms of newborn skin health and disease in a prospective fashion will allow the evidence-based refinement of skin care regimens and recommendations. This guideline is directed towards neonates (birth to 28 days of age) of babies born at term.

Understanding the physiological and anatomical skin differences of preterm and term baby skin is important to the Neonatal Nurse aiding thorough assessment and appropriate management of the skin.

1. Skin assessment

It is importance to conducting a 'skin assessment' in addition to a 'general risk assessment'. The Neonatal Skin Condition Score (NSCS) (The Royal Children hospital, Melbourne) may be used to measure skin condition objectively. The use of the NSCS is advocated for prevention of atopy as well as for infants at increased risk of systemic infection. Neonates who stays in hospital for a longer than usual time, should undergo a skin assessment daily, or more frequently as clinically indicated.

Neonatal Skin Conditions Score Criteria

Criteria	Description	Score	This score
Dryness	Normal, no signs of dry skin	1	
	Dry skin with visible scaling	2	
	Very dry skin with cracking and/or fissures present *	3	
Erythema	No evidence of erythema	1	
	Visible erythema (<50% body surface)	2	
	Visible erythema (>50% body surface) *	3	
Breakdown	None evident	1	
	Small and/or localized areas	2	
	Extensive	3	

Interpretation of the results

The relevant medical team must be notified if an infant scores a single score of 3 in one area or a combined score of 6 and above. A dermatology referral may also be appropriate.

2. Skin anatomy

Stratum Corneum

The Stratum Corneum is the outermost layer of the epidermis which acts as mechanical barrier. It protects against toxins, irritants, allergens and pathogens, retains heat and water as well as maintaining a normal microbiome. At birth, baby skin barrier is adequately developed to tolerate extrauterine environment; however, it continues to develop throughout the

initial years of life (Stamatas, Nikolovski, MacK, & Kollias, 2011:III; Fluhr et al., 2012:III; Nikolovski, Stamatas, Kollias & Wiegand, 2008:III).

The fact that infant skin is functionally continuing to develop after birth is indicated by the high surface hydration, high transepidermal water loss (TEWL), high pH, and high desquamation and proliferation rate, extending over at least the first year of life, which is significantly longer than previously indicated.

Key Differences in Infant Skin compared to adult skin

1. The ratio of baby body surface to body weight is higher than that for adult (Nikolovski et al., 2008:III).

2. Infants born at term have a well-developed stratum corneum containing 10-20 layers. The epidermis is the outermost layer and provides an important barrier function. In preterm infants the stratum corneum may only have 2-3 layers. Stratum Corneum in full term infants is 30% thinner, and the epidermis 20% thinner than that of adult skin (Stamatas, Nikolovski, Luedtke, Kollias, & Wiegand, 2010:III). This deficiency and immaturity of the stratum corneum results in increased fluid and heat loss leading to electrolyte imbalance, reduced thermoregulation and increased infection risk. Consequently, the epidermal barrier function is compromised, leaving infant skin vulnerable to chemical and microbial aggression and skin disease. Impaired barrier function is characteristic of infant skin afflicted with diaper dermatitis (Nikolovski et al., 2008:III; Seidenari & Giusti, 1995; Visscher & Narendran, 2014:III).

3. Cohesiveness of the epidermis to the dermis differs in term infants which is not yet fully developed. Corneocytes are smaller, Granular keratinocytes smaller, and more densely packed (Stamatas et al., 2010:III). The dermal papillae are more homogenous (in size, density and distribution), and matched one-to-one with surface glyphics. There is no marked distinction between papillary and reticular dermis. This decreased cohesion increases the risk of skin injury. If the adhesive used forms a stronger bond with the epidermis than that of the epidermis to the dermis, skin breakdown is likely.

4. Infant skin apparently employs distinct mechanisms to regulate water homeostasis, as natural moisturizing factor (NMF) and surface lipid concentrations are below the levels of adults. Baby skin has greater propensity to greater transepidermal water loss (TEWL) and reduced stratum corneum hydration. TEWL is lower at birth, similar or higher in older infants depending on the anatomical location (Nikolovski et al., 2008:III; Chiou & Blume-Peytavi, 2004:III; Nakagawa et al., 2004:III). Baby skin is drier at birth (Yosipovitch, Maayan-Metzger, Merlob, & Sirota, 2000:II-2), and more hydrated in older infants (Nikolovski et al., 2008:III; Giusti, Martella, Bertoni, & Seidenari, 2001:II-2) but there is higher inter-personal variability with a higher water concentration within the upper 26 µm (Nikolovski et al., 2008:III). Infant skin has a lower concentration of the natural moisturising factor (NMF) (Nikolovski et al., 2008:III) including lower concentration of melanin (Mack et al., 2010:III). This can thus explain the infant skin's lower-holding capacity as well as it's greater absorption propensity (Nikolovski et al., 2008:III).

5. Differences exist within the skin surface pH. A slightly acidic skin surface plays an important role in the maturation and maintenance of the stratum corneum, also inhibiting the growth of pathogenic microorganisms. Vernix caseosa also helps to maintain skin hydration, thermoregulation and skin acidification. Premature infants of varying gestational ages and term infants are born with an alkaline skin surface (pH >6.0). For term infants, this usually falls to less than pH 5.0 within the first 3 days of life, providing an "acid mantle" and protection from external pathogens. Due to an immature skin structure and the reduced or negligible amount of vernix caseosa, the preterm infant has an alkaline skin surface for a longer period of time. The skin pH of a preterm infant may take one week to decrease to pH 5.5 and up to a month to reach pH 5.1 and is therefore more susceptible to infection in this time. The importance of maintaining and promoting development of the newborns skin 'acid

mantle', lies in inhibiting the growth of pathogenic microorganisms and gives immunological properties to the skin. Babies have a higher skin surface pH (low acidity) which amplifies protease activity and the breakdown of corneodesmosomes, the supportive connective components of the stratum corneum (Yosipovitch et al., 2000:II-2; Giusti et al., 2001:II-2; Cork et al., 2009:III; Hachem et al., 2003:III; Nikolovski et al., 2008:III).

6. Baby's skin microbiome: Colonization of the skin with microorganisms may also play a role in the newborn period. Recent advances in science have enabled the identification of different microbes present at birth. Skin microbiome describes the diverse microorganisms that live on human skin. The skin is colonized differently in infants born vaginally compared with those delivered by Caesarean section. The influence of this needs further understanding, but may give us insight in to the development of some skin disorders and assist us in providing optimal skin care from birth (Younge, Araujo-Perez, Brandon & Seed, 2018:III; Dyer, 2013:III).

Conclusion:

Preservation of skin integrity, reduction of the potential development of atopic dermatitis (eczema) and education of parents is a key care priority in the care of the term and preterm infant.

VERNIX CASEOSA

Term babies are born covered with vernix caseosa, although varying in amount. This material coats the foetal skin surface during the last trimester of gestation and provides multiple beneficial functions for the foetus and newborn infant. The vernix caseosa protects the thin immature skin of the foetus intra-utero. Postnatally, vernix is simultaneously a cleanser, a moisturizer, an anti-infective, and an anti-oxidant (Hoath, Pickens, & Visscher, 2006: III). It also contributes to thermal stability **(Visscher, Narendran, Pickens, LaRuffa, Meinzen-Derr, Allen, & Hoath, 2005: I)**. Vernix facilitates acid mantle development and supports normal bacterial colonization (Hoath et al., 2006: III). As newborn skin have poor water holding capacity during the first few days after birth, it is beneficial to leave the vernix in place after birth **(Visscher, Narendran, Pickens, LaRuffa, Meinzen-Derr, Allen, & Hoath, 2005: I)**. However, the vernix is often wiped or cleaned off, stripping the infant from receiving the protective benefits of vernix caseosa.

CLINICAL PRACTICE/ BENEFITS	EVIDENCE
Be aware of and provide education to parents, where appropriate, about the functions and potential benefits of vernix for the newborn:	This guideline provides the evidence that support the benefits of vernix caseosa.
a. Protection against infection	The epidermal barrier is the first line of protection against bacterial cutaneous infection. Vernix contains antimicrobial peptides and proteins that are active against common bacterial and fungal pathogens and therefore have a direct role in defence against bacteria **(Larson & Dinulos, 2005: III; Tollin et al., 2005: II-1)**. Recent studies identified a collection of surfactant proteins in vernix that are known to be important for airway sterility. They also suggest that these proteins fulfil a vital antimicrobial role in protection against intrauterine infection and postnatally until bacterial colonization of the gut occurs **(Akinbi, Narendran, Pass, Markart, & Hoath, 2004: II-3; Haubrich, 2003: III)**.
b. Decreased skin permeability and TEWL	Prenatally, vernix "waterproofs" the foetus and allows for epidermal growth free from the potential maceration caused by extended amniotic fluid exposure **(Yoshio, Lagercrantz, Gudmundsson, & Agerbeth, 2004: II-1; Youssef, Wickett, & Hoath, 2001: II-1)**. In one adult study, vernix was applied as a topical barrier cream and compared with commercial topical emollients and petrolatum. Vernix treatment resulted in immediate increases in baseline surface hydration, moisture accumulation, and water-holding capacity greater than the other ointments **(Bautista, Wickett, Visscher, Pickens, & Hoath, 2000: II-1)**. Application of synthetic vernix has been studied and may be an effective therapy to enhance epidermal barrier formation and function **(Tansirikongkol, Visscher, & Wickett, 2007: II-I)**.
c. Skin cleansing	In a study to test various cleansers' ability to remove test soil from adult forearms, vernix exhibited a cleansing capability comparable or superior to standard skin cleansers **(Hoath & Pickens, 2003: III; Moraille et al., 2005: II-2)**.
d. Moisturization of the skin surface	Vernix contains 80% water, while petrolatum jelly contains 0.03% water. For this reason, vernix has been called a naturally occurring barrier cream with moisturizing capacity. It functions as a moisturizer by increasing skin hydration and water-holding capacity, which helps to maintain the suppleness and plasticity of the stratum corneum **(Haubrich, 2003: III; Hoath, Narendran, & Visscher, 2001: III; Tansirikongkol et al., 2007: III; Visscher et al., 2011: II-1; Youssef et al., 2001: II-1)**.

CLINICAL PRACTICE/ BENEFITS	EVIDENCE
e. pH development	After birth, the skin surface pH drops from a neutral pH to an acidic pH, forming the acid mantle. The acid mantle inhibits the growth of pathogenic bacteria **(Larson & Dinulos, 2005: III)**. The presence of vernix produces earlier acidification of the skin and may facilitate colonization by the normal flora after birth **(Tollin et al., 2005: II-1; Visscher et al., 2005: I)**.
f. Wound healing	Vernix is important for epidermal barrier formation and rejuvenation after wounding of the skin **(Haubrich, 2003: III)**. Glutamine, which constitutes greater than 20% of the amino acids in vernix, is a known trophic factor for the gut and is required by rapidly proliferating cells **(Hoath et al., 2001: III)**. Early studies raise the possibility of using vernix as the prototype of a new barrier cream to facilitate the formation of an effective stratum corneum **(Tansirikongkol et al., 2007: II-1; Visscher et al., 2005: I)**.
g. Temperature regulation	In one study, leaving vernix intact had no effect on axillary temperatures during the first hour after birth in older preterm infants (greater than 32 weeks of gestation) **(Visscher et al., 2005: I)**.

Conclusion:

Do not remove vernix caseosa from newborn skin. Even when blood, meconium or faeces have to be removed, it should be done in a gently way to protect the vernix, since vernix protects the infant against infection, decrease skin permeability and TEWL, cleanse and moisturise the skin, protect the acid mantel, act as epidermal barrier and skin rejuvenation and contribute to temperature control.

