Note: this is a draft of the journal article:

*Hannah L. Liversedge, Dan L. Bader, Lisette Schoonhoven, Peter R. Worsley. Survey of neonatal nurses' practices and beliefs in relation to skin health.  Journal of Neonatal Nursing 2017; in press corrected proof.  https://doi.org/10.1016/j.jnn.2017.07.007*

The final, fully proofed and peer-reviewed journal article is available from the publisher online, via

the following link:

http://www.sciencedirect.com/science/article/pii/S1355184117300674

JOURNAL OF NEONATAL NURSING
Survey of neonatal nurses’ practices and beliefs in relation to skin health

ABSTRACT

Despite the reported high prevalence of skin damage in neonatal units, little is known regarding assessment and management of neonatal skin.

A questionnaire was designed addressing beliefs and practices of participants. This was distributed to neonatal nurses across southern England.

In total 56 responses were returned (7% response rate). Incidence of damage was perceived to be high, with 26% of participants reporting that this occurred daily. Skin damage was frequently associated with medical devices, including nasal continuous positive airway pressure, medical tape, and peripheral cannulas. Staff education emerged as a key theme in promoting skin health. However, only 10% of participants had received skin care training. Participants highlighted concerns about the lack of previous research in this area.

The results confirm the vulnerability of neonatal skin to medical devices, with participants citing these as the primary cause of damage. Additionally, skin care is constrained by lack of training and resources.

KEYWORDS

Skin damage, neonates, medical devices, nursing attitudes, nursing practice, skin care

INTRODUCTION

Hospitalised neonates, especially those who are premature, are at risk of skin breakdown, with reported pressure ulcer (PU) prevalence of 23-31.2% in neonatal intensive care (Baharestani and Ratliff, 2007; Fujii *et al.*, 2010; August *et al.*, 2014). The advances in neonatal care have resulted in increasing survival of preterm neonates, thus injuries associated with intensive treatment are becoming more apparent (Fox and Rutter, 1998; Smith and Roy, 2006; Hogeling *et al.*, 2012). The structural integrity of the skin has not been fully established in extremely preterm or very preterm neonates (Hammarlund and Sedin, 1979; Harpin and Rutter, 1983; Okah *et al.*, 1995; Kalia *et al.*, 1998). Indeed, in neonates born at 24 weeks’ gestation, the stratum corneum is only one or two cell layers thick, dermal elastic fibres are sparse in distribution (Visscher and Narendran, 2014), and the characteristic features of the dermal-epidermal junction are poorly developed (Tortora and Derrickson, 2014). In addition, neonates, including those born at term, have a neutral skin pH, in contrast to the “acid mantle” of older children and adults (Ali and Yosipovitch, 2013; Visscher and Narendran, 2014). Each of these factors contribute to abnormal skin physiology in the neonate, including increased transepidermal water loss (TEWL), invasion of micro-organisms, and absorption of potential toxins from topical products (Rutter, 2003). Although the development of skin following premature birth has not yet been fully elucidated, there is some indication that it may take up to nine weeks for extremely premature neonates to develop a functional barrier maturity (Kalia *et al.*, 1998). The extent to which this affects the risk of breakdown is still to be clarified.

In premature neonates, over 90% of PUs are associated with interventional medical devices (Visscher and Taylor, 2014). Other forms of iatrogenic skin damage have also been reported in this population, including diaper dermatitis, skin tears, and burns (Visscher *et al.*, 2009; Sardesai *et al.*, 2011). Although skin care has been recognised as a key aspect of neonatal nursing (Furdon, 2003), there is a paucity of evidence with which to inform practice, and skin care is primarily based on clinical expertise. Indeed national and international guidelines on the prevention and treatment of PUs do not provide much information related to this specialist group (Health and Social Care Information Centre, no date; NHS Institute for Innovation and Improvement, 2011; NPUAP, EPUAP and Pan Pacific Pressure Injury Alliance, 2014). Guidelines have been issued in the US for the care of both full-term and preterm neonatal skin (Lund, Kuller, *et al.*, 2001; Association of Women’s Health Obstetric and Neonatal Nurses, 2013), but these have not been universally adopted internationally and may not be appropriate for specific regional healthcare models. Accordingly, it is essential to explore nurses’ perceptions of these issues in order to understand current practice. Although studies exploring adult nurses’ perceptions of pressure ulcer prevention have been performed in association with general and critical care settings (Strand and Lindgren, 2010; Gunningberg *et al.*, 2013), very few studies have involved the highly specialised neonatal care environment. One exception to this involving a questionnaire of neonatal nurses in Malaysia reported gaps in participants’ theoretical and practical knowledge of preterm neonates’ skin (Mohamed, Newton and Lau, 2014). However, this questionnaire did not focus on nurses’ perceptions of incidence and risk, and specific prevention practices were not reported.

