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Nurses' perspectives on pain management practices during newborn blood sampling in China

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ABSTRACT

Introduction: Nurses' use of evidence-based pain treatments for newborns during needle-related procedures in China was unknown. This study aimed to ascertain knowledge and use of pain management strategies and usefulness of a publicly accessible 'BSweet2Babies' video, produced in Mandarin, demonstrating the use of breastfeeding, skin-to-skin care (SSC), and sweet solutions during painful procedures.
Methods: An online survey was conducted during six nursing conferences in China ascertaining nurses' previous viewing of the video and knowledge and use of the demonstrated strategies.
Results: 221 nurses participated. Only 25 (11.3%) had previously seen the video. Over half knew that breastfeeding (n = 138, 62.4%) and SSC (n = 173, 78.3%) reduced pain, and 89 (40.3%) knew that sucrose reduced pain, but these strategies were infrequently used. Most intended to use the strategies in the future.
Discussion: A knowledge-to-action gap for newborn pain management was identified. Future research is needed to improve the implementation of effective pain treatment for newborns.

1. Introduction

All newborns require painful procedures for diagnoses and treatments as part of routine medical care. Healthy newborns receive at least one heel lance or venipuncture to collect a small amount of blood for disease screening and a single intramuscular injection of vitamin K (McMillan & Canadian Paediatric Society Fetus and Newborn Committee, 2016; Newborn Screening Ontario, 2017). However, preterm and sick infants may experience multiple painful procedures throughout hospitalization. The epidemiology of painful procedures synthesized in a systematic review showed that each critically ill neonates received an average of 7.5–17.3 distressing and painful procedures per day (Cruz et al., 2016).

Poorly treated procedural pain causes unnecessary suffering to newborns and can have short- and long-term adverse effects (McGrath et al., 2014). Neonates, who are exposed to repeated painful procedures without adequate pain relief, may have decreased pain tolerance then can persist into childhood and possibly over a lifetime (Hatfield et al., 2013). A systematic review of 13 studies shows that unrelieved pain in preterm infants was associated with reduced attention and arousal, lethargy, suboptimal reflexes, and structural brain abnormalities, including reduced white matter, subcortical gray matter maturation, and cortical thickness (Valeri et al., 2015). This highlights the need to ensure that painful procedures are minimized and that effective pain management interventions are consistently used during painful procedures. There is high-quality evidence of analgesic effects of three effective, simple, and low-cost strategies to minimize pain in newborns during painful procedures: small amounts of sweet solutions (sucrose or glucose) with or without a pacifier (Harrison et al., 2017a), skin-to-skin care (SSC) (Johnston et al., 2017), or breastfeeding (Benoit et al., 2017). These strategies effectively and safely reduce pain in newborn infants during needle-related painful procedures (Lim and Godambe, 2017). A systematic review of 168 studies identified that oral sweet solutions reduce crying time and composite pain intensity scores in infants during painful procedures compared with no treatment or placebo (Harrison et al., 2017a). A systematic review of 25 studies (n = 2001 infants) found

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that SSC reduces pain responses to skin-breaking procedures (Johnston et al., 2017) and a systematic review of 21 studies (n = 2336 infants) showed that direct breastfeeding was more effective in reducing procedural pain in infants than maternal holding, topical anesthetics, and music therapy, and was as, or more effective, than sweet solutions and SSC (Benoit et al., 2017).

However, numerous studies consistently show infrequent use of these effective and simple pain reduction strategies during needle-related painful procedures in many settings (Cruz et al., 2016). A provincial-wide survey in 2015 in Canada ascertained that more than half newborn units in Ontario never or occasionally used sweet solutions, SSC, and breastfeeding during heel lance or venipuncture (Harrison et al., 2015). Two recent studies in Canada found that no pain treatments were used during around 40% of painful procedures (De Clifford-Faugere, Aita, & Le May 2019; Orovec et al., 2019). Sucrose was not consistently used despite being a standard pain management intervention in the study settings, and SSC and breastfeeding were rarely used (De Clifford-Faugere et al., 2019; Orovec et al., 2019). This knowledge-to-action gap also existed in low-to middle-income countries, including China (Cruz et al., 2016). For example, one study in China that was published in 2012 showed that hospitalized neonates (n = 108) in the study did not receive any pain treatment during all painful procedures (n = 10,633) (Chen et al., 2012).