CORD CARE

Neonatal sepsis remains a leading cause of the disease burden and neonatal deaths worldwide **(Coffey, Brown, 2017: II-3; Camacho-Gonzalez, Spearman, Stoll, 2013: III)** with cord sepsis (omphalitis) being exceptionally high in developing countries **(Mullany, Darmstadt, Katz, Khatry, LeClerq, Adhikari & Tielsh, 2009: I)**. The recently cut umbilical cord can create a pathway for infection thus emphasizing the importance of effective cord care practices in neonates **(Coffey, Brown, 2017: II-3; Shah, Padbury 2014: III)**.

CLINICAL PRACTICE	EVIDENCE
Immediate cord care	
Implement standard precautions, including wearing gloves before touching or caring for the umbilical cord stump and surrounding area and before cleansing the infant. After the initial cleansing, implement standard infection control measures, including hand hygiene.	Transmission of community-acquired infections, including MRSA, can be prevented with adherence to standard infection-control measures, including hand hygiene **(CDC, 2006: III; Watson, 2006: II-3)**.
Clean the umbilical cord and surrounding skin surface as part of the initial bath. a. Wash the umbilical area with clean tap water or cooled-down, boiled water to remove debris. b. Use cleanser (chlorhexidine) sparingly if needed to remove debris. c. Dry thoroughly to remove excess moisture. d. Leave umbilical area and clamped umbilical cord stump clean, dry, and uncovered. e. Chlorhexidine can be used	The umbilical cord of the newborn is a potential portal of entry for invasive bacterial pathogens **(Dinulos & Pace, 2008: III)**. In hospital settings in developed countries, the routine use of antimicrobial sprays, creams, or powders for cord care has not been shown to be more effective in preventing infection than keeping the infant's cord clean and dry at birth **(AAP & ACOG, 2012: III; Zupan, Garner, & Omari, 2004: I)**. According to a 2013 Cochrane review, there is significant evidence to suggest that topical application of chlorhexidine to umbilical cord reduces neonatal mortality and omphalitis in community and primary care settings in developing countries. There is no evidence that it increases risk of subsequent morbidity or infection, although it may increase cord separation time **(Imdas, Bautista, Senen, Uy, Mantaring 111 & Bhutta, 2013)** Bathing does not delay cord healing or increase infection rate **(Bryanton et al., 2004: I)**.
Ongoing cord care	
Use natural drying for umbilical cord care. Natural drying involves keeping the cord area clean and dry, without the routine application of topical agents. (See section on Special Needs in Developing Countries)	Cord separation time is shorter for full-term neonates receiving natural drying (dry cord care) when compared with those receiving isopropyl alcohol to the cord on a daily basis **(8.1 vs. 9.8 days) (Dore et al., 1998: I)**. Application of topical drying agents or antibiotics has demonstrated no beneficial effect on cord separation time or frequency of cord infections **(Medves & O'Brien, 1997: I; Zupan et al., 2004: I)**.

CLINICAL PRACTICE	EVIDENCE
The following steps should be implemented when providing cord care: a. Keep umbilical cord area clean and dry. b. Maintain aseptic technique to minimize contamination by pathogens. c. Wash hands before handling umbilical stump. d. Keep umbilical stump exposed to air or loosely covered with clean clothes. e. Keep diaper folded down and away from umbilical stump to prevent contamination with urine or stool. f. If the umbilical cord stump becomes soiled with urine or stool, cleanse the area with water. g. After cleansing with water, dry thoroughly with clean absorbent gauze to remove excess moisture, and then discard the gauze.	In preterm infants, cord separation time was reported to be shorter with natural drying (13 days) compared with alcohol care (16 days). Natural drying prevents exposure to isopropyl alcohol and the potential skin breakdown from chemical irritation **(Evens, George, Angst, & Schweig, 2004: I).** One study reported that infants receiving dry cord care (natural drying) may have more exudate and odour as compared with infants treated with triple dye and alcohol protocols and had a higher colonization rate with microorganisms but no increase in infections **(Janssen, Selwood, Dobson, Peacock, & Thiessen, 2003: I).** For developed countries, a 2013 Cochrane review, found that there is significant evidence to suggest that topical application of chlorhexidine to umbilical cord reduces neonatal mortality and omphalitis in community and primary care settings in developing countries. There is no evidence that it increases risk of subsequent morbidity or infection, although it may increase cord separation time **(Imdas, Bautista, Senen, Uy, Mantaring & Bhutta, 2013: III).**
Discourage the routine use of the following antimicrobial topical agents: - Isopropyl alcohol - Topical antimicrobial/ antibacterial agents, including but not limited to povidoneiodine, CHG, and triple antibiotic ointment - Triple dye (brilliant green, crystal violet, and proflavine hemisulfate). Refer to the section on disinfectants for more about selecting topical/ cleansing agents.	a. Isopropyl alcohol prolongs cord separation time and does not decrease bacterial colonization or infection rates **(Dore et al., 1998: I).** b. The use of antimicrobial topical agents is not supported in the literature **(Zupan et al., 2004: I).** In a high humidity, subtropical country, cord separation time was significantly decreased with natural drying when compared with cleansing with 95% alcohol, and the incidence of cord infection was not increased **(Hsu et al., 2010: I).** A comparison of triple dye application at birth plus routine isopropyl alcohol with triple dye application alone showed no difference in time to cord separation **(Suliman et al., 2010: I).** Because of the developmental immaturity of neonatal skin, the potential for absorption and toxicity from antimicrobial/antibacterial agents is increased. Topical antimicrobials have been associated with allergic contact dermatitis and, rarely, anaphylaxis **(Chamnanvanakij, Decharachakul, Rasamimaree, & Vanprapar, 2005: I; Donlon & Furdon, 2002: III; Guala et al., 2003: II-2; Pezzati et al., 2003: I).** c. Triple dye can cause skin necrosis if it is inadvertently applied to the skin surrounding the umbilical stump. Cords treated with triple dye had the longest separation time when compared with dry cord care and alcohol cord care **(Chamnanvanakij et al., 2005: I).** Infants who received initial cord care with triple dye followed by alcohol had a longer time to cord separation than infants who received only alcohol applied to the cord **(Golombek, Brill, & Salice, 2002: II-2; Suliman et al., 2010: I).**

CLINICAL PRACTICE	EVIDENCE
Recognise danger signs to distinguish normal umbilical cord healing from potential problems, including infectious and non-infectious conditions. Contact the primary care provider if signs of a potential problem are present. Signs: redness and swelling around stump area, discharge (not only small amounts of cloudy mucoid material) a. Examples of infectious conditions that may affect the umbilical cord include but are not limited to the following: • Omphalitis • Periumbilical erythema • Neonatal tetanus • Periumbilical necrotizing fasciitis b. Examples of non-infectious conditions that may affect the umbilical cord include but are not limited to the following: • Umbilical granuloma • Clear drainage and inflammation confined within the umbilical ring • Urachal anomalies	INormal healing of the newborn umbilical cord may create a moist, gelatinous appearance. The isolated presentation of a moist, gelatinous appearing cord has not been associated with infection. The stimulatory effect of bacteria on wound healing has long been recognized. All wounds are colonized, but not all wounds are infected. Bacteria are believed to help initiate the inflammatory or first stage of wound healing **(Donlon & Furdon, 2002: III; Mendenhall & Eichenfield, 2000: III)**. Small amounts of cloudy mucoid material normally collect at the junction of the necrotic cord stump and abdominal skin and should not be misinterpreted as pus (Brook, 2002: III). Infectious and noninfectious conditions of the cord may also be present and cause delayed cord separation. Conditions that place the newborn at risk of umbilical infections include a nonvaccinated mother, nonsterile delivery conditions, and unusual cord care practices **(Donlon & Furdon, 2002: III; Janssen et al., 2003: I)**. a. Omphalitis is characterized by drainage from the umbilical stump or its base at the point of attachment to the abdominal wall. Secretions may be thin and serous, sanguineous or frankly purulent, and, at times, foul smelling. Signs of inflammation of the tissues surrounding the cord support the diagnosis of omphalitis, which may also be associated with fever, lethargy, or poor feeding **(Brook, 2002: III)**. Necrotizing fasciitis presents with a blue, gray, or black appearance of the skin and can rapidly progress to thrombosis **(Donlon & Furdon, 2002: III)**.
Educate staff and families about the normal mechanism of umbilical cord healing with the following principles: a. The umbilical cord should be kept clean as part of normal hygiene practices. b. Moist, gelatinous appearance may be normal. c. Redness, swelling, and drainage are abnormal outcomes. d. Do not pull on the cord stump; allow natural detachment to take place.	The umbilical cord typically appears moist and gelatinous and, at times, has a characteristic odour. The umbilical cord stump will change from yellowish green to brown to black as it dries out and eventually falls off. The mechanism of umbilical cord separation involves infarction, mechanical drying, collagenase activity, granulocyte influx, and aseptic necrosis (Donlon & Furdon, 2002: III; Mendenhall & Eichenfield, 2000: III; Zupan et al., 2004: I).

CLINICAL PRACTICE	EVIDENCE
Special Needs in Developing Countries	
Consider the topical use of Chlorexidine for cord care in developing countries. Chlorhexidine products may include solutions, gels, and powders.	In developing countries, umbilical cord infection is a major cause of neonatal morbidity and mortality. Mothers often deliver at home under unhygienic conditions and may live in areas in close proximity to animals and animal dung. The prevalence of neonatal tetanus, gram-negative sepsis, and omphalitis is higher. It is possible that different standards of practice are needed for developing countries, where standard hygiene practices are not currently met (AAP & ACOG, 2012: III; Mullany, Darmstadt, & Tielsch, 2003: III). The WHO recommendations for developing countries include using nothing on the cord stump, folding the diaper below the stump, and using soap-and-water solution to clean the cord if visibly soiled (WHO, 2006: III). However, these recommendations have been questioned by researchers conducting trials that compare various cord care regimens in countries lacking basic resources, including clean water (Mullany et al., 2003: III; Mullany et al., 2006: I). According to a 2013 Cochrane review, there is significant evidence to suggest that topical application of chlorhexidine to umbilical cord reduces neonatal mortality and omphalitis in community and primary care settings in developing countries. There is no evidence that it increases risk of subsequent morbidity or infection, although it may increase cord separation time (Imdas, Bautista, Senen, Uy, Mantaring 111 & Bhutta, 2013). One study in Nepal showed a 75% reduction in omphalitis and a 24% reduction in mortality when using an initial bath with 0.25% CHG followed by single application of 4% CHG solution to the umbilical cord within the first 24 hours of life (Mullany et al., 2006: I). Another study in the same country compared CHG gel to aqueous CHG for cord stump care. The gel formulation resulted in a superior reduction in bacterial growth 24 hours after application (Hodgins et al., 2010: I). A randomized, controlled trial of 9,741 newborns in Pakistan found the application of 4% CHG to the umbilical cord by trained birth assistants with continued daily application at home by family members resulted in a decreased risk of infection and a reduction in neonatal mortality when compared with infants having only dry cord care (Soofi et al., 2012: I). In Bangladesh, a study showed a decrease in overall cord redness and pus when cleansing the cord with 4% CHG as soon as possible as a single application after home birth or when using the same solution as a daily application for 7 days after home birth when compared with dry cord care. The single-application group also demonstrated a decrease in overall neonatal mortality when compared with the other two groups (Arifeen et al., 2012: I).
Consider using breast milk as a substitute for other topical agents for umbilical cord care in developing countries.	Breast milk has been shown to be effective in reducing colonization compared with other topical agents and may be used effectively for umbilical cord care in developing countries (Ahmadpour-Kacho, Zahedpasha, Hajian, Javadi, & Talebian, 2006: I; Vural & Sezer, 2006: II-2). Breast Milk has antimicrobial properties that act as a defensive agent protecting the cord from getting infected. It also has influence on detachment of the umbilical cord. This evidence therefore conclude that breast milk is the best tropical agent in reducing timing of cord separation (Pujar, Deepa & Francis, 2013: II).