Although validated tools exist to assess nurses’ knowledge and skills in the area of PU prevention (Beeckman, Defloor, *et al.*, 2010; Beeckman, Vanderwee, *et al.*, 2010), these are focused on general nurses caring for adults. Thus these tools are not suitable for direct translation to the present study for several reasons:

1. the neonatal nursing workforce is made up of staff from a variety of clinical backgrounds (midwives, paediatric nurses, and general nurses)
2. skin damage in neonates often appears to be related to medical device use, which is not addressed by existing tools
3. prevention of PUs in neonates is fundamentally different in neonates than in adults due to the immaturity of the skin (Visscher and Narendran, 2014)
4. current evidence on skin care in neonates is limited (Lund, Kuller, *et al.*, 2001).

This provides the motivation for the present study: to explore current practice in assessing skin integrity, and to understand nurses’ perceptions of factors that increase risk of skin breakdown, and the extent to which nurses view prevention of skin breakdown as a priority. This study forms part of a larger multiphase mixed methods doctoral research project looking at the care and management of neonatal skin.

METHODS

Survey methodology was used in the form of a 19-part questionnaire tool.

Development of tool

Given the lack of pre-existing tools appropriate for this population and purpose, a new tool was developed. Items for the new questionnaire were developed following a combination of processes to ensure face validity (Rattray and Jones, 2007). Nursing staff in a variety of roles were involved in generating, reviewing, and pilot testing the questionnaire (Table 1). Draft items were generated from a literature review, the researcher’s own experience as a paediatric nurse, and discussion with the lead nurses from a regional neonatal network in the south of England. This draft tool then underwent a process of review by neonatal nurses and nursing assistants from neonatal intensive care units within the network (Figure 1). During this process, changes in wording were adopted in order to ensure that the questions measured the topics we intended to measure (de Leeuw, Hox and Dillman, 2008). Once the content had been finalised, the questionnaire was pilot tested with a further group of six registered nurses (RNs). These RNs had either adult or paediatric qualifications, which is reflective of the neonatal nursing workforce in the UK. During this process they were asked to comment on the functionality, formatting, and ease of use of the online tool. Following their feedback, the font size was increased, but no other changes were made. It took the RNs on average 15 minutes to complete the questionnaire.

The questionnaire uses both open and closed questions. The majority of questions are multiple-choice in nature, with between two and eleven possible responses depending on the question. Ranking and free-text questions are also used. Initial questions concern general demographic information, with more specific questions gradually introduced throughout the questionnaire (Table 1).

*Figure 1.* *Development process of questionnaire*

*Recruitment*

The study recruited RNs and nursing assistants from the South of England working in three levels of neonatal unit:

1. Special Care Baby Unit (SCBU): for babies who need monitoring of vital signs, supplemental oxygen, tube feeding, phototherapy or convalescence from other care.
2. Local Neonatal Unit (LNU): for babies needing short-term intensive care with respiratory support, including continuous positive airway pressure (CPAP)
3. Neonatal Intensive Care Unit (NICU): for babies who are born at < 28weeks, need respiratory support including ventilation, who weigh <1000g, and/or need significant CPAP support. These babies may also require surgery or other intensive treatment.

Lead nurses from a total of 16 units agreed to disseminate the questionnaire to a staff of approximately 800 via email. Paper copies were also issued to the three NICUs, and placed in staff coffee rooms alongside copies of the information sheet and a poster advertising the study. Recruitment took place from July to December 2014.

Participants were given an information sheet. Implied consent was taken on completion of the questionnaire. All participant data were anonymised.

