Promotion of early breast milk expression among mothers of preterm infants in the neonatal ICU in an obstetrics and gynaecology hospital: a best practice implementation project

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ABSTRACT

Introduction: The supply of breast milk to preterm infants is low. It is important to adopt strategies to promote early, frequent and effective expression of breast milk.

Objectives: The aim of this best practice implementation project was to promote early breast milk expression among mothers of preterm infants in the neonatal ICU in an obstetrics and gynaecology hospital.

Methods: The JBI Practical Application of Clinical Evidence System and Getting Research into Practice audit and feedback tool were used in this project. Questionnaire surveys and interviews were used for baseline and follow-up audits.

Results: An overall improvement was observed after the implementation of various strategies. The compliance regarding education provided to healthcare professionals, and mothers after delivery, as well as mothers' access to breast pump increased to 100%. The compliance concerning mothers' education before delivery rose from 0 to 77%. A remarkable increase from 23 to 87% was observed for compliance related to expression of breast milk within 6 h following delivery. The compliance of expression for 8–12 times daily in the first 48 h after delivery also experienced dramatic improvement from 0 to 50%.

Conclusion: The current project has demonstrated that the implementation of evidence-based practice was effective in promotion of early breast milk expression among mothers of preterm infants in the neonatal ICU. The role of a nurse specialist in breastfeeding, involvement of multidisciplinary staff and utilization of online networking software were highlighted in this project. Future audits may be undertaken to evaluate the long-term effect of the implementation.

Key words: best practice implementation, breast milk expression, breastfeeding, preterm infant


What is known about the topic?
- The benefits of expressed breast milk for preterm infants and mothers have been identified.
- Early and frequent expression of breast milk for mothers of premature infants was important.
- Healthcare professional-led education could improve the rates of breastfeeding initiation.

What does this article add?
- The role of a nurse specialist in breastfeeding was highlighted.
- Involvement of multidisciplinary staff was important.
- Utilization of online networking software was valuable.

Introduction

Breast milk has been identified as the best source of nutrition for neonates and infants.1,2 Although breast milk can sometimes provide inadequate nutrition if provided alone, it is still recommended for preterm infants