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Bathing a Premature Infant in the Intensive Care Unit: A Systematic Review☆

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ABSTRACT

Problem: Daily bathing of the preterm infant in the Neonatal Intensive Care Unit (NICU) is a process that is usually done routinely, but it can cause many adverse effects on the stability of the infant. Highlights include decreased body temperature and increased stress, which can cause alterations in its proper growth and development.
Eligibility Criteria: We included both descriptive studies and analytical studies that evaluated the effects of bathing on the physiological state of the preterm infants admitted to NICU. The limit on the time of publication was not established and the languages included were Spanish and English.
Results: Ten articles (438 patients) met the inclusion criteria, of which one was a quasi-experimental trial, five randomized clinical trials, one cohort study and three followed a descriptive design. A comparison has been made according to the type of bath: sponge bath, bathtub and Swaddle bath, showing that the Swaddle bath was less related to temperature changes and stress levels. It was also shown that the frequency of bathing can be reduced every 96 h without increasing the risk of infection. Finally, it has been observed that the nurse's behavior is also closely related to the stress suffered by the premature infant.
Conclusions: This paper reveals the importance of correctly bathing premature infants as hospital admission, reentry and morbidity and mortality may be reduced.
Implications: Swaddle bath has been shown to be the best method for bathing preterm infants in the Neonatal intensive Care Unit.

Background

The daily bath of preterm infants is a routine activity in Neonatal Intensive Care Units (NICU) with many adverse effects on the physiological stability and behavior of the premature infant. This population is particularly vulnerable to heat loss, so daily bathing can produce a state of hypothermia (Cramer, Wiebe, Hartling, Crumley, & Vohra, 2005; Gilliam & Williams, 2009; Quinn, Newton, & Piecuch, 2005) due to the immaturity of thermoregulatory mechanisms (Edraki, Paran, Montaseri, & Montaseri, 2014; Kuller, 2014; López Cócera, Ros Navarret, Pérez LaFuente, & Mimón Rahal, 2010; Loring et al., 2012). In addition, temperature instability often leads to clinical complications such as hypoglycemia, apnea, hypoxia, impaired neurological status, acidosis, pulmonary insufficiency and hemorrhage (de Almeida et al., 2014; Edraki et al., 2014; Wilson et al., 2016).

On the other hand, daily bathing is a highly stressful factor for the premature infant, which can be observed in some related behaviors such as crying, fussing, hiccoughing or yawning (Edraki et al., 2014; Lawhon & Hedlund, 2008). High levels of stress can have negative consequences for the delay in development of the premature infant like sleep alterations, changes in growth or neurodevelopmental, so that stressful procedures should be minimized. Bathing is a stressful procedure for premature infants that, despite triggering an adverse physiological response, provides many benefits such as the elimination of pollutants from the skin and thus prevention of infections (Pineda, Newnham, & Wallendorf, 2011; Quraishy, Bowles, & Moore, 2013).

The goal of the first bath should be to remove unwanted material such as blood and meconium and to leave residual vernix intact (Kuller, 2014). Bathing in the immediate postbirth period carries risks of hypothermia, respiratory compromise and increased oxygen consumption. The literature affirms that the first bath should not be given until the infant's vital signs and temperature have stabilized (Colwell, 2015; Hurtado Suazo et al., 2014; Kuller, 2014; Lawn et al., 2013). The World Health Organization (WHO) recommends delaying the bath for 24 h, or if this is not possible due to cultural reasons, waiting at least 6 h, in an effort to prevent hypothermia (El-Atawi & Elhalik, 2016; Lund, 2016).

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The optimal technique for the first and the second bath is discussed, the most used techniques being sponge bathing with a small tub such as those provided in the hospital, or a large tub or immersion bathing or the swaddle bath (Edraki et al., 2014; Lund, 2016). There are also no clear recommendations regarding the frequency of bathing and the risk of infection (Lund, 2016; Quinn et al., 2005).

Techniques used include sponge bathing with a small tub such as those provided in the hospital, or a large tub or immersion bathing. Immersion bathing places the infant's entire body, except the head and neck, into warm water.

Objective

The objective of this systematic review has been to synthesize the best available evidence on bathing premature infants in the Neonatal Intensive Care Unit.