ANALYSIS

Quantitative data

Quantitative data were analysed using descriptive statistics (mode, percentage). Mode is used here to refer to the most commonly occurring response to a given question. For one question, participants were asked to rank multiple medical devices according to associated risk of skin damage. Responses to this question were analysed by calculating the rank sum based on the top five devices selected by the participants.

Qualitative data

Qualitative data generated in the comment boxes accompanying some multiple-choice questions, as well as in open-ended questions about nurses’ opinions and practices, were analysed using content analysis (Saldaña, 2013). A codebook was developed in the process of analysis due to the lack of previous research in this area (Gibbs, 2007). Data were coded descriptively, recoded, and then organised into categories and subsequently into themes (Saldaña, 2013). These themes were then used to identify any new areas of interest or concern that have not yet been reported in the literature, in addition to providing general information about beliefs and practices of nursing staff (Greene, Caracelli and Graham, 1989).

Following this process, the data, codes, and emerging categories were triangulated with an experienced qualitative researcher (X) to minimise bias.

RESULTS

Demographics

In total, 56 responses were received, equivalent to a response rate of 7%. A breakdown of participants by subgroup, indicated in Figure 2, reveal responses predominantly from experienced neonatal nurses, with 44 participants working as senior staff nurses or above. A senior staff nurse is defined here as an RN who has completed post-registration education in neonatal care. The majority of participants cared for HDU and/or ITU patients as part or all of their caseload (n=50/56, 89.2%).

In total, six data sets had missing or unusable variables. The data from all completed questions were included for analysis.

Perception of incidence and risk

The majority of participants rated the risk of skin damage in their patients as “high” (n=20, 35.7%) or “extremely high” (n=13/56, 23.2%). No participant selected the option for “no risk”. Equally, when asked about the frequency of skin damage, no participant responded that they had never seen skin damage in neonates. However, there are some apparent inconsistencies. For example, two participants rated their patients as being at slight risk of skin breakdown and yet reported that they observed skin damage every day in practice (Figure 3). The majority of participants reported that they observed skin damage at least once or twice per month (n=30/56, 53.5%).

Participants were asked to list locations in which skin damage commonly occurs. The most common sites were the nose, the foot/heel, and the groin/buttocks, as indicated in Figure 4. Figure 4 also includes comments which did not directly specify a location; for example, damage from IV access.

*Figure 4. Common locations for damage*

Subsequently, participants were asked to rank medical devices according to associated risk of skin breakdown. CPAP, peripheral cannulae, and medical tape were all ranked equally, as most likely to cause skin damage, with pulse oximeters the next highest. This generally matches the comments related to location.

Educational needs

Only 6 participants had received formal skin care training since they started working with neonates. No clinical educator had received formal skin care training, and one participant, who self-identified as “tissue viability link nurse”, had received neither formal skin care training nor bedside training. Junior staff nurses did not report formal skin care training, although this was reported to be part of their induction. By contrast, the majority of participants had received bedside training from their peers (n=37/56, 66.4%).

Assessment

The majority of participants reported that they carried out skin assessments with nappy changes or cares (n=35/56, 62.5%). “Cares” are defined as clustered episodes of care delivery, when many interventions that require handling of the neonate are delivered together in order to minimise disturbance. From the additional comments provided, it is clear that this differs between participants and between patients. A further 15 of the participants reported that they carried out skin assessment more often than this. Two participants reported that they carried out skin assessment “only when necessary”.

An examination of the additional comments reveals that reports of “skin assessment” may not constitute full body assessment. Participants commonly reported that “it depends on condition of baby/gestational age” (n=12/56, 21.4%), “cannula sites checked hourly when infusion is running” (n=11/56, 19.6%), and “4-6 hourly with cares” (n=7/56, 12.5%). Contradictions are apparent in some of these responses. For example, two participants state that the nose must be assessed hourly when a patient is on CPAP, while two suggest that this should occur every two hours. In total, 21 different assessment practices were reported by the participants.

When asked about grading or assessing skin damage, 41 participants reported describing them “in words” in the medical notes as opposed to using a standardised system of reporting. Both of the standardised tools referred to by participants in this section relate to assessment of peripheral cannulae, the Visual Infusion Phlebitis (VIP) score (Infusion Nurses Society, 2011) and the Neonatal Extravasation Score (NESS) (Edwards, 2015).