CLINICAL PRACTICE	EVIDENCE
Provide education on cord care strategies to health care professionals in developing countries.	A Sri Lankan study found that a comprehensive education program for health care professionals about evidence-based cord care can be an effective strategy in changing maternal behaviour **(Senarath, Fernando, & Rodrigo, 2007: II-2).**

Conclusion:

The South African guideline:

1. Ensure a clean birth
2. Apply 4% CHG as a single application following birth.
3. Thereafter, use breastmilk to clean the cord with nappy changes or when soiled, until it has separated.
4. In the absence of breastmilk use cooled-down, boiled water or clean tap water to clean the cord with each nappy change (natural drying).
5. The cord may be submerged when the infant is bathed and washed with water and soap when soiled.
6. Keep the cord uncovered/lightly covered and dry until separated.
7. In case of infection, threat the infection systemically.

BATHING

The neonate has a large body surface area, thin skin, little insulating fat with easily overwhelmed thermoregulatory mechanisms which are susceptible to hypothermia **(Adejuyigbe et al. 2015: III; Lunze, Hamer, 2012: III)**. Thermal care practices including bathing, drying and wrapping the baby, particularly during the first week of life, are influenced by cultural practices and can have a significant influence on the ability of the baby to maintain body temperature. Bathing post-delivery is undertaken for hygiene reasons and to remove body fluids and blood which could be a source of contamination for health workers **(Adejuyigbe et al. 2015: III; Kuller, 2014: III; Lunze, Hamer, 2012: III)**.

CLINICAL PRACTICE	EVIDENCE
General Newborn Bathing Principles	
Implement a hand hygiene policy for staff and visitors that includes hand cleansing with a facility-approved antibacterial cleanser before bathing infants. • Use a standardized handwashing procedure such as the Centers for Disease Control and Prevention (CDC) guidance for hand hygiene in health care settings.	Transmission of community-acquired infections, including methicillin-resistant Staphylococcus aureus (MRSA), can be prevented with adherence to standard infection control measures, including hand hygiene and environmental cleaning **(CDC, 2006: III; Watson, 2006: II-3)**. Hand hygiene before and after patient contact is the most important practice in the prevention of hospital-acquired infections **(American Academy of Pediatrics [AAP] & American College of Obstetricians and Gynecologists [ACOG], 2012: III; CDC, 2013: III)**.
Use standard infection control precautions, including wearing gloves, until after the newborn's first bath.	Maternal blood and blood-stained amniotic fluid may pose a threat to health care professionals. Neonates should be considered contaminated with blood-borne pathogens until they are cleansed of blood and amniotic fluid **(Blume-Peytavi et al., 2009: III; CDC, 2006: III; Da Cunha, Procianoy, Franceschini, De Oliveira, & Cunha, 2008: I)**. Removal of blood and secretions from the newborn may help to minimize the risk of infection **(AAP & ACOG, 2012: III)**.
Ensure that bath equipment is disinfected, as per facility approved policy, before and after each use.	Bathing equipment can harbour microorganisms. Cleaning and disinfecting the tub is necessary for decontamination (AAP & ACOG, 2012: III). Clean and disinfect the bath and other equipment (consistent with hospital policy) to avoid nosocomial infection **(Blume-Peytavi et al., 2009: III)**.
Implement environmental controls to create a neutral thermal environment and to minimize neonatal heat loss during bathing, including the following: a. Prepare the environment by closing doors and windows, turn of the air conditioner and prevent any draughts. b. Ensure that bath water temperature ranges from 38°C to less than 40°C. c. While not a necessity, consider using a thermometer to assess water temperature before bathing. d. If not available, use an elbow, wrist or hand to test water temperature e. Ensure that the room temperature is 26–27°C). f. Swaddle bath the infant to prevent heat loss	Bathing is a significant factor influencing thermoregulation during the early neonatal period **(Loring et al., 2012: I)**. b. When using the thermometer, the water temperature should be 37°C–37.5°C **(Blume-Peytavi et al., 2009: III)**. c. The water temperature should be comfortably warm to touch **(Burd, 2010: III; WHO/RHR/ MSM/97.2: III)**. d. With appropriate environmental controls, heat loss during bathing is minimized, regardless of setting, timing, or provider **(Medves & O'Brien, 2004: I; Nako et al., 2000: I)**.

CLINICAL PRACTICE	EVIDENCE
Use warm tap water with a mild cleanser for bathing.	Water has limits in cleansing efficacy **(Adam, Schnetz, Mathey, Pericoi, & De Prost, 2009: II-1)**. The use of water versus soap-and-water baths demonstrated no difference in the bacterial colonization of the skin after the bath in both premature and full-term newborns **(Da Cunha & Procianoy, 2005: I)**. Bathing with mild cleanser compared with bathing with water alone has minimal effect on skin bacterial colonization. Skin colonization increases over time, regardless of use of cleansers **(Medves & O'Brien, 2001: I)**. No difference in the transepidermal water loss (TEWL) measurement was found between babies bathed in water alone vs. with a cleansing product. The researchers concluded that the baby wash used in this study, or other technically equivalent cleansers, would not disrupt skin barrier integrity **(Lavender et al., 2013: I)**.
General Considerations for choosing Cleansers	
Use skin cleansers with the least irritating formulation. a. Select mild cleansing bars or liquid cleansers that have a neutral or mildly acidic pH (5.5–7.0) or those that have minimal impact on the baby's skin surface pH. b. Ideally, a cleanser should not: • cause skin irritation, • disrupt the normal pH of the skin, or • cause stinging or irritation of the eyes.	Cleansers serve as cleaning agents for the removal of oils, soil, dirt, and bacteria from skin and also provide mildness and moisturizing benefits. (Ananthapadmanabhan, Moore, Subramanyan, Misra, & Meyer, 2004: III). Cleansers emulsify oil, dirt, and microorganisms on the skin surface, so they can be more easily removed. Only about 65% of oil and dirt on the skin can be removed with water alone **(Kuehl, Fyfe, & Shear, 2003: III)**. A mild baby wash is more effective than water at removing components of faeces and urine from the skin surface **(Blume-Peytavi et al., 2009: III)**. A randomized, controlled trial of 180 healthy infants showed improved skin hygiene and reduced skin irritation when a mild cleanser was used rather than water alone for bathing **(Dizon, Galzote, Estanislao, Mathew, & Sarkar, 2010: I)**. a. Soap-based cleansers generally have a higher likelihood of drying or irritating skin and compromising the skin barrier, particularly when used under hard-water conditions. Water hardness, determined by the dissolved mineral content, can affect how skin reacts to different cleansing products. The pH of the skin surface and the degree of water hardness have been linked to atopic dermatitis in children **(Blume-Peytavi et al., 2009: III; Ertel, 2003: III; Hopkins, 2004: III; Kuehl et al., 2003: III)**. A higher pH of the skin surface has also been related to increased bacterial proliferation on the skin **(Garcia Bartels et al., 2010: I)**. Soap made with lye is alkaline (pH >7.0), whereas mild cleansing bars, including synthetic detergent bars, and mild liquid cleansers are formulated to a mildly acidic pH (5.5–7.0) (Gfatter et al., 1997: I **(Ananthapadmanabhan, Moore, Subramanyan, Misra, & Meyer, 2004: III)**. Liquid cleansers generally cause less skin irritation and less disruption of the skin barrier, normal pH, and acid mantle, and they rinse more easily than soap **(Gfatter et al., 1997: I; Kuehl et al., 2003: III; Sarkar, Basu, Agrawal, & Gupta, 2010: III)**. b. The irritation potential of soaps may be attributed to their alkalinity **(Dizon et al., 2010: I; Tyebkhan, 2002: III)** and is also a direct reflection of the presence of surfactants in soaps **(Korting & Braun-Falco, 1996: III)**. Solutions with a high pH can increase stratum corneum swelling and the potential for skin damage **(Ananthapadmanabhan, Moore, Subramanyan, Misra, & Meyer, 2004: III)**. c. An infant's blink reflex is present at birth but is much slower than in adults. Defensive blinking is essential to protect the eyes from injury and is not a fully reliable response until about 4 months of age **(Kayed, Farstad, & van der Meer, 2008: II-1)**.
Avoid antimicrobial soaps whenever possible.	Antimicrobial soap is not recommended for use in neonates because of the harshness of the soap as well as the potentially negative effect it may have on normal skin colonization **(AAP & ACOG, 2012: III)**.

CLINICAL PRACTICE	EVIDENCE
Choose products containing preservatives that have demonstrated safety and tolerability in newborns.	Preservatives are usually necessary in liquid soaps or cosmetics with high water content to prevent the overgrowth of microorganisms that may occur with regular use. Ensuring that cleansing products are effectively preserved is essential for their safety. However, these may be the cause of allergic irritant or contact dermatitis **(Blume-Peytavi et al., 2009: III; Na'was & Alkofahi 1994, II; Lundov, Moesby, Zachariae, & Johansen, 2009: III; Tyebkhan, 2002: III)**.

Bathing Procedures

The following methods of bathing can be used for first and routine bathing (see below).:
Whatever procedure is followed first prepare the materials needed warm water at, basin, one or two small towels, baby wet wipe, baby bath lotion, cloth or disposable diaper, buttock protecting cream for infantile use

a. Sponge-bathing:
Place the infant on a soft surface.
- Keep the infant wrapped in a towel, in a side-lying position.
- Gently expose one body part at a time for cleansing and rinsing.

b. Tub (immersion)-bathing:
- Fill the tub with water deep enough to keep the infant's shoulders covered.
- Wash the infant's face first with warm water and a clean cloth or cotton wools balls.

Wash the infant's hair (if needed) and dry immediately to prevent heat loss.
Hold the infant firmly under the buttocks and the back of the neck and

c. Swaddled bathing:
- Place the infant in a flexed, midline position on his/her side, swaddled in a soft receiving blanket or soft towel.
- Clean the face with cotton wool balls or a clean face cloth.
- Wash the infant's hair and dry immediately.
- Apply soap on the infant's skin underneath the towel, but not on the hands.
- Immerse the infant in a tub of warm water.
- Unwrap and gently wash one body part at a time and cover again.
- Keep the infant in a flexed, side-lying position and remove from the bath.

a. Sponge-bathing: washing with a cloth from a small basin of warm water—may cause increased heat loss leading to cold stress, which can contribute to crying and agitation of the newborn **(Cole, Brissette, & Lunardi, 1999: III)**.

b. Tub-bathing: Gently placing the infant feet-first into the tub and covering the entire body with water ensures an even temperature distribution and decreases evaporative heat loss **(Anderson, Lane, & Chang, 1995: II-I)**.

When compared with sponge-bathing, infants bathed in a tub showed a reduction in crying and inducement of a calm, quiet state. In addition, maternal pleasure and confidence were greater with immersion bathing of their infants when compared with sponge-bathing **(Bryanton, Walsh, Barrett, & Gaudet, 2004: I; Cole et al., 1999: III)**.

No differences in bacterial colonization of the cord, cord infection, or frequency of diaper dermatitis were found among infants who were immersed in water compared with sponge-bathed infants **(Henningson, Nystrom & Tunnel, 1981: I; Bryanton et al., 2004: I; Garcia Bartels et al, 2009: I; Loring et al., 2012: I)**.

Whenever possible, tub bath routines should be modified to match the infant's developmental patterns and growth **(Liaw, et al., 2006: II-3)**.

c. Swaddle bath: Infants may experience uncontrolled motor activity when placed in a bathtub. Swaddled bathing promotes a secure feeling. Swaddled bathing allows the infant to remain in a contained position during the entire bath and decreases random movements. Parental stress may also be reduced because swaddled bathing promotes a quiet-calm newborn state **(Fern, Graves, & L'Huillier, 2002: III)** and temperature control.