Understanding nurses' knowledge and use of pain management strategies, as well as their perceptions of knowledge translation tools aimed to improve newborn pain management, could inform the adoption of evidence into the local context, increasing the likelihood of integrating evidence into routine clinical practice. Thus, the objective of this study was to investigate nurses' knowledge and use of evidence-based pain management strategies for newborns during needle-related painful procedures in China and their perceptions of a knowledge translation tool produced in Chinese, demonstrating use of breastfeeding, SSC and sucrose during painful procedures. As attending professional conferences is one way in which nurses learn about evidence and recommended practices, conducting this study during a series of conferences in China was seen as a valuable venue to recruit nurses.

2. Methods

2.1. Sample and setting

A descriptive cross-sectional survey was conducted in six nursing conferences in China from May 2017 to November 2018. Convenience sampling was used to recruit clinical nurses who attended these conferences where the authors (D.H. and W.G.) were presenting on newborn pain management and implementation science. Nurses were invited to complete a survey after they watched the 'BSweet2Babies' video in Chinese, which was shown during the presentations by the authors (D.H. and W.G.), accompanied by a Quick Response (QR) code with a link to the online survey. The video (https://youtu.be/L43y0H6XEH4) was originally developed in Canada, has been translated into Mandarin Chinese and clearly shows the calming effects of breastfeeding, SSC, and sweet solutions for procedural pain management in neonates (Harrison et al., 2017b,c).

2.2. Data collection

The electronic survey was created in Research Electronic Data Capture (Harris et al., 2009) and accessed via a hyperlink. This link was provided with the Chinese 'BSweet2Babies' video during the author's (D.H.) presentations on evidence-based pain management strategies for newborns during needle-related procedures. Paper-based surveys were also available at the conference for participants who were interested in this study but could not get access to the electronic survey. After completion, research coordinators were available for respondents for the return of the surveys.

The survey did not collect any demographic information. The survey included eight brief questions on nurses' perspectives on evidence-based pain management strategies for newborns during needle-related procedures. Six single-choice questions asked the respondents' about their previous viewing of the video, previous knowledge of the three pain treatments (i.e., breastfeeding, SSC, sweet solutions), previous experience of using these treatments, future intention to use these treatments, the existence of a newborn pain management policy in the nurses' respective clinical settings, and what treatments were recommended in their policy. In addition, two free-text questions asked about the barriers to using the three pain treatments in clinical settings.

2.3. Data analysis

All quantitative data were exported to the IBM SPSS for Windows Version 25 statistical package (IBM Inc, Chicago, IL, USA) for statistical analyses. Descriptive statistics using frequencies in numbers and percentages were reported. Qualitative data (i.e., barriers) were imported into NVIVO version 12 (QSR International Ltd, Warrington, UK) and analyzed by the author (Y.Z.) using content analysis (Elo and Kyngas, 2008). The Consolidated Framework for Implementation Research (CFIR), which consists of five domains and 39 constructs, was used to guide the content analysis (Damschroder et al., 2009). CFIR is a widely used framework to identify contextual factors that could influence the implementation of evidence-based practices (Kirk et al., 2016). The data were independently analyzed by two authors (J.H. and Y.Z.) in Chinese. Any discrepancies were resolved by discussion and with mutual agreement and consensus. Then, the coded results were translated and reported in English. The frequency of each identified barrier was calculated and reported.

2.4. Ethics approval

Written consent forms to share the video to the public were provided by all the nurses and parents portrayed in the video. The research ethics board at the affiliated hospital approved this study for displaying the translated video and conducting a survey in the conferences (protocol #14/108×).

3. Results

A total of 221 nurses responded to the survey throughout six different conference presentations. These included Shanghai, May 2017 (n = 37), Hunan, June 2017 (n = 45), Shanghai, November 2018 (n = 11), Hangzhou, November 2018 (n = 75), Guangdong, November 2018 (n = 25), and Guangdong, November 2018 (n = 28).