Qualitative data

Two themes emerged from the analysis of the free text comments; namely, clinical factors and cultural factors. These factors intersect with one another at several points and both have an impact on patient care.

*Clinical factors*

Participants’ comments included information about specific clinical aspects of care delivery. These comments address four categories: individualisation of care, medical devices, use of barrier products, and resources, as described in Table 2.

*Cultural factors*

For the purposes of this analysis, a description of organisational culture was used (Kaufman and McCaughan, 2013). This encompasses factors such as rituals (including ward rounds and patient handovers), teamwork, communication, and values/behaviour. The categories within this theme are “team effort”, “role of evidence”, and “unit routines”. Summaries of categories and key codes are indicated in Table 3.

DISCUSSION

This study comprised a 19-part questionnaire, distributed to neonatal nursing staff covering a network in the south of England. The aims were to explore current practice in assessing skin integrity, nurses’ perceptions of factors that increase risk of skin breakdown, and the extent to which nurses view prevention of skin breakdown as a priority. The results showed inconsistencies in practice, particularly in relation to skin assessment. Indeed participants expressed concern about the lack of evidence available and limited education on the subject. These findings also highlighted the complications associated with interventional medical devices in this vulnerable population.

Research from the United States suggests that over one third of hospital-acquired PUs in adults can be associated with medical devices (Black *et al.*, 2010). The importance of devices in relation to skin health in neonates has also been well established (Kopelman and Holbert, 2003; Buettiker *et al.*, 2004; Hogeling *et al.*, 2012; Collins *et al.*, 2014). Indeed a recent study found 90% of PUs in neonates were associated with medical devices (Visscher and Taylor, 2014). In the present study, participants highlighted this as a critical causal issue. CPAP was mentioned frequently throughout the responses and ranked as one of the three devices most likely to cause damage. This finding is similar to that which highlights nasal trauma resulting from CPAP use (Yong, Chen and Boo, 2005), particularly in extremely preterm and very preterm neonates (Fischer *et al.*, 2010). Extremely preterm neonates are also significantly more likely to develop skin necrosis following extravasation (Kostogloudis *et al.*, 2015).

A survey of a comparable group of neonatal nurses in Malaysia by Mohamed and colleagues (2014) sought to explore participants’ skin care practices and their perceptions of their own knowledge. In contrast to the present study, they surveyed only neonatal nurses and not nursing assistants. Although that study did not seek to explore nurses’ perceptions of device-related damage, questions related to pulse oximeters, CPAP, and peripheral cannulae were included. The results suggested that nursing staff of all levels of experience had adequate knowledge of pulse oximeters and IV cannulae, but only 15.4% of junior staff nurses demonstrated adequate knowledge regarding the care of neonates on CPAP. Comparisons between the two studies, however, is limited due to differences in both format and content of the questions, with the previous study utilising a series of true/false questions as opposed to a scale or open-ended questions as in the present study. There are nonetheless clear similarities. The findings of our study confirm that neonatal nursing staff are aware of the risks associated with these and other devices, but struggle to manage this due to resource limitations. Staff working with critically ill patients have to balance the need to maintain functionality of the device, while preserving the health of vulnerable skin. It is notable that an NPUAP committee were unable to reach a consensus regarding whether the proper use of medical devices overrides protecting the skin (Black *et al.*, 2011). This issue is particularly complex in critical care environments, where the devices causing complications may be lifesaving.

One finding of the current study was that type and frequency of skin assessment varied between respondents. Indeed 21 different assessment practices were reported, with participants citing personal preference, condition of neonate, and other influencing factors. No single system for skin assessment was identified. To this end, the Neonatal Skin Condition Score has been trialled in the US, but has not been adopted in the UK (Lund, 2004). “Classification and observation” has previously been reported as a gap in adult nurses’ knowledge (Demarré *et al.*, 2012; Gunningberg *et al.*, 2013). In one study in the UK, nurses correctly classified 56% of PUs, increasing to 62% following intensive training (Kelly and Isted, 2011). In a neonatal environment, classification is complicated further by factors such as minimal subcutaneous fat deposits (Ness, Davis and Carey, 2013). International standards for classifying incontinence-associated dermatitis in adults have been proposed (Beeckman *et al.*, 2015), but these may not prove appropriate for classifying diaper dermatitis in neonates.