CLINICAL PRACTICE	EVIDENCE
First Bath	
Give the first bath once the neonate has achieved thermal and cardiorespiratory stability	At birth, the skin of newborns enters a process of adaptation. Many controversies exist about skin care in newborns, particularly whether healthy, full-term babies should be bathed or washed during the first week of life. Regimens vary in frequency, use of water or cleansing agents, bathing procedures (tub or sponge), and the appropriate age in hours for giving the first bath **(Garcia Bartels et al., 2009: I)**. Bathing full-term infants immediately following birth can potentially compromise thermal and cardiorespiratory stability during transition. A flexible bathing time is recommended according to the characteristics and stability of the newborn and to family desires. **(Behring, et al., 2003: I; WHO 1997: III; Kuller, 2014: III)**. When environmental controls are implemented, bathing does not compromise neonatal thermal stability **(Blume-Peytavi, et al., 2009: III; Bryanton et al., 2004: I; Nako et al., 2000: I)**.
For full-term infants who are not compromised, bathe after axillary temperature is 36.8°C or more and the infant is at least 1 hour of age.	Bathing the full-term newborn with an axillary temperature of 36.8°C or more after 1 hour of age has not been shown to compromise neonatal thermal stability and may reduce health care providers' exposure to blood-borne pathogens **(Behring, Vezeau, & Fink, 2003: I; Varda & Behnke, 2000: I)**.
a. The location of bathing can also vary depending on family preference, either at bedside or in the nursery. b. Bathing may be performed by the nurse or the parent under nursing supervision at the bedside in the first few hours of birth	With appropriate environmental controls, there is no difference in heat loss whether the first bath is at the bedside by the parent or in the nursery by the parent assisted by the nurse **(Medves & O'Brien, 2004: I; Bryanton et al., 2004: I)**. Bathing by the parent under nursing supervision at the bedside in the first few hours of birth with bathing by a nurse in an admission nursery showed that there was no difference in temperature change between the two groups **(Blume-Peytavi, et al., 2009: III)**. Bathing can provide tactile stimulation for the newborn and a bonding opportunity for parents and caregivers **(Bryanton et al., 2004: I)**.
Keep the duration of the bath as short as possible. • 5–10 minutes is typically an adequate length of time for the bath.	Sponge-bathing changes the infant's physiologic parameters, including temperature. Therefore, short baths based on assessment of the individual infant's physiologic stability are recommended **(Tapia-Rombo, Morales-Mora, & Alvarez-Vazquez, 2003: III)**. Some clinicians prefer limiting the bath to 5 minutes to prevent cold stress and limit exposure to soap **(Blume-Peytavi et al., 2009: III)**.

CLINICAL PRACTICE	EVIDENCE
Use warm tap water and a minimal amount of pH-neutral or slightly acidic cleanser to assist with removal of blood and amniotic fluid. a. Use of tap water is safe unless there are known concerns about the quality of the water supply. In such a case water should be boiled and cooled prior to bathing baby. b. Put a small amount of cleanser into your hand and wash the of the baby's body from the top down, with special attention to creases, finishing with the diaper area. Infants with significant breaks in skin integrity may benefit from being bathed in warmed sterile water. If sterile water is used, appropriate methods to warm the water and confirm the correct temperature is achieved before bathing are necessary.	No specific scientific evidence identifies the preferred source of water for neonatal bathing. However, a number of researchers have used tap water in studying bathing practices for both term and preterm neonates **(Bryanton et al., 2004: I; Da Cunha & Procianoy, 2005: I; Nako et al., 2000: I)**. Sterile water reduces risk of contamination with microorganisms when skin integrity is altered **(Lund & Kuller, 2007: III)**.
Leave vernix on the skin. If contaminated with blood, meconium, or other intrauterine debris, gently remove the contaminate but do not vigorously scrub to remove all vernix.	Leaving vernix on the skin allows for earlier newborn skin acidification and the World Health Organization (WHO) guidelines for newborn care specify that vernix on the newborn's skin should not be removed **(Stokowski, 2006: III, Moraille, Pickens, Visscher, & Hoath, 2005: II-1)**. The use of soap and vigorous scrubbing to remove vernix can result in skin damage. The protein components of vernix have protective properties against certain bacterial and fungal organisms that are lost if the vernix is removed **(Medves & O'Brien, 2001:I)**. *Refer also to the "Vernix" section of this Guideline.*
a. Use a soft towel with a hood to cover head, dry the infant by patting dry with special care to creases b. clean and dry the cord, apply skin lotion and buttock cream, immediately diaper, place cap on her or his head, and wrap in warm blankets. b. Within approximately 10 minutes after the first bath, dress the infant, change the cap, and wrap her or him in dry, warm blankets. c. If skin dryness, flaking, or cracking are apparent after bathing, an emollient may be applied.	Infants frequently cry when they are removed from the warm bath, and their skin temperature cools rapidly. Having towels ready will help prevent cooling and decrease crying **(Sarkar et al., 2010: III; Kuller, 2014: III)**. Significant neonatal temperature decreases have been reported to occur 10 minutes after the first bath. Clothing placed on the infant immediately after the bath can become damp and a source of rapid evaporative heat loss **(Anderson et al., 1995: II-1; Medves & O'Brien, 2004: I; Varda & Behnke, 2000: I)**. Emollients have been shown to protect the integrity of the skin barrier **(Blume-Peytavi et al., 2009: III)**.

CLINICAL PRACTICE	EVIDENCE
Routine Bathing	
Bathe the infant every few days using appropriate safety measures. Bathe to remove debris and for general hygiene purposes. a. Bathing is not an innocuous procedure. The benefits of daily bathing have not been clearly justified. b. Under normal circumstances, neonates need not be bathed more frequently than approximately every other day. Decisions about the frequency of bathing and time of day should be based on the individual neonate's needs and consideration of family beliefs and values of the local culture, for example beliefs that babies should be bathed 4 – 5 times every day because "it is good for them and prevents diseases" (Adejuyigibe et al., 2015). c. Shampooing once or twice a week is usually adequate. Massage the entire scalp gently, including the area over the fontanelles.	Bathing introduces acute and unexpected changes in stratum corneum with water interaction, potentially leading to drier skin surface **(Visscher et al., 2002: II-1)**. a. Less frequent bathing minimizes behavioural and physiologic instability of premature infants, as a result of less handling and cold stress. In a randomized, controlled study of preterm infants, bathing every fourth day did not result in a significant increase in the number of skin flora or colony counts when compared with bathing every other day. No infants in either group developed an infection as a result of the frequency of bathing **(Quinn, Newton, & Piecuch, 2005: I)**. b. Individualized assessment of infants and their families is needed so that bathing practices better address their concerns **(Tapia-Rombo et al., 2003: III)**. Evening bathing may help to calm the baby and improve sleep **(Blume-Peytavi et al., 2009: III; Adejuyigbe et al, 2015: III)**. c. Shampoos should meet the same safety requirements as those of a baby wash and should demonstrate eye mildness **(Blume-Peytavi et al., 2009: III)**.
Educate parents and family members about bathing safety, including but not limited to the following guidance: a. Place the bathtub in a safe place on a sturdy surface. Never leave the baby alone or with other children during bathing. b. Mix bath water (cold water first, then add warm water) to ensure an even temperature and check water with wrist or elbow before placing the baby into it. c. Selection of baby bathing products	a. The baby should never be left alone while in the bath, even if a bath seat is used. Young children should not be allowed to wash the baby on their own (Blume- Peytavi et al., 2009: III). b. Full thickness scald burns can occur to adults within 5 seconds at 60° and to children with even briefer exposure. Parents should be educated to lower their water heater temperature to below 40o (Spencer, Shileds, & Smith, 2005: III). c. Select bathing products that are mild and non-irritating to the skin and eyes and parents should choose the best they can afford (Blume-Peytavi et al., 2009: III).

CLINICAL PRACTICE	EVIDENCE
Special Needs in Developing Countries	
Consider the topical use of CHG (Chlorexidine Gluconate) cleanser for newborn bathing and skin care in developing countries.	Morbidity and mortality continue to be a concern for newborns in developing countries. Chlorhexidine is often used because of its effectiveness against gram-positive and gram-negative bacteria. One study of 93 full-term infants found reduced S. aureus colonization 24 hours after the CHG bath when compared with infants bathed with a mild, neutral cleanser **(Da Cunha et al., 2008: I)**. The use of 0.25% CHG wipes, normal saline washing, or no skin care was evaluated in 60 preterm (28–36 weeks), low-birthweight infants (1,001–2,000 g). Axillary colonization was reduced at 24 hours for those infants washed with CHG wipes; however, there was no difference in axillary colonization at 72 hours of age **(Sankar et al., 2009: I)**. One study of 286 newborns in Nepal compared skin culture rates on newborns that were cleansed with various concentrations of CHG solutions. At 2 hours of age, all newborns had a reduction in positive skin cultures; however, the overall skin cultures at 24 hours of age were only lower when higher concentrations of CHG were used **(Mullany et al., 2008: I)**. Another study of 133 newborns in Bangladesh compared skin cultures with CHG cleansing versus placebo cleansing. Positive skin culture results in the axillary, periumbilical, and inguinal areas were lower at various timed measurements in those infants in the CHG cleansing group **(Darmstad, Hossain, et al., 2007: I)**. One small study of 12 children (ages 3 months to 12 years) showed small concentrations of CHG in the blood but no evidence that repeated exposure led to CHG accumulation in the blood **(Lee et al., 2011: II-1)**.

Conclusion:

Delay the first bath until the infant is physiologically stable and do not remove the vernix. Swaddle bath the infant to prevent heat loss and stress.

BUTTOCK CARE

The thin skin barrier in neonates makes them vulnerable for skin diseases such as diaper dermatitis. Skin barrier development in babies is incomplete until about 12 months of age **(Lavender et al. 2012: II-2)**, highlighting the importance of good skin care for infants. Wetness and friction are the main contributors to diaper rash which are caused by prolonged skin contact with urine or faeces or skin occlusion by napkin use. This leads to an increase in the skin surface pH thus increasing the activity of proteases and lipases which in turn hinder normal skin microflora leading to a disruption of the normal skin barrier integrity **(Lavender et al. 2012: II-2)**.