Methods

This systematic review will be reported in line with the guidance from the Cochrane Handbook of Systematic Reviews of Interventions (versión 5.1.0) (Higgins, Green, & Collaboration, 2011) and the recommendations of the PRISMA statement (Urrútia & Bonfill, 2010). It has not been possible to develop a meta-analysis due to the heterogeneity of the designs and the results obtained.

Criteria for Selecting Studies

We included both descriptive studies and analytical studies that evaluated the effects of bathing on the physiological state of the preterm infants admitted to NICU. The limit on the time of publication was not established and the languages included were Spanish and English. Those studies whose data were collected outside the NICU and which included term infants were excluded.

Search Strategy

An exhaustive search was carried out in the following databases: Pubmed, ScienceDirect, Web of Science, Scopus, Wiley, Biblioteca Virtual de Salud y Joanna Briggs. The search was carried out during the months of November and December 2016.

The descriptors used for the search were located in the Thesaurus Medical Subjects Headings (MeSH) and in Descriptors in Health Sciences (DeCS). The search strategy was: “baths” AND infants, premature OR infants, preterm OR neonatal prematurity AND intensive care units, neonatal OR ICU premature.

Selection of Studies

After the search in the different databases, a first selection of the studies was made with the reading of the title and the summary by two reviewers. The full text of the studies and the verification that they fulfilled both the inclusion criteria and the exclusion criteria was then read. The discrepancies between the two reviewers have been resolved by consensus. This selection process is detailed in Fig. 1.

Instrument for Evaluating Study Quality

The methodological quality of the studies was evaluated through the “Critical Appraisal Skills Program Spain” (CASPe) (Cabello, 2005a, 2005b) according to the type of study, in order to assess the risk of bias. We have included studies that obtained a score higher than 6, considering that between 6 and 8 are of medium quality and above 8 of good quality. The critical reading of the descriptive studies has been made through the statement STROBE (Von Elm et al., 2008).

Results

In the described studies, a total of 2167 bibliographic references were found, of which 19 complete texts were reviewed. Finally, 10 references fulfilled the inclusion and exclusion criteria.

Characteristics of Studies

A total of 438 preterm infants were included in the studies analyzed. Six studies focused on the physiological instability of prematurity according to the type of bath, differentiating bath with sponge, bath in bathtub and swaddle bath (Edraki et al., 2014; Lee, 2002; Liaw, Yang, Yuh, & Yin, 2006; Loring et al., 2012; Montes Bueno et al., 2005; Tapia-Rombo et al., 2012). Three other studies analyzed how decreasing bath frequency did not increase colonization of pathogens in the skin (Franck, Quinn, & Zahr, 2000; Zahr, 1996). And a last study analyzed the relationship of the nurse with the newborn in order to reduce the levels of stress (Liaw, Yang, Chou, Yang, & Chao, 2010).

Five of these studies were randomized clinical trials (Edraki et al., 2014; Liaw et al., 2006; Loring et al., 2012; Quinn et al., 2005; Zahr, 1996), three used a descriptive methodology (Franck et al., 2000; Lee, 2002; Liaw et al., 2010) and the remainder were a quasi-experimental (Tapia-Rombo et al., 2012) and cohort study (Montes Bueno et al., 2005). A description of the selected studies is given in Table 1.

In the analysis of the selected studies, three characteristics of the bath have been identified that influence the neonatal stress and the instability of the temperature. The following describes these types of bath, the frequency of the bath and the behavior of the nurse in relation to its influence on the premature infant.

Type of Bath

Six of the studies included in this systematic review analyzed the changes in temperature and the stress that the premature infant suffers according to the type of bath that it received, distinguishing between bath in bathtub, bath with sponge and swaddle bath (Edraki et al., 2014; Lee, 2002; Liaw et al., 2006; Loring et al., 2012;Montes Bueno et al., 2005; Tapia-Rombo et al., 2012).

Sponge Bathing

Four of the studies analyzed the variation of vital signs and signs of neonatal stress during sponge bathing (Lee, 2002; Loring et al., 2012; Montes Bueno et al., 2005; Tapia-Rombo et al., 2012). In three of these, measurements were performed before, during and after the sponge bath (Lee, 2002; Montes Bueno et al., 2005; Tapia-Rombo et al., 2012), while in the fourth, measurements were performed before bathing, and 10 and 30 min later (Loring et al., 2012).