Participants in the current study identified gestational age as a factor associated with increased risk of skin breakdown. No questions were asked with the intention of assessing participants’ knowledge of neonatal anatomy and physiology, as this did not represent one of the aims of the study. In the survey of Malaysian nurses (Mohamed, Newton and Lau, 2014), questions related to TEWL suggested that the nursing staff managed this in their patients without knowing what it represented in physiological terms. No other study to date has explored neonatal nurses’ knowledge of postnatal development of the skin. This is likely to be relevant to skin care in this population, as the underdeveloped skin barrier in extremely premature neonates increases the vulnerability of the skin to breakdown (Visscher and Narendran, 2014).

Participants expressed reservations regarding the availability and quality of skin care education. Several respondents also cited lack of education or gaps in education as barriers to promoting skin health in their patients. This contrasts with findings among adult nurses in both general and intensive care environments, where staff do not perceive lack of education as a barrier to practice (Moore and Price, 2004; Strand and Lindgren, 2010). Some participants in the present study linked lack of education to diminished confidence in this area, a finding also reported previously (Mohamed, Newton, and Lau, 2014). However, it is clear from the present findings that participants are motivated to improve their own practice and that of others. This contrasts with suggestions that nurses’ reluctance to change is a barrier to implementing evidence-based practice, even in intensive treatment units (Soh *et al.*, 2013).

There were some limitations associated with the method and sample. The response rate was low at 7% related to 800 potential participants. This limits the generalisability of the results. The sample was self-selecting, suggesting a degree of interest in skin care that may not be mirrored across all staff. Participants were predominantly senior staff, with only three nursing assistants participating and few junior staff nurses (n=9). This may mean that in the majority of the neonatal nursing workforce, the level of awareness and knowledge demonstrated may be lower than that demonstrated by participants. There were also some errors by participants when filling out the paper version of the questionnaire (e.g. ticking devices rather than ranking them, meaning that the data could not be used). Additionally, some participants did not answer questions when filling out the paper copy that had been marked as “mandatory”. These limitations restrict the generalisability of the results to other populations, and may not reflect the whole of the neonatal nursing population even in these units surveyed.

Despite these limitations, this is a useful first step in understanding nurses’ perspectives on the issues associated with providing skin care to this highly vulnerable population. Given the demographics of the participants, the findings of this study are likely to represent the part of the neonatal workforce with the most skin care experience. Although a previous questionnaire has looked at neonatal nurses’ knowledge of skin care (Mohamed, Newton and Lau, 2014), this is the first to explore nurses’ perceptions of barriers and opportunities unique to this population. Given that neonatal nurses are experts in their patient group, it is essential to consider their perspectives and views as research continues into this area.

In light of this, the study has implications for clinical practice as well as future research. First, although some participants in this study received skin care training during induction, this is not consistent across all participating units. Given previously reported concerns around confidence (Mohamed, Newton and Lau, 2014), it is likely that this is a common issue for nurses working with premature or critically ill neonates. This can only be addressed with further clinically-focussed studies, as the problem is associated with lack of evidence. However, increasing the availability of skin care training could lead to increased consistency of practice. Additionally, the study highlights the complex clinical issues surrounding the use of interventional medical devices. Although these devices are often essential and life-saving, this study draws attention to devices that may require frequent observation while in situ in order to minimise the risk of skin damage.

CONCLUSION

The participants in this study represent a skilled group of staff, primarily RNs, in a range of clinical positions. Their responses demonstrate enthusiasm for improving practice and learning more about neonatal skin. The collective experience and knowledge of the team is used to deliver individualised preventative care, monitor skin health, and to respond rapidly to the onset of skin damage. However, discrepancies in the responses are indicative of gaps in evidence and education. Several participants mention actively seeking out new research in this area with the intention of improving practice. The paucity of published research on neonatal skin health makes this difficult. Research into all areas of neonatal skin integrity is required to inform practice, thus minimising the risks posed to preterm skin by intensive treatment. The reporting structures for skin damage in neonates should also be considered, as at present these are predominantly adapted from those designed for adults and may not be appropriate for this population. A role for industry is also indicated in developing devices tailored to the specific needs of preterm neonates, preferably in partnership with clinicians including nurses.