CLINICAL PRACTICE	EVIDENCE
The neonatal skin is delicate and improper buttock care may cause diaper dermatitis with local skin breakdown or infection, if the case is serious. Diaper dermatitis often happens at the hip, and perianal area. Once diaper dermatitis happens, local skin will show redness and the newborn infant may be irritable and cry, and the infant's feeding and sleep may be affected due to pain and discomfort. In order to prevent the occurrence of diaper dermatitis, the buttock area should be cared for with caution. Breast fed babies have less allergic reactions on perineal and buttock skin than babies fed on formula. Therefore, breast feeding is encouraged and supported through infancy.	Diaper dermatitis is an acute inflammatory reaction of perianal and buttock skin **(Heimall, Storey, Steller, & Davis, 2012: III)**. It generally appears 1 to 3 weeks after birth of a newborn infant **(Atherton, 2004: III; Visscher, Chatterjee, Munson, Bare, & Hoath, 2000: II-3)**. Skin's long-time contact with urine and faecal mixture is the primary risk factor causing diaper dermatitis. Wrapping the skin with diaper will increase skin humidity and make pH value on skin surface rise. Some bacteria in faeces contain urea (enzymes), which can release amines from urine, making pH value rise. Skin moisture can make the skin more sensitive to damage caused by friction. Alkaline skin surface pH can increase the activity of skin irritant (faecal protease and lipase) and prevent normal skin commensals from maintaining the integrity of the **(Atherton, 2001: III; Atherton, 2004: III; Atherton, 2005: III; Davies, Dore, & Perissinotto, 2006: I; Lin, Tinkle, & Janniger, 2005: III; Scheinfeld, 2005: III; Stamatas, Zerweck, Grove, & Martin, 2011: II-1; Visscher et al., 2000; II-3)**. Compared with the infants raised on formula milk, the faeces of infants that are breast fed is of lower pH value and at a lower level of faecal enzymes (i.e. proteinase, lipase and urea), which can reduce the probability for perineal allergic symptoms **(Berg, 1987: III)**. Moreover, the urine of breast fed infants is of lower pH value, which is favourable for pH on skin surface **(Lin et al., 2005: III)**.
Procedure for buttock care a. Environment, room temperature and worker preparations are same as those in the bath section. b. Use warm water and cotton balls with mild cleanser or soap or baby wet wipes to gently wipe the perineum and buttock area from anterior to posterior. Attention should be paid to the cleaning of perianal area, inguinal and skin folds. c. Wipe the skin dry and spread the diaper rash protecting cream in small amounts and evenly over the perianal area and buttocks. d. Put the diaper on and fit it properly. e. Change the diaper frequently when wet or soiled to reduce the occurrence of skin inflammation and breakdown.	It's possible that cleaning the perianal with clean water alone can't completely clean out faeces. Some researches show that using clean water alone can make skin drier, while some baby bath lotions may contain body lotion that can provide further protection **(Blume – Peytavi et al., 2009: III)**.

CLINICAL PRACTICE	EVIDENCE
Matters needing attention	
a. Clean gently, taking measures to protect the newborn infant from cold or injury. b. In case of faeces in the diaper area, use a mild cleanser to wash the skin at the diaper area; wet baby wipes may be more convenient. c. After buttock cleaning, evenly spread the buttocks with a protective cream containing zinc oxide. In case of confirmed diagnosis of bacterial infection, treatment should be given under the doctor's guidance. d. A disposable diaper should be changed according to the neonate's needs under the normal conditions. The diaper should be changed frequently when it is soiled or wet. e. Disposable diapers should be used instead of cloth diapers.	Application of a layer of zinc oxide provides an occlusive barrier protecting the skin from further injury **(Darmstadt & Dinulos, 2000: III)** Changing diapers in time can reduce skin humidity and reduce contact with faecal enzymes. If diaper dermatitis appears, providing a barrier can protect skin from damage and promote wound healing **(Atherton, 2005: III; Darmstadt & Dinulos, 2000: III; Ghadially et al., 1992: II-I)**. In the process of skin healing, applying a layer of zinc oxide can form a protective barrier preventing further damage **(Lund et al., 1999: III)**. Compared with washable diaper, disposable diaper which is very hygroscopic can reduce the morbidity of diaper dermatitis caused by irritation and decrease its seriousness. This discovery might be the outcome that the core of the disposable diaper quickly absorbs the urine and then keeps the urine far away from the skin, while reducing skin humidity and minimizing mixture between urine and faeces; cloth diaper is saturated quickly, so the skin humidity cannot be reduced **(Atherton, 2005: III; Erasala, Romain, & Merlay, 2011: III; Humphrey, Bergman, & Au, 2006: III; Babu et al., 2015: II)**.
Implement strategies to reduce the risk or severity of diaper dermatitis: a. Perform a focused skin assessment of the perineal area. b. Encourage and support breastfeeding through infancy. c. Use petrolatum-based ointments or skin barriers containing zinc oxide at every diaper change in infants at risk for developing diaper dermatitis. Give preference to formulations that contain fewer additives. Risk factors may include the following: • Frequent stooling • Antibiotic use • Malabsorption • Opiate withdrawal • Abnormal rectal sphincter tone d. Avoid vigorously rubbing the skin barrier product off during cleansing. e. Use alcohol-free skin protectants to provide a barrier between skin and urine or faeces in infants more than 28 days old. f. Avoid products containing chemicals that are potentially toxic if absorbed through the skin, such as topical vitamin A.	Uncomfortable erythema and mild scaling are some of the first signs of diaper dermatitis **(Scheinfeld, 2005: III; Visscher et al., 2000: II-3)**. If not appropriately treated, diaper dermatitis can rapidly progress to painful excoriated or ulcerated lesions **(Davies et al., 2006: I; White, Kalus, Caron, & Suski, 2003: III)**. a. One guideline for the care of diapered/incontinent patients developed at a large pediatric hospital, provides a systematic assessment tool and suggested treatment recommendations for diaper dermatitis using six categories **(Heimall et al., 2012: III [See Appendix B])**: • intact skin and no erythema; • intact skin, high risk of breakdown due to causticity of stool, with or without erythema; • intact skin, erythema and no *Candida*; • intact skin, erythema, and evidence of *Candida*; • denuded skin and no *Candida*; • denuded skin with evidence of *Candida* b. The stools of breastfed infants have a lower pH than formula-fed infants and have lower levels of enzymes (proteases, lipases, ureases), resulting in less irritation in the perineal area **(Berg, 1987: III)**. Breastfed infants also have a lower urinary pH, which may favourably affect the skin surface pH **(Lin et al., 2005: III)**. Risk factors for contact irritant diaper dermatitis include frequent stooling caused by infections, antibiotic use, malabsorption, opiate withdrawal and abnormal rectal sphincter tone (extrophy of the bladder, spina bifida) **(Darmstadt & Dinulos, 2000: III; Davis et al., 1989: I; Lund et al., 1999: III)**.

CLINICAL PRACTICE	EVIDENCE
	c. The use of consistent prevention strategies, such as the application of topical barriers with every diaper change, can physically block chemical irritants and moisture from contacting the skin and minimize friction, thus significantly reducing the incidence of diaper dermatitis **(Jackson, 2010: III; Noonan, et al., 2006: III)**. Because petrolatum provides protection from wetness, a thick layer of petrolatum over the perineal area may prevent skin breakdown **(Heimall et al., 2012: III)**. Providing an occlusive barrier can protect the skin from injury and promote wound healing if diaper dermatitis is present **(Atherton, 2005: III; Darmstadt & Dinulos, 2000: III; Ghadially et al., 1992: II-I)**. Application of a thick layer of zinc oxide in full term infant provides a protective barrier that helps prevent further injury while the skin heals **(Lund et al., 1999: III)**. d. Some barriers are thick and stay on the skin after gentle cleansing. It is appropriate to remove only the soiled layer of barrier to avoid vigorous rubbing of skin in the diaper area **(Taquino, 2000: III)**. e. Plastic-polymer barrier films that are alcohol-free have been labelled by the FDA as treatment for diaper dermatitis in infants more than 28 days old **(Heimall et al., 2012: III)**. Apply these products once every 24 hours. f. Diapers, especially when moist, occlude and can compromise the skin barrier, thus increasing the risk of local skin irritation and percutaneous absorption. Some products, such as those containing vitamin A, that are designed to treat diaper dermatitis pose a risk for potential toxicity in neonates, especially those products with multiple active and inactive ingredients. There is insufficient evidence to support the use of topical vitamin A to treat or prevent diaper dermatitis in the newborn. Although percutaneous absorption of retinoic acid (a metabolite of vitamin A) is believed to be minimal, further research is warranted to confirm its safety for use in the neonatal population **(Davies et al., 2006: I)**.
Treat skin excoriation from contact irritant diaper dermatitis: a. Identify and treat the underlying cause. b. Protect injured skin with thick applications of barrier cream or paste, such as zinc oxide. • Consider using an alcohol-free, pectin-based layer covered with petrolatum if zinc oxide alone does not adequately protect the skin from re-injury. • Apply barrier paste or cream in a thick coating. • Cover all skin that may be exposed to irritating agents. • Residual cream should not be removed with diaper changes. • Gently cleanse the area and reapply barrier cream. c. Consider oral or topical cholestyramine agents as ordered by the health care provider.	a. Treatment goals range from the prevention of skin breakdown in an infant with intact skin and no erythema to providing a barrier when there are high risk factors present for skin breakdown and erythema **(Heimall et al., 2012: III)**. Malabsorption following acute infectious diarrhea, intestinal resection, or opiate withdrawal may be the underlying causes for significant contact irritant diaper dermatitis. Treatment may include nutritional interventions such as changing to a more elemental diet or use of medications to treat underlying causes such as opiate withdrawal **(Darmstadt & Dinulos, 2000: III; Lund et al., 1999: III)**. b. Severe diaper dermatitis caused by contact with urine, stool, and gastric contents benefit from optimal use of barrier products. Barrier product should be applied in a thick coating. Removing residual cream or paste with diaper changes may cause further damage to the delicate healing tissue **(Taquino, 2000: III)**. c. Cholestyramine agents bind to bile acids and help prevent loose stools. These agents work well in infants who excrete high amounts of bile acids in their stools **(White et al., 2003: III)**.

CLINICAL PRACTICE	EVIDENCE
Matters needing attention	
Identify and treat diaper dermatitis complicated by *Candida albicans* (as evidenced by the presence of red satellite lesions or diagnosed by culture). Apply topical treatment, including antifungal ointments or creams, as ordered. Some antifungal agents include but are not limited to the following: • Nystatin ointment • Clotrimazole ointment • Mupirocin b. Treat combination contact irritant and Candida diaper dermatitis with a combination of antifungal powder and a barrier as ordered. One suggested protocol is to use the crusting technique, which involves the following: • Apply an antifungal powder. • Seal in the antifungal powder by covering area with a skin protectant. • Apply a thick layer of zinc oxide or petrolatum.	*Candida* infection is characterized by the presence of beefy red skin with lesions scattered at the edges (satellite lesions). **(Heimall et al., 2012: III)**. When candida is present, treatment as well as application of a barrier for the prevention of skin breakdown or further skin breakdown is the goal **(Heimall et al., 2012: III)**. Low concentration of antifungal agents in a zinc/petrolatum base has shown to be well tolerated and effective in treating mild-to-severe diaper dermatitis complicated by *Candida* **(Concannon, Gisoldi, Phillips, & Grossman, 2001: I; Spraker et al., 2006: I)**. Nystatin (antifungal) ointment is often selected for treatment of diaper dermatitis complicated by *C. albicans*. However, some resistant strains of *Candida* may not respond as well, and another antifungal product may be indicated. In a study of older infants with *Candida* diaper dermatitis, clotrimazole reduced the symptom scores and global assessment more effectively than nystatin ointment; however, both achieved microbiological cure and were safe and well tolerated **(Hoeger, Stark, & Jost, 2010: I)**. Mupirocin 2% may also be effective as a topical treatment for diaper dermatitis complicated by *C. albicans*, especially if Staphylococcus or Streptococcus species are present **(de Wet, Rode, van Dyk, & Millar, 1999: I)**. Treat the mother's breast and infant mouth as well. b. The treatment goal for skin that has both contact irritation and evidence of *Candida* is to prevent further skin breakdown by treating the *Candida* and providing a barrier. This goal can be accomplished using a crusting technique ("crust" is made using an ostomy powder and an alcohol-free barrier film to help protect the skin from stool and urine) **(Heimall et al., 2012: III)**.
Use of talcum baby powders or corn starch is unnecessary and is not recommended to prevent or treat diaper dermatitis in neonates.	Although antifungal powders are useful and safe to treated *Candida* diaper dermatitis, conventional baby powders and corn starch are not recommended. These powders may exacerbate diaper dermatitis by promoting bacterial and **Candida** growth. Inhaled powder particles can cause respiratory irritation **(Darmstadt & Dinulos, 2000: III; Farrington, 1992: III; Nield & Kamat, 2007: III)**.
Evaluate the effectiveness of therapeutic interventions and consider allergic contact dermatitis as a potential diagnosis if the response to therapy is not favourable. Consider using dye-free diapers for allergen avoidance in special circumstances, such as an infant with known allergic contact dermatitis.	Fragrances, preservatives, and emulsifiers can cause allergic contact dermatitis The allergic reaction usually develops when new products are introduced. It can involve any skin to which the agent is applied, including sites outside the diaper area on the trunk, extremities, and face. The sensitization can last 1- to 3-week before symptoms appear. The lesions may persist for another 2 to 4 weeks after discontinuation of the causing agent. Emollients can help with this type of dermatitis but a tapering course of topical steroid ointment may be necessary for several weeks, depending on the severity of symptoms (Cohen, 2017:III)

Conclusion:

Clean the diaper area whenever wet or soiled, with clean water and cotton wool balls. Dry the skin gently and apply a protective cream containing zinc oxide. Rather use disposable nappies and encourage breastfeeding. Treat Candida albicans with antifungal ointment. Do not use talcum powder or corn starch.