Only 25 (11.3%) survey respondents had seen the 'BSweet2Babies' video before the conference presentations. More than half of the participants knew that breastfeeding (n = 138, 62.4%) and SSC (n = 173, 78.3%) were effective strategies to reduce newborn pain during painful procedures. However, less than half (n = 89, 40.3% knew that sweet solutions reduced newborn pain (Table 1). Ninety-seven participants (43.9%) reported they had supported parents to breastfeed during painful procedures, while 138 (62.4%) had used SSC. Only 59 (26.7%) had used sweet solutions for newborns during painful procedures. After viewing the 'BSweet2Babies' video, more than 80% of the participants were willing to use sucrose (n = 184, 83.3%) or help parents to use

Table 1
Nurses' previous knowledge, previous use and future intention regarding newborn procedural pain treatments (number of participants, %).

	Previous knowledge	Previous use	Future intent
Breastfeeding	138 (62.4)	97 (43.9)	195 (88.2)
Skin-to-skin care	173 (78.3)	138 (62.4)	205 (92.8)
Sweet solutions	89 (40.3)	59 (26.7)	184 (83.3)

breastfeeding (n = 195, 88.2%) and SSC (n = 184, 83.3%) during non-urgent painful procedures (Table 1). Only 38 participants (17%) reported that there was a procedural pain management policy for newborns in their workplace. Of these 38, 21 reported having a policy related to breastfeeding (10%), 32 for SSC (15%), and 31 for sweet solutions (14%).

Illustrated in Table 2, participants reported 18 barriers to using sweet solutions and helping parents to breastfeed or use SSC during needle-related painful procedures. These barriers were aligned with three CFIR domains (i.e., Outer setting, Inner setting, Characteristics of individuals) and 12 CFIR constructs: patient needs & resources, external policy and incentives, networks and communications, tension for change, compatibility, relative priority, goals and feedback, leadership engagement, available resources, access to knowledge and information, knowledge and beliefs about the intervention, self-efficacy.

The most frequently reported barriers to using these three strategies were that parents did not understand the importance of using pain management strategies for newborns during painful procedures and that there was no policy in hospitals or units about these strategies. Lack of training for nurses was also frequently reported in relation to using sweet solutions, and reduced work efficiency and increased workload were commonly reported to barriers to implementing breastfeeding and SSC.

4. Discussion

This unique study, conducted over a series of conference presentations in China attended by nurses, found that most nurses were aware of the evidence of analgesic effects of breastfeeding and SSC, but less than half knew that small volumes of sweet solutions reduced pain and actual use of these three strategies was inconsistent. This finding highlights a discrepancy between what nurses know and what they do for procedural pain management in neonates. The high intention of nurses in China to use breastfeeding, SSC, and sweet solutions during painful procedures after watching the 'BSweet2Babies' video is promising. Similar findings have been highlighted in studies evaluating the English and Portuguese versions of the 'BSweet2Babies' videos (Bueno et al., 2018; Harrison et al., 2017a,c ; Korki de Candido, Harrison, Ramallo Veríssimo and Bueno, 2020; Lavin Venegas et al., 2019; Vieira et al., 2020). However, the substantial number of barriers reported by nurses to using the interventions may impede these intentions. It was not possible during this study to determine whether high intentions can actually result in the consistent use of these strategies during future needle-related procedures for newborns.

Identification of contextual factors influencing the implementation of these strategies is an essential step of translating knowledge into action (Graham et al., 2006). Eighteen barriers across three CFIR domains and 12 constructs were identified both for using sweet solutions and helping parents to use breastfeeding and SSC in this current study. These findings were in accordance with a previous qualitative descriptive study exploring nurse and physician leaders' perceptions of barriers and facilitators to using evidence-based procedural pain treatments for hospitalized infants and children in the Chinese context (Hu et al., 2020).

Only 17% of participants in this survey stated that their workplace had a policy related to newborn procedural pain management. Lack of policy was also one of the most common barriers identified by participants in using the pain treatments during needle-related painful procedures in newborns. This finding is in accordance with those in the previous studies (Harrison et al., 2015; Hu et al., 2020). One of the functions of policies and guidelines in the field of evidence implementation is to guide health care providers' behavior in specific ways to optimize specified outcomes (Detrich et al., 2016). At the national or local level, health-related policies usually come in the form of guidelines or regulations (Detrich et al., 2016). Health-related policies can also be enacted at the institutional or organizational level and commonly take

Table 2
Identified barriers using the Consolidated Framework for Implementation Research.