Three of these studies analyzed the temperature alterations caused by sponge baths. Two studies found significant differences between before-and after-bath temperature (Montes Bueno et al., 2005; Tapia-Rombo et al., 2012). The Tapia-Rombo et al. study found differences in comparing temperatures before and during bathing, and during and after bathing (Tapia-Rombo et al., 2012). Montes-Bueno et al. found that in 87.4% of infants the temperature dropped below 36.5 °C and 45.5% below 36 °C, remaining below 36.5 °C for an average of 1 h (Montes Bueno et al., 2005). Loring et al. analyzed the temperature changes before, and 10 and 30 min after, bathing and found little variability between temperature measurements (Loring et al., 2012).

To assess neonatal distress, studies have used different parameters such as heart rate (HR), breathing rate (BR) and vagal tone. Two studies compared these parameters before, during and after sponge bathing (Lee, 2002; Montes Bueno et al., 2005). In the Tapia-Rombo et al. study they only found statistical differences when comparing HR before and during bathing, and during bathing and after bathing (Tapia-Rombo et al., 2012), while Lee's (2002) study did find statistically significant differences before and after bathing. For HR, no statistically significant

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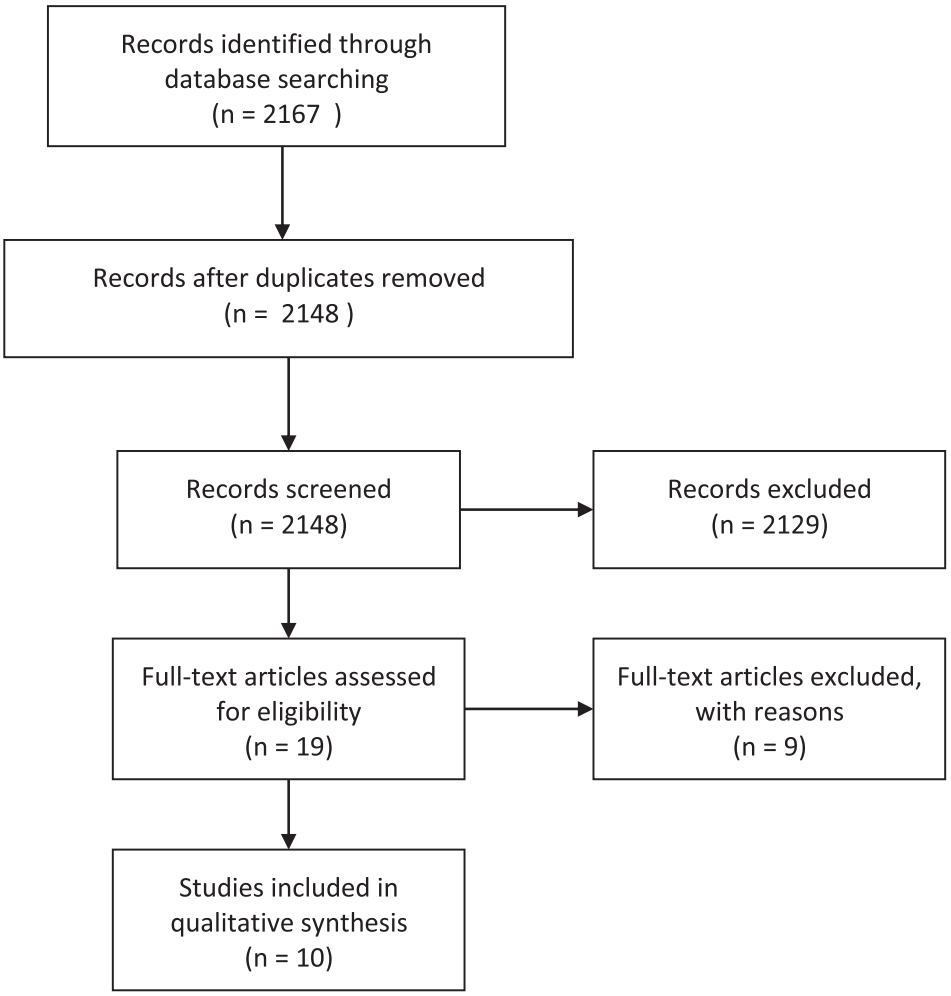

Fig. 1. Article selection process.

differences were found either before, during or after sponge bathing (Tapia-Rombo et al., 2012). Vagal tone analysis showed significant reduction during bathing (Lee, 2002). Table 1 shows the results of the studies.

These articles also analyzed the influence of sponge bathing on oxygen saturation, finding significant differences in both, before and after bath comparisons such as comparing the temperature during bathing (36.8 ± 0.4 °C) with the before (37 ± 0.4 °C) and after (35.5 ± 0.5 °C) (Lee, 2002; Tapia-Rombo et al., 2012). In addition, skin coloring was also investigated and significant differences were found by comparing skin coloring 10 min before and during bathing, 10 min after bathing and 10 min before and 10 min after bathing. The biggest difference in skin coloring was when comparing color before bath that was pink in most children and the color after bath that changed to pale or acrocyanosis in some of the children (Tapia-Rombo et al., 2012).

Bathing in Bathtub

Three articles studied bathing in a bathtub or immersion bath and its influence on the physiological stability of preterm infant. The Loring et al. (2012) study showed that bathing in a bathtub produces a drop in body temperature from 98.7 °F (37 °C) before bathing to 98.1 °F during bathing; after bathing the children recovered an average temperature of 98.4 °F (36.8 °C) after bathing. Edraki et al. (2014) concluded that the value of the temperature difference before and after (−0.59 °C) was significant.

In relation to the stress caused by bathing in bathtubs, crying time was examined in fifty infants comparing the two types of bathing. Mean amount of crying time of infants who were bathed in a tub was 43.41 s as compared to 5.81 s for infants who received the swaddle bath (Edraki et al., 2014). Liaw et al. in 2006 analyzed both crying time, tremor, shaking and grip as signs of neonatal stress and distress. These parameters were measured three times, showing statistically significant differences in distress behaviors that increased during bathing (Liaw et al., 2006).

Swaddle Bath

Only one study in the review examined the influence of swaddle bath on temperature and preterm stress. The swaddle bath consists of placing the child on the midline position with bent arms and legs and wrapping him/her in a soft blanket. In this position the infant will be immersed in a bathtub wrapped in the blanket, making sure that the water covers him/her just below your shoulders. First, the face will be cleaned using a gauze soaked in soap-free water. Next, carefully unfold one of the child's extremities in order to wash it and then cover it again with the blanket, repeating this process with each of the extremities individually. This allows the infant to remain in the same position for as long as the bath lasts (Edraki et al., 2014; Hall, 2008; Quraishy et al., 2013).

As regards temperature, its measurement showed a minimal reduction when measured 10 min before and after the bath (36.5 °C vs 36.4 °C). In relation to crying, the time was measured during the swaddle bath (5.81 s) and during bathing in the bathtub (43.41 s) showing statistical differences. It can be observed that neonatal distress time was significantly shorter in the swaddle bath (Edraki et al., 2014).

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Table 1
Description of the selected studies.

Authors	Year	Journal	Method	Main results	Authors' conclusions
Edraki et al.	2013	J Caring Sci	RCT. Sample of 50 premature infants	There is less thermal difference in the swaddle bath than in the conventional bath and less crying time ($p < 0.001$)	The results of this study indicate that the swaddle bath may help maintain body temperature and reduce stress in preterm infants during bathing.
Franck et al.	2000	JOGNN	Descriptive study of repeated measurements to compare the colony count 4 days after bathing.	The colony count increased during the first 48 h but remained stable at 48 h.	The results suggest that the frequency of bathing could be reduced to every 4 days without increasing skin flora colony counts or pathogen colonization.
Lee, H.K.	2002	J Clin Nurs	Descriptive study. Data were collected 10 min before, during and after the bath.	Significant differences in heart rate and oxygen saturation before and after bathing have been found	The sponge bath significantly increases the child's stress and should be reduced in frequency.
Liaw et al.	2006	JNR	RCT. Measurements were taken before, during and after bathing.	Signs of neonatal stress such as shaking, tremor, and crying have increased during bathing ($p < 0.001$)	The onset of distress increased significantly during bathing. Bathing not only disrupts the sleep of premature babies, but also causes an increase in distress behavior.
Liaw et al.	2010	J Clin Nurs	Correlational descriptive study	Nurse's support relationship decreases child's stress ($p < 0.001$)	When nurses provided more supportive behaviors, stress was reduced in newborns, and their self-regulation during bathing improved.
Loring et al	2012	JOGNN	RCT. Sample of 100 premature infants.	There is less difference in temperature in the bath with bathtub than in the sponge bath ($p = 0.024$)	The findings of this study suggest that immersion bath, compared to sponge bath, results in better thermoregulation.
Montes Bueno et al.	2005	An Pediatr	Prospective study of a cohort of low birthweight preterm infants.	The sponge bath produces a significant decrease in temperature. Below 36.5 °C being an average of 1 h in 87.4% of the cases.	The results emphasize the need for close attention to changes in body temperature during the grooming of preterm infants.
Quinn et al.	2005	JOGNN	RCT. Sample of 53 premature infants.	There was no difference in colony count in children bathed every 2 to 4 days	The findings of this study suggest that it is safe to reduce bathing time every 4 days for premature infants in the NICU.
Tapia et al.	2012	REV INVEST CLIN	Quasi-experimental study, with a sample of 48 preterm infants.	There were significant differences in temperature, heart rate and oxygen saturation. Respiratory rate remained constant. The coloring of the children also underwent significant variations.	Sponge bathing should be done in the shortest possible time to minimize its adverse effects. And at the end of it, the newborn baby should be observed, as it may require extra help to recover its temperature or oxygen saturation.
Zahr, L. K.	1996	Infant Behav Dev	RCT. Sample of 40 premature infants.	There were no differences between groups in skin culture results at 48 and 96 h after bathing.	The results indicate that children who bathed had significant falls in oxygen saturation levels. There was no difference in skin culture results.

Frequency of the Bath

Three of the studies included in this review looked at bathing frequency. The studies of Quinn et al. and Zahr compared the type of flora and skin colonization in children who are bathed every two days and those who are bathed every four days (Franck et al., 2000; Quinn et al., 2005), while Franck et al.'s study collected samples in the same children 48 and 96 h after bathing (Franck et al., 2000).

No statistically significant differences were found between the control group (bath every two days) and the experimental group (bath every 4 days) in either study (Franck et al., 2000; Quinn et al., 2005). Analyzing skin flora for 4 weeks, an increase in the average colonies was observed in both groups over the course of weeks, but no differences between the two groups were detected. In none of the cases was the development of infection observed as a consequence of prolonged bathing time (Quinn et al., 2005).

In Franck et al.'s article a colony count was performed before, after and at 48 and 96 h of bath time. Colony counts increased during the 48 h after bathing and remained stable thereafter. No statistically significant differences were found between 48 and 96 h of bathing time for colony counts (Zahr, 1996).

Relationship Between Nursing Care and Premature Response

Liaw et al. linked the nurse's handling of the baby during bathing to the responses of preterm infants. Physical support from the nurses (soft touch, grip, positional support, or containment) was found to be associated with decreased stress levels. It has been found that these were also negatively correlated with signs such as grimacing or crying (Liaw et al., 2010). On the other hand, the nurse's handling of the baby quickly and roughly correlated positively with all signs of neonatal stress. Other behavior that increased neonatal stress levels was talking to other people and handling the child incorrectly. In cases where the nurse's behavior was neutral, it was also related to stress and eye opening (Liaw et al., 2010).

Discussion

This systematic review shows how the type of bath, the frequency of bathing and the behavior of the nurse have a great influence on the stress experienced by premature infants and the temperature changes to which they are exposed. These aspects are of particular importance as they increase neonatal distress and physiological instability, increasing the prevalence of complications such as hypoglycaemia, respiratory instability, hyperbilirubinemia or disturbances in sleep, growth or neurodevelopment delay. Therefore, bathing in premature infants admitted to neonatal ICU should not be done routinely because of the negative effects it can have (Edraki et al., 2014; Loring et al., 2012; Quinn et al., 2005).

The WHO recommends waiting a minimum of 6 h and preferably 24 h after birth before the first bath, as the risk of cold stress increases significantly during those hours. After waiting for this time, there is no clear recommendation as to what type of bath is the one of choice.

Different types of baths have been compared with the temperature changes they cause. Comparison of sponge bath and tub baths has shown less variability in body temperature of the second versus sponge bath (Hall, 2008; Lee, 2002; Liaw et al., 2006; Loring et al., 2012; Montes Bueno et al., 2005; Tapia-Rombo et al., 2012). The comparison of the bath with a conventional bathtub and swaddle bath showed that the body temperature after bathing was lower in the bath group in the

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bath tub (Edraki et al., 2014). It may be noted that the swaddle bath is the one that produces the least variation in body temperature and the sponge bath is the one that has caused the most changes in temperature, although the evidence is limited.

Premature infant stress negatively affects its growth and development and also causes a decrease in oxygen saturation (Harrison, Roane, & Weaver, 2004; Peng et al., 2014). Studies have shown that a control of environmental stimuli or postural support improves cognitive, behavioral and motor development of premature infants in the long term by decreasing stress levels (Ruiz Fernández, 2016; Sánchez-Rodríguez, Quintero-Villejas, Rodríguez-Camelo, Nieto-Sanjuanero, & Rodríguez Balderrama, 2010). The nurse's behavior with the premature infant is a factor that also influences stress. All nursing care leads to increased neonatal stress, especially in the bath, but it has been shown that supportive and protective behavior by the nurse significantly decreases the child's stress levels, helping him/her to cope more positively and calmly with the bathing process (Liaw, Yang, Chang, Chou, & Chao, 2009; J.-J. Liaw et al., 2010).

The swaddle bath is presented as the least stressful and safest bathing technique to avoid large temperature changes in premature infants, as fewer decreases in body temperature have been observed compared to other types of baths (Edraki et al., 2014; Hall, 2008; Quraishy et al., 2013). Then again, sponge bathing has been shown to significantly increase heart rate, respiratory rate and decrease vagal tone (Lee, 2002; Montes Bueno et al., 2005; Tapia-Rombo et al., 2012). When comparing the bath with bathtub and swaddle bath, the time spent crying has been measured as a parameter of neonatal stress, being significantly shorter in the swaddle bath (Edraki et al., 2014). Therefore, even though bathing is a stressful process for a premature infant, if a swaddle bath is performed and the nurse shows supportive and protective behavior, the stress levels to which the baby is exposed and thus its adverse effects could be minimized.

As seen above, bathing can have a negative effect on the stability of a premature infant, so it is necessary to know the ideal bathing frequency to minimize these effects, but without an increase in colony count. The premature infant has greater immunological immaturity, which means an increased risk of infection (Coronell, Pérez, Guerrero, & Bustamante, 2009).

Three of the studies included in this review looked at the possibility of decreasing bath frequency without increasing colony count or increasing susceptibility to infection. All studies compared 48 and 96 h, with no increase in colony count observed from day two to day four. Therefore, findings indicate that it is safe to prolong the bath for at least 96 h because it will not increase the risk of infection (Franck et al., 2000; Quinn et al., 2005; Zahr, 1996).

Limitations

The literature on the subject matter of this review is very scarce, so one limitation of this review has been the inclusion of observational studies in it. However, all of them have been subjected to an assessment of their methodological quality.

Recommendations for Practice and Research

Swaddle bath has been shown to be the best method for bathing preterm infants in the Neonatal intensive Care Unit. Randomized Controlled Trials in this population is necessary to develop due to a shortage of trials.

Conclusion

In this systematic review we have studied some of the processes that can help us to minimize the negative effects of bathing on the health of preterm infants. Based on the results obtained and despite the limited literature found, we can recommend the swaddle bath, since is the type of bath that produces fewer changes in temperature and less neonatal stress. It is also essential to highlight the importance of supportive and protective behavior by the nurse during the premature infant's bath experience, so nurses should be trained in the acquisition of attitudes that minimize the stress of the baby. Regarding the frequency of bathing, the analysis carried out recommends that it should be every 96 h since it does not increase the risk of acquiring an infection.

Clinical evidence on this issue is limited and research on this issue needs to be generated in the neonatal intensive care units. Randomized clinical trials centred in the swaddle bath should be encouraged. It would also be important to assess the influence of the nurse in the preterm infant's bath.

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Conflict of Interest

None to declare.

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