NEONATAL MALE CIRCUMCISION

Male circumcision can be performed at any age. Infant male circumcision is simpler than a procedure performed on older boys or men as the penis is less developed and the foreskin is thinner and less vascular. In neonates, circumcision is performed during the first two weeks after birth and is primarily based on personal parental decision usually related to religious and tradition reasons (WHO, 2010). The benefits of circumcision during infancy include no sutures required in the wound, reduced risk of urinary tract infections **(Shaikh et al. 2008; To et al. 1998)** and the procedure is not complicated by erections. Furthermore, complications are rare **(Christakis, Harvey, Zerr, 2000)**. For those who choose circumcision for their newborns, the benefits of circumcision include prevention of urinary tract infections, penile cancer, and transmission of some sexually transmitted infections, including HIV **(AAP & ACOG, 2012: III)**. Despite concerns about community-acquired S. aureus, no relationship has been found between circumcision and MRSA infections in neonates **(Fortunov, Hulten, Hammerman, Mason, & Kaplan, 2006: II-3)**.

CLINICAL PRACTICE	EVIDENCE
The practitioner performing the procedure should be appropriately trained and experienced Take the following steps for site preparation and care before, during, and after the procedure: a. Prepare the site with skin disinfectant (see the "Disinfectants" section of this Guideline). b. Following the procedure, completely remove any disinfectant with sterile water or saline. c. Pay special attention to leg creases and the lower back and buttocks, where pools of fluid tend to form during the procedure	In order to prevent complications, the practitioner who performs the procedure should be appropriately trained and experienced. As the procedure becomes more prevalent, particularly in developing countries, the prevention of post-circumcision complications becomes more urgent. **(Ekenze, Ezomike, 2013: III; Blank, Myers, Preeti et al., 2012: ; Ekenze, Ugwu, Onumaegbu, 2015: III; DeMaria, Abdulla, Pemberton et al 2013: II-3)**.
When circumcision is performed, analgesia should be provided.	24% Sucrose given by mouth, non-nutritive sucking, swaddling, and acetaminophen administration may reduce the stress response but are not sufficient for operative pain when used alone. While anaesthetic creams and local anaesthesia (1% Lidocaine without Epinephrine) provide some benefit, both dorsal penile blocks and ring blocks provide more effective analgesia **(AAP, 1999: III; AAP & ACOG, 2012: III; Cagno, Gordon, 2012; 367: e3)**.
Following the procedure, cover the penis with petrolatum-impregnated gauze strips for 24 hours. • Lubricants and dressings should generally not be used if the procedure is performed with a plastic circumcision device, unless indicated.	Petrolatum promotes healing **(Ghadially, Halkier-Sorensen, & Elias, 1992: II-1)**. Using single, prepackaged petrolatum-impregnated gauze strips may decrease the risk of bacterial contamination associated with multiple-use containers **(Brown-Trask, Van Sell, Carter, & Kindred, 2009: III; Gelbaum, 1993: III)**. Dressings and petrolatum are usually not indicated when a plastic device has been used for circumcision, because they could cause the plastic shield to move out of place **(Brown-Trask et al., 2009: III; Kaufman, Clark, & Castro, 2001: III)**.

CLINICAL PRACTICE	EVIDENCE
The benefits of antimicrobial ointments should be evaluated relative to the potential for subsequent allergic contact dermatitis.	In studies of adults with minor surgical procedures, use of white petrolatum and bacitracin resulted in equally low infection rates; petrolatum ointment has a minimal risk for induction of local and systemic allergic reactions compared with topical antibiotic ointments **(Smack et al., 1996: I)**. Bacitracin has been noted as one of the 12 most frequent allergens causing a positive patch test reaction in patients between the ages of 8 and 92 years **(Marks et al., 1995: II-2)**.
Educate staff and families about how to care for the newborn penis. a. Circumcised penis • Cleanse with water only for the first 3–4 days to prevent irritation. • Apply petrolatum to any red or raw areas on the head or shaft of the penis with each diaper change. b. Uncircumcised penis • Foreskin should not be retracted or forced away from the tip of the penis during bathing or diaper care.	d. Soaps and cleansers can be irritating to healing tissue **(Darmstadt & Dinulos, 2000: III). Petrolatum helps prevent the healing tissue from sticking to the diaper (Brown-Trask et al., 2009: III)**. e. After birth, the foreskin is attached to the tip of the penis, but it will gradually separate over time. The foreskin does not usually retract completely for several years and therefore should not be forcibly retracted **(AAP & ACOG, 2012: III; Ressler-Maerlender & Sorensen, 2005: III)**.
Breastmilk as woundcare agent in circumcision.	While studies found that fresh human breast milk was as effective for treatment of eczema as 1% hydrocortisone **(Kasray et al., 2015: I)**, and no secondary infection was seen **(Berents et al., 2015: I)**, only anecdotal evidence is available on the use of breastmilk for care of circumcision wounds.

Conclusion:

Neonatal male circumcision should only be performed by skilled practitioners, in healthcare settings with good infection control measures. The penis should be cleansed with water or expressed breast milk only for the first 3-4 days and petrolatum applied to the raw areas. No lubricants and dressings should be used when plastic circumcision devices were used.

DISINFECTANT

Disinfectants plays an important role in protecting neonates from contracting infection, including disinfecting skin surfaces prior to invasive procedures as well as working areas. Products used in the care of neonates should be selected with great care **(Sathiyamurthy, Banerjee & Gofambe, 2016: III)**.

CLINICAL PRACTICE	EVIDENCE
Disinfect must be used to prepare skin surfaces before invasive procedures, such as insertion of peripheral IV catheters, umbilical vessel catheterization, venipuncture, or heel sticks for laboratory samples, as well as nasogastric tube placements or before hearing screenings.	Disinfecting skin surfaces with antiseptic solutions before invasive procedures reduces the risk of bactaeremia, catheter-related infections, and skin contamination during blood culture sampling **(CDC, 2011: III; Polin, Denson, Brady, & AAP Committee on Fetus and Newborn and Committee on Infectious Diseases, 2012: III)**.
Select a disinfectant by evaluating risks and benefits of each product relative to efficacy, potential for toxicity, and skin irritation. Evidence is insufficient to recommend a single product for all neonates. a. Consider efficacy. •b. Consider potential for systemic toxicity if skin disinfectants are absorbed through the skin. • c. Consider the potential for skin irritation, chemical burns, or erosive contact dermatitis.	a. CHG • 2% aqueous CHG in 4-oz. bottles • 0.5% CHG in 70% isopropyl alcohol • 2% CHG in 70% isopropyl alcohol • 3.15% CHG in 70% isopropyl alcohol • 10% povidone-iodine 4% Chlorhexidine gluconate (CHG) is a chlorinated cationic biguanide and is used in both aqueous solutions and in combination with isopropyl alcohol. Its bactericidal properties increase cell membrane permeability, and it is effective against both gram-positive and gram-negative organisms. It also binds to protein in the stratum corneum of the epidermis, leaving a residual bactericidal effect that is resistant to alcohol removal **(Chapman, Aucot & Milstone, 2012: III; Cagno, Gordon, 2012;367:e3; Sathiyamurthy, Banerjee & Gofambe, 2016: III)**. According to current FDA labelling regulations, some CHG/isopropyl alcohol-containing products are now labelled: "Use with care in premature infants or infants less than 2 months of age. These products may cause irritation or chemical burns" (FDA, 2012: III). However, NICUs may be using this product "off label" for infants less than 2 months of age as indicated for disinfection. In a survey of 100 NICU training programs, 61% of respondents used some form of CHG in infants under 2 months of age to reduce catheter-related blood infection **(Tamma, Aucott, & Milstone, 2010: III)**. Although a meta-analysis of eight studies involving a total of 4,143 catheters in adult patients determined that CHG-containing solutions used for insertion and catheter site care reduced the risk for catheter related bloodstream infection by 49% (risk ratio, 0.51; confidence interval, 0.27–0.97) **(Chaiyakunapruk, Veenstra, Lipsky, & Saint, 2002: I)**, current CDC guidelines indicate that there is insufficient evidence to make a recommendation about the safety or efficacy of CHG products in infants less than 2 months of age **(CDC, 2011: III)**. In the United States, aqueous CHG products (2% and 4%) must be poured from bottles onto sterile gauze for application, although aqueous single use products are available in other countries **(Andersen, Hart, Vemgal, & Harrison, 2005: II-2; Lashkari, Chow, & Godambe, 2012: III)**. In adults, aqueous 2% CHG reduced catheter-related infections when compared with 10% povidone-iodine and 70% isopropyl alcohol **(Maki, Ringer, & Alvarado, 1991: I)**.

CLINICAL PRACTICE	EVIDENCE
	Use of 0.5% CHG in isopropyl alcohol reduces peripheral IV catheter colonization in premature and term newborns when compared with povidone iodine **(Garland et al., 1995: II-3)**. In a sequential study in a NICU, the rate of positive blood cultures, the number of true infections or contaminated cultures during the time when 10% povidone-iodine was used, was not statistically different from the second time when 0.5% CHG/70% isopropyl alcohol was used **(Linder et al., 2004: II-3)**. A pilot trial of 47 infants weighing more than 1,500 grams and more than 7 days of age compared cutaneous tolerance of 2% CHG in 70% isopropyl alcohol to 10% povidone-iodine. There were no differences in number of blood stream infections or sepsis evaluations. This small study, however, was terminated by the sponsor because of slow enrolment and was not powered to look at the overall infection rates **(Garland et al., 2009: I)**. Blood culture contaminants in a paediatric emergency department were significantly lower when skin was disinfected using 3.15% CHG in isopropyl alcohol compared with povidone-iodine **(Marlowe et al., 2010: II-2)**. Chlorhexidine gluconate has been used for several decades in Europe and increasingly in the United States and Canada in adults and children, including premature neonates. Chlorhexidine gluconate exposure has been implicated in rare cases of contact dermatitis and anaphylactic reactions in adults, particularly in CHG-impregnated devices, such as urinary catheters, or exposure to atopic skin **(Knight, Puy, Douglass, O'Hehir, & Thien, 2001: III)**. An observational case series highlighted the association between the use of CHG-impregnated dressings and erosive contact dermatitis, even in young infants **(Weitz, 2013: III)**.
	A pilot trial to examine the cutaneous tolerance of 2% CHG in isopropyl alcohol in newborns under 32 weeks of gestation found measurable concentrations of CHG in 7 of the 10 infants who had levels drawn. However, there were no reported systemic effects. The role of isopropyl alcohol in combination with CHG may be a possible contributing factor to cutaneous absorption of CHG **(Garland et al., 2009: I)**. Chlorhexidine gluconate can be safely used on the scalp for IV or central line placement if applied judiciously, without splashing or excess solution, and should be completely removed after the procedure is complete (Lund & Kuller, 2007: III). There is no clinical data to discourage the use of CHG for skin preparation prior to lumbar puncture or epidural catheter placement **(Milstone, Passaretti, & Perl, 2008: III)**. Wound cleanser studies in human tissue cultures suggest that a number of cleansers, disinfectants, and liquid bath soaps can damage or destroy fibroblasts and keratinocytes in healing wounds; these findings may also be applicable to potential damage to neonatal skin, particularly for the premature neonate **(Wilson, Mills, Prather, & Dimitrijevich, 2005: II-1)**. A number of case reports document chemical burns from disinfectants containing 0.5% CHG in methanol **(Bringué Espuny et al., 2010: III; Reynolds, Banerjee, & Meek, 2005: III)**, 0.5% CHG in 70% isopropyl alcohol **(Mannan, Chow, Lissauer, & Godambe, 2007: III)**, and 2% aqueous CHG **(Andersen et al., 2005: II-2)**. Case reports indicating chemical burns from isopropyl alcohol and povidone-iodine solutions in extremely-low-birthweight infants are also reported **(Sardesai, Kornacka, Walas, & Ramanathan, 2011: III)**. Povidone-iodine is widely available in a 10% aqueous solution and in single-use wipes and applicators. It is more efficacious than isopropyl alcohol for skin disinfection **(Choudhuri, McQueen, Inoue, & Gordon, 1990: II-1; Maki et al., 1991: I)**. In newborns, povidone-iodine has been shown to be less effective than CHG in reducing peripheral IV catheter colonization (Garland et al., 1995: II-3) and equally effective as CHG in reducing bacterial colony counts before IV catheter insertions **(Malathi, Miller, Leeming, Hedges, & Marlow, 1993: II-2)**.