Construct		Sweet solutions	Breastfeeding & Skin-to-skin care
1 Outer setting			
1.1	Patient needs and resources	1) Newborns do not like sweet solutions. (n = 8). 2) Parents do not like sweet solutions due to fear of sweet food addiction and teeth health (n = 15). 3) Parents do not understand the importance of using sweet solutions to reduce procedural pain in newborns (n = 37). 4) Sweet solutions are not appropriate to some specific newborns, for example, who are mechanically ventilated or who have medical orders of nothing by mouth or who have high blood sugar (n = 28).	1) Sometimes newborns do not want to be breastfed (n = 1). 2) Mothers or parents are not available (n = 27). 3) Parents do not understand why they need to be involved in medical procedures (25). 4) Parents do not understand the importance of using breastfeeding and skin-to-skin care to reduce procedural pain in newborns (n = 62). 5) Breastfeeding or skin-to-skin care is not appropriate to some specific newborns, for example, who have diseases not allowing breastfeeding or holding or who have too many lines (n = 33). 6) Parents will have complaints if they are invited to provide breastfeeding or skin-to-skin care (n = 32). 7) It is not convenient if the nurse who provides the painful procedure is male (n = 3).
1.2	External policy and incentives	/	8) There is no association recommendation (n = 4).
2 Inner setting			
2.1	Networks and communications	5) There is a lack of support from physicians (n = 2)	/
2.2	Tension for change	6) Nurses do not feel urgent to reduce procedural pain in newborns (n = 17)	9) Nurses do not feel urgent to reduce procedural pain in newborns (n = 24)
2.3	Compatibility	7) It is difficult to store sweet solutions in units (n = 1). 8) Prescription is necessary for nurses to provide sweet solutions for newborns (n = 1)	10) Some units or wards are not open to parents due to hospital infection control (n = 30). 11) It is difficult to perform painful procedures when parents are breastfeeding or holding newborns or (n = 18).
2.4	Relative priority	9) Providing successful painful procedures (i.e., venipuncture) is more important than providing sweet solutions to reduce pain during painful procedures (n = 3).	/
2.5	Goals and feedback	10) There is no policy in hospitals or units about pain management for newborns during	12) There is no policy in hospitals or units about pain management for newborns during

(continued on next page)

Table 2 (*continued*)

Construct		Sweet solutions	Breastfeeding & Skin-to-skin care
		needle-related painful procedures (n = 45).	needle-related painful procedures (n = 57).
2.6	Leadership engagement	11) There is a lack of support from the head nurse and department of nursing (n = 5).	/
2.7	Available resources	12) It is difficult to obtain or prepare sweet solutions (n = 29). 13) This practice will influence work efficiency and add workload (n = 22). 14) Two nurses are necessary to provide sweet solutions with venipuncture for blood sampling (n = 6).	13) There is no private and comfortable space in units for parents (n = 21). 14) This practice will influence work efficiency and add workload (n = 58). 15) Nurses lack effective reminder (1)
2.8	Access to knowledge and information	15) Nurses feel a lack of training (47).	16) Nurses feel a lack of training (36).
3 Characteristics of individuals			
3.1	Knowledge and beliefs about the intervention	16) Sweet solutions may cause vomiting or choking for newborns (n = 30). 17) Too much sweet solutions may not be good for newborns' health (n = 3).	17) Breastfeeding may cause vomiting or choking for newborns (n = 38).
3.2	Self-efficacy	18) Nurses are not confident in providing sweet solutions to newborns during painful procedures (n = 1).	18) Nurses are not confident in helping mothers to provide breastfeeding or parents to perform skin-to-skin to newborns during painful procedures (n = 9).

Note: n refers to number of participants.

the form of standards or protocols (Detrich et al., 2016).

As perecieved by the responding nurses in this current study, parents' low awareness of the importance of using effective strategies to reduce procedural pain in their child was another barrier in the top three list across these three pain treatments. Neonatal care is considered a partnership between health care professions and the family, and breastfeeding and SSC during painful procedures are parent-led pain treatments. Thus, it is important to account for parents' needs and perceptions. Multiple studies over many years have illustrated that parents desire to be more engaged in supporting their child during painful procedures (Adamsen et al., 2003; Franck et al., 2012; Gallagher and Franck, 2012; Marceau et al., 2012). However, recent systematic reviews illustrated that few studies addressed parent-targeted knowledge translation strategies regarding pediatric pain (Gagnon et al., 2020; McNair et al., 2020; Richardson et al., 2020). Innovative parent-targeted educational activities are warranted to enhance parents' knowledge and advocacy skills to increase involvement in neonatal procedural pain management activities, to increase the likelihood that effective pain reduction interventions will be used in the clinical setting.