CLINICAL PRACTICE	EVIDENCE
	If absorbed through the skin, povidone-iodine can cause alterations in thyroid function in premature and term newborns **(Khashu, Chessex, & Chanoine,2005: III; Linder et al., 1997: II-3; Mitchell, Pollock, Jamieson, Fitzpatrick, & Logan, 1991: II-2; Parravicini et al., 1996: II-2; Smerdely et al., 1989: II-2)**. However, two studies in the United States did not report alterations in thyroid function with povidone-iodine use. One study used povidone-iodine for skin disinfection in premature infants with a mean gestational age of 33 weeks; there was no evidence of abnormal thyroid levels. However, it is important to note that the study's use of a single measurement of thyroid function, obtained on day 7–10 of life, may have been too soon to identify the systemic effects of iodine absorption **(Gordon, Rowitch, Mitchell, & Kohane, 1995: III)**. Another study reported elevated urine iodine in 30 infants less than 30 weeks of gestation and transiently decreased T3 and T4 levels, while levels of thyroid-stimulating hormone did not rise. These findings may reflect a euthyroid state or normal thyroid physiology of prematurity **(AvRuskin, Greenfield, Prasad, Greig, Juan, 1994: II-1)**. Another possible explanation for the difference between studies in the United States and those in other countries may be attributed to higher iodine intake during pregnancy in U.S. women.
Consider the following suggested techniques for applying disinfectants: a. Apply CHG for 30 seconds or with two consecutive applications. Aqueous CHG may not dry but can be wiped with sterile gauze after the application. b. Apply povidone-iodine as per facility guidelines and allow to dry for 30 seconds.	Guidelines from the CDC state that antiseptics should be allowed to dry according to the manufacturer's recommendation prior to inserting a central venous catheter **(CDC, 2011: III)**. At present, no single product is recommended for all neonates. a. A small study of 11 infants with 25 peripheral catheters compared techniques of application of 0.5% CHG/isopropyl alcohol with povidone-iodine, using single- or double-swabbing and different time intervals ranging from 5 to 30 seconds. Two consecutive cleansings or a longer duration of cleansing is recommended for more effective skin sterilization **(Malathi et al., 1993: II-2)**. Chlorhexidine gluconate has been shown to be efficacious in reducing skin colonization at IV catheters in neonates **(Garland et al., 1995: II-3)** and catheter-related blood stream infections in adults **(Chaiyakunapruk et al., 2002: I; Maki et al., 1991: I)**. However, CHG products with a single-use applicator that are currently available in the United States contain isopropyl alcohol and may result in chemical burns or skin irritation in premature infants. Aqueous 2% and 0.5% CHG products are available in other countries. However, even aqueous CHG products can potentially cause skin irritation **(Anderson et al., 2005: II-2)**. b. Povidone-iodine has been shown to have similarly high toxicity index to fibroblasts and keratinocyte cells in vitro when compared with CHG and a variety of skin cleansers **(Wilson et al., 2005: II-1)**. Most case reports concerning povidone-iodine solutions discuss systemic toxicity involving thyroid function, although cutaneous injury has also been reported **(Sardesai et al, 2011: III)**. Povidone-iodine is readily available in single use applicators. Using a disinfectant in premature infants who weigh less than 1,500 grams and are less than 7 days old carries the risk of skin injury, especially with CHG-containing solutions **(Garland et al., 2009: I)**. Solutions with povidone-iodine carry a risk of potential toxicity from iodine absorption in this population **(Khashu et al., 2005: III; Linder et al., 1997: II-3; Mitchell et al., 1991: II-2; Parravicini et al., 1996: II-2; Smerdely et al., 1989: II-2)**.

CLINICAL PRACTICE	EVIDENCE
Remove all disinfectants as completely as possible with sterile water or saline after the procedure is complete. • Avoid the use of isopropyl alcohol as a primary disinfectant or for removing povidone-iodine or CHG.	Disinfectants should be used with caution on underdeveloped or damaged skin and should always be removed after use on intact skin to prevent tissue damage **(Wilson et al., 2005: II-1)**. Chlorhexidine strongly binds to protein in the stratum corneum and can withstand removal even with isopropyl alcohol; thus, it may not be possible to completely remove CHG **(Chapman et al., 2012: III)**. Isopropyl alcohol is drying to skin and less efficacious than CHG and povidone-iodine **(Choudhuri et al., 1990: II-1; Maki et al., 1991: I)** and has been associated with chemical burns in premature infants.

Conclusion:

Disinfect the newborn skin with 3.15% CHG in isopropyl alcohol when indicated.

EMOLLIENT/PROTECTING NEWBORN SKIN AGAINST DRYNESS

Protecting newborn skin is a challenging but important aspect of neonatal care. Topical emollients are moisturising treatments applied directly to the skin to protect the stratum corneum, enhance epidermal barrier function and reduce evaporative water loss. Use of emollients have been shown to restore lipid levels, improve hydration, preserve natural moisturising factors and have significant buffering capacity to normalize skin pH and maintain the microbiome. While the use of emollients is effective in treating dry or cracked skin, recent studies indicate the routine use of emollients is contraindicated due to increased risk of infection. However, other studies examining the prophylactic use of emollients have not found higher infection rates when comparing emollient therapy with no treatment.

CLINICAL PRACTICE	EVIDENCE
Routine use of emollient ointments for skin hydration in term babies	The available data provide no clear pattern in the evidence that routine use of emollient ointments in term babies is beneficial towards improving TEWL or skin surface pH and other outcomes (skin assessment scores; infection) in healthy, term neonates, except in reducing the incidence of atopic eczema in the high-risk babies. Strong evidence from one RCT, moderate evidence from one RCT and weak evidence from two RCTs and two experimental studies for this comparison indicates that overall, for hydration the effect favoured using emollient, particularly at 4 weeks and 8 weeks (Horimukai et al. 2014: I; Simpson et al. 2010:I; Simpson et al. 2014:I; Lowe et al. 2012:I; Garcia Bartels et al. 2010: I; Garcia-Bartels et al., 2011:I; Smoker, 2007: III).
Benefits of emollients	
Barrier enhancement Emollients may be used to restore integrity to dry or cracking skin.	Emollients protect the integrity of the stratum corneum and enhance barrier function **(Lane and Drost 1993):II; (Kiechl-Kohlendorfer, Berger, and Inzinger 2008:I; Lane and Drost 1993:I)**.
Use emollients at the first sign of dryness, fissures, or flaking, apply an emollient every 12 hours or as needed.	Emollients can reduce or treat dry scaly skin, cracking, or fissures on skin surfaces **(Blume-Peytavi et al. 2009: III.; Ghadially, Halkier-Sorensen, and Elias 1992: II-2; Lane and Drost 1993: I)**.
Apply emollient gently to skin, especially with very low-birthweight neonates, to avoid friction.	Friction may cause skin irritation and breakdown, especially in very-low birthweight babies **(Darmstadt and Dinulos 2000): III**.
Observe for development of systemic infections, such as coagulase-negative *Staphylococcus* infections, especially in neonates weighing less than 750 grams.	While the use of emollients is effective in treating dry or cracked skin, a Cochrane review of four randomized, controlled studies found that prophylactic emollient use for the first 2 weeks of life is associated with an increased risk of coagulase-negative *Staphylococcus epidermidis* infection **(Conner et al 2003: I)**. Other studies examining the prophylactic use of emollients have not found higher infection rates when comparing emollient therapy with no treatment **(Beeram et al. 2006:II-2; Kiechl-Kohlendorfer, Berger & Inzinger 2008: I)** or with alcohol-free skin protectants (Brandon et al. 2010: I). The benefits of emollient use for prevention of dermatitis and skin breakdown should be weighed against the risk of infection.
Emollients should be provided in unit dose or patient-specific containers. Every effort should be made to maintain sterility of the emollient container. All surrounding treatment surfaces that may be contaminated by emollients should be thoroughly cleaned.	Contamination of surfaces and emollient containers should be avoided to prevent infections (Campbell, Zaccaria, and Baker 2000): III.; **(Darmstadt and Dinulos 2000): III**.

CLINICAL PRACTICE	EVIDENCE
Emollients may be used to treat discrete areas of skin dryness, flaking, or fissures for infants on radiant warming tables or receiving phototherapy.	There is little evidence of increased hyperthermia or tissue burns when emollients are used for infants on radiant warming tables or under phototherapy lights **(Darmstadt & Dinulos 2000): III; (Nopper et al. 1996): I**. Transepidermal water loss was reduced when a clear topical ointment was used on jaundiced preterm infants under phototherapy **(Wananukul, Praisuwanna, & Kesorncam 2001): II-2.**
Routine emollient use may be indicated in healthy, full-term newborns with "cradle cap" or atopic dermatitis (eczema).	Results show that daily application of an emollient is a safe and effective approach to prevention of atopic dermatitis/eczema **(Horimukai et al. 2014): I; (Simpson et al. 2010):I; (Simpson et al. 2014):I; (Lowe et al. 2012):I; (Garcia Bartels et al. 2010): I; Garcia-Bartels et al., 2011):I; (Smoker, 2007: III)**. These studies advocates for the daily application of an emollient in newborns at risk of atopic dermatitis/eczema because of a strong family history for this disease (either parent or sibling with atopic dermatitis) **(Blume-Peytavi et al. 2009: I; Bieber, 2010: III)**. A clinical trial indicated that there was no difference between the application of human breast milk and 1% hydrocortisone ointment. Human breast milk was used because of low cost and accessibility **(Kasray et al., 2015: I)** while one study found no effect on eczema with the application of human breast milk and no secondary infection was seen **(Berents et al., 2015: I;)**.
Management of dry skin (Restoration of hydration)	
Use olive oil for skin hydration	Strong evidence from one RCT for comparison of no oil use with the use of sunflower or olive oil, indicates that olive oil impedes the development of the lipid structure of the skin barrier; however, the skin was more hydrated in the olive oil group (dual effect explained by triglyceride lipolysis). There was no difference in TEWL, skin surface pH, erythema or skin assessment score between the groups **(Cooke et al., 2016: I)**.
Use of sunflower oil for skin hydration	Strong evidence from one RCT for this comparison indicates that sunflower oil impedes the development of the lipid structure of the skin barrier; however, the skin was more hydrated in the sunflower oil group (dual effect explained by triglyceride lipolysis). There was no difference in TEWL, skin surface pH, erythema or skin assessment score between the groups **(Cooke, et al. 2016: I)**.
Application of coconut oil for massage and weight gain	Coconut oil application improves the weight gain velocity in full term neonates over and above the benefits of tactile kinaesthetic stimulation due to massage alone (placebo group) **(Sankaranarayanan et al. 2005: I)**.
Traditional practice of oil massage of neonates	The traditional practice of oil massage of neonates in certain cultures is common and socially acceptable **(Darmstadt & Saha 2002) :III)**. Topically massaged oil can be absorbed percutaneously in significant degrees in the newborn, and (b) the types of oil used (Essential fatty acid rich safflower oil and (ii) Saturated rich coconut oil) can alter the lipid profile of the baby

Conclusion:

Emolients should be applied routinely to newborn skin without friction and specifically at the first sign of dryness. Until further research is conducted, caution should be exercised when recommending oils for neonatal skin (Cooke et al., 2016: I).

MEDICAL ADHESIVE

The skin is an important barrier against invasive organisms as well as against uncontrolled loss of water. Repeated application and removal of adhesive tapes or dressings cause skin injury such as skin stripping, skin tears, tension blisters and dermatitis reactions which disrupt the normal protective barrier function of the skin.

CLINICAL PRACTICE	EVIDENCE
Medical adhesives are often used to secure life support, monitoring, and feeding devices in newborns. • Removal of medical adhesives can cause skin trauma, such as skin stripping and pain.	Different types of medical adhesives are used in tapes and wound dressings. These include acrylics, hydrocolloids, polyurethanes, hydrogels, silicones, and zinc oxide **(Cutting, 2008: III)**. Because of diminished cohesion between the epidermis and dermis **(Holbrook, 1982: III)**, even one removal of an adhesive can result in alteration in skin barrier function **(Harpin & Rutter, 1983: II-2; Lund et al., 1997: II-1)**. A study including adult volunteers demonstrated an increase in "peel force"—or amount of force needed to remove the adhesive from the skin—has been shown to increase the level of discomfort with adhesive removal **(Dykes & Heggie, 2003: II-2) and cause trauma, which reduces skin barrier function and increases cutaneous irritancy (Dykes 2007: II-3)**. Some anatomic sites, such as the cheek and back, have a thinner stratum corneum layer and are more vulnerable to skin stripping and disruption of skin barrier function when adhesives are removed **(Breternitz, Flach, Prässler, Elsner, & Fluhr,2007: I)**. Adhesives were found to be the primary cause of skin breakdown among infants in the NICU in an evidence-based practice project involving 2,464 neonates **(Lund, Osborne, et al., 2001: II-3)**. In one prevalence survey, the incidence of epidermal stripping in paediatric patients reported at a single paediatric hospital was 8% **(Noonan et al., 2006: III)**. This prevalence was lower than the 17% reported in a multisite paediatric pressure ulcer and skin breakdown prevalence survey **(McLane et al., 2004: II-2)**. The lower rate of epidermal stripping was attributed to the routine use of skin barrier protective films and avoidance of direct tape to skin contact (Noonan et al., 2006: III; Lund, 2014: III).
Choose medical adhesives that cause the least tissue trauma and irritation (Medical adhesive-related skin injuries -MARSI) while effectively securing medical devices (such as endotracheal tubes, intravascular catheters, and nasogastric tubes) and monitoring equipment, as well as wound dressings. The choices include the following: a. Acrylics b. Hydrocolloids c. Hydrogels d. Polyurethanes e. Silicones f. Zinc oxide adhesives	Some adhesives have been shown to cause less tissue trauma in studies comparing different products **(Cutting, 2008: III; Dykes, 2007: II-3; Morris, Emsley, Marland, Meuleneire, & White, 2009: II-3)**. Other considerations include how well the adhesive functions, such as how well it adheres when there is exudate or moisture, how it protects from these, and how it functions as a barrier **(Taquino, 2000: III)**. a. A single application of plastic, perforated acrylic tape resulted in disruption of skin barrier function in neonates ranging from 25–42 weeks of age **(Lund et al., 1997: II-1)**. Yet these types of adhesives adhere effectively to skin and medical devices and are commonly used in intensive care settings. b. Hydrocolloids have been shown to cause skin trauma equal to acrylic tape when removed at 24 hours **(Lund et al., 1997: II-1)**. Other studies also report decreased skin barrier function, seen with increased TEWL and erythema under hydrocolloids **(Zilmer, Agren, Gottrup, & Karlsmark, 2006: II-3)**. However, these barriers are still used because they absorb moisture, mould well to skin surfaces, and serve as a platform for other adhesives **(Lund & Tucker, 2003: III)**. c. Hydrogel adhesives should not be used when adherence is critical, as the adhesive product may dislodge **(Lund et al., 1997: II-1)**. Use of hydrogel adhesives can reduce the trauma associated with electrode removal **(Darmstadt & Dinulos, 2000: III; Lund et al., 1997: II-1; Webster & McCosker, 1994: I)**. Use of limb electrodes leaves the chest wall free of devices and permits easier access for auscultation and assessment **(Malloy & Perez-Woods, 1991: III)**.

CLINICAL PRACTICE	EVIDENCE
	d. Polyurethanes, such as transparent adhesive dressings, allow visualization of catheter insertion sites and are permeable to water vapor, oxygen, and carbon dioxide, allowing the skin to breathe **(Darmstadt & Dinulos, 2000: III; Lund & Kuller, 2007: III)**. Polyurethanes are commonly used as dressings for intravascular devices, such as central venous catheters. e. Silicone-based adhesive products have been shown to improve adherence to wounds and reduce discomfort to patients with adhesive removal. This technology holds promise for developing products that adhere and cause minimal trauma when removed from neonatal skin **(Dykes & Heggie, 2003: II-2; Dykes, 2007: II-3; Dykes, Heggie, & Hill, 2001: II-1; Morris et al., 2009: II-3)**. However, silicone adhesives do not adhere well to plastic devices, such as nasogastric tubes and cannulas, which may limit their use for attaching some medical devices. f. Zinc oxide adhesives have been shown to significantly reduce skin barrier function, resulting in increased TEWL, compared with a hydrocolloid adhesive **(Nielsen et al., 2005: II-2)**.
Consider protecting the skin from medical adhesives with silicone-based skin protective films.	Skin barrier films have been shown to protect the skin from adhesives, as well as faecal and ostomy output and urine. However, these protective films can be irritants to skin and require removal with solvents, which can also irritate the skin. Some also contained benzyl alcohol, which should be avoided in neonates **(Black, 2007: III)**. Silicone-based skin barrier films do not sting when applied, rapidly evaporate, and do not leave a residue. In addition to the general benefits of silicone-based skin protectants in neonates **(Irving, 2001: III)**, one study of premature infants showed both skin protection and the additional benefit of reduced TEWL **(Brandon et al., 2010: I)**.
Remove emollients before using adhesives	Emollients may interfere with adherence of adhesives. Skin residues can also interfere with adhesion of adhesives **(Kiechl-Kohlendorfer, Berger, & Inzinger 2008): I. ; Lund & Tucker, 2003: III)**. Preservative-free, watermiscible, petrolatum-based emollients can be removed with soap and water if necessary **(Nopper et al. 1996): I**.
Remove medical adhesives slowly and carefully using moistened gauze or saline pledgets. a. Pull medical adhesive tapes on a horizontal plane, folding the tape back onto itself while continuously wetting the adhesive-skin interface. b. Alternatively, use mineral oil or petrolatum to loosen tape unless re-taping is necessary at the site. c. Consider the use of silicone-based adhesive remover when applicable.	There are three categories of adhesive removers: alcohol/organic-based solvents, oil-based solvents, and silicone-based removers **(Black, 2007: III)**. a. A technique involving slowly pulling adhesives at a very low angle, parallel to the skin surface, while holding the surrounding skin in place, may reduce epidermal stripping **(Lund & Tucker, 2003: III)**. b. Mineral oil or petrolatum leaves an oily residue that may prevent the next adhesive appliance from attaching properly **(Lund & Kuller, 2007: III)**. c. Silicone-based removers form an interposing layer between adhesive and skin, evaporate readily after application, do not leave a residue, and are inert, reducing the risk of toxicity **(Black, 2007: III)**. The use of silicone-based removers has been advocated for patients with extremely fragile skin, such as infants with epidermolysis bullosa **(Stephen-Haynes, 2008: III)**.

CLINICAL PRACTICE	EVIDENCE
Avoid using the following products whenever possible: a. Alcohol/organic-based products b. Oil-based solvents c. Enhancing bonding agents d. Adhesive bandages after drawing laboratory samples	a. Alcohol/organic-based products dissolve the adhesive components. They evaporate readily and do not leave a residue **(Black, 2007: III)**, but insufficient evidence exists to demonstrate the safety of these solvents, as they contain hydrocarbon derivatives or petroleum distillates that have potential or proven toxicity. The potential risk of absorption and toxicity is greater in premature babies because of their immature stratum corneum and in newborns because of their large surface-area-to-body-weight ratio. One case report described a severe skin reaction to an adhesive remover applied to a premature infant **(Ittman & Bozynski, 1993: III)**. b. Oil-based solvents release the bond between skin and adhesive and are based on paraffin or citrus oil extracts. However, these do not evaporate when applied, leave a residual on the skin similar to mineral oil or petrolatum, and can potentially be absorbed, with unknown effects **(Black, 2007: III)**. c. The bond between adhesive and epidermis is stronger than the fragile cohesion between epidermis and dermis in premature infants **(Holbrook, 1982: III)**; thus epidermal stripping may result when adhesives are removed. Tincture of benzoin, when used in adults, is drying to skin, can cause irritation, and can occlude the skin and impair its function **(Gill, 1982: III; Weber et al., 1987: III)**. d. Application of adhesives should be avoided whenever possible. Pressure with a cotton ball may be sufficient to stop bleeding after venepuncture **(Gordon & Montgomery, 1996: III)**.

Conclusion:

Routine use of skin barrier protective films and avoidance of direct tape to skin contact lowers the rate of epidermal stripping. Medical adhesives should be selected to cause the least tissue trauma, yet effectively securing medical devices. Medical adhesives should be removed slowly, pulling on a horizontal plane, using moistened gauze. Mineral oil or petrolatum can also be used to loosen tape. Application should be avoided whenever possible and the following products should be avoided: alcohol/organic-based products, oil-based solvents, enhancing bonding agents and adhesive bandages after venepuncture.

SUMMARY

The skin is a complex organ responsible for many vital functions in human beings. Therefore, protecting skin integrity which limits the risk of dermatitis or skin breakdown, is essential as the skin acts as a mechanical barrier. This barrier provides protection against pathogens and irritants as well as retaining heat and hydration.

Guidelines have become a valuable tool to provide safe and quality care through evidence-based practice. They are contemporary and therefore would require updating from time-to-time to incorporate new evidence as it is developed.

This guideline has been developed based on the AWHONN guideline by a Dermatologial consultant and three professional nursing organisations, namely NEA, NNASA and SOMSA. The aim of the guideline is to assist carers with the important task of protecting the neonate's skin integrity. The guideline is informed by evidence to assist health workers and parents to provide the best care possible in their own environments and within the resources available. The guideline provides the characteristics of neonatal skin followed by guidelines for vernix caseosa, new-born skin care, cord care, circumcision, bathing, diaper rash, disinfectant, emollients, and medical adhesives.

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