Although using sweet solutions to reduce pain in neonates during needle-related procedures is considered a simple, feasible, and effective intervention that has high-quality evidence and strong recommendations, many nurses identified a lack of training as a major barrier to using this strategy. The current 'BSweet2Babies' video sucrose scenario, only showed the effectiveness of using sweet solutions for reducing procedural pain. The identified barrier may suggest a need to develop a new video introducing the detailed steps of using sweet solutions for newborns during painful procedures. This reported lack of training also highlights the importance of including neonatal procedural pain management in Chinese nursing education programs.

The reported barriers of reduced work efficiency and perceived heavy workload associated with using breastfeeding and SSC for pain management identified in this study have been reported in other studies regarding pediatric procedural pain management (Czarnecki et al., 2019; Harrison et al., 2015; Hu et al., 2020). This perceived barrier by nurses may be due to two different reasons: the complexity of coordinating interventions with parents and the limited available resources. The presence of mothers for breastfeeding or parents for SSC is necessary during painful procedures; however, parents may not be available during the early morning blood sampling or when they need to work (Harrison et al., 2015; Hu et al., 2020). Multiple supporting resources in the hospitals are also essential to reduce nurses' workload and increase their work efficiency, including the compatibility of these new interventions with existing workflows. Other knowledge translation strategies may also assist in improving the use of these analgesic strategies, such as user-friendly reminders and ergonomics instructions of performing neonatal blood sampling while breastfeeding or SSC.

5. Clinical implications

Knowledge translation initiatives are needed to facilitate the process of translating nurses' high intentions into behaviors – i.e., actual use of breastfeeding, SSC, and sweet solutions in clinical settings. The CFIR, which was used in this study, provides a comprehensive list of contextual factors influencing the successful implementation of evidence in clinical settings. The 18 barriers identified in this study can inform adoption of evidence-based neonatal procedural pain treatments into the Chinese context and advise the choice of implementation strategies that could increase the likelihood of integrating evidence into routine clinical practice.

In addition, the Expert Recommendations for Implementation Change (ERIC) has been developed and mapped to CFIR to mitigate the barriers to evidence implementation (Powell et al., 2015; Waltz et al., 2019). The CFIR-ERIC matching map can serve as an aid to researchers or health care professionals by supporting consideration of appropriate implementation strategies that might address the 18 barriers found in this current study. For example, parents' low awareness related to newborn procedural pain treatments was one of the key barriers to implementing recommended pain management strategies. According to the CFIR-ERIC matching map, seven ERIC implementation strategies are recommended to address this barrier (Powell et al., 2015; Waltz et al., 2019). The top three of these seven strategies are to obtain and use parents' feedback on neonatal procedural pain management implementation effort, to engage or involve parents in the implementation effort, to conduct local consensus discussions that address whether neonatal procedural pain is important and whether the use of breastfeeding, SSC, and sweet solutions are effective and appropriate (Powell et al., 2015; Waltz et al., 2019).

6. Limitations

In this current study, nurses attending six different conferences, where the authors (D.H and W.G.) were lecturing on pain management and implementation science, were invited to complete an online survey. The drawback of convenience sampling is the inability to know whether the survey respondents are representative of nurses in China. In addition, as the actual number of nurses attending each conference was not counted, the actual response rates are unable to be reported. In addition, to ensure the survey was brief, and feasible to be delivered online

throughout the conferences, there were no data collected on demographic characteristics or the contexts in which nurses work.

7. Conclusion

A knowledge-to-action gap for procedural pain management in neonates was identified in the study. The high intention of nurses to use and support breastfeeding, SSC, or sweet solutions for neonates during painful procedures is promising. Eighteen barriers across three CFIR domains and 12 constructs were identified. Lack of policy and parents' low awareness of the importance of reducing procedural pain were the top barriers to using sweet solutions and helping parents breastfeed or use SSC for procedural pain management in neonates. These identified barriers will inform the choice of implementation strategies that could increase the likelihood of integrating these evidence-based pain treatments into routine care.

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Declaration of competing interest

The authors disclose no conflict of interest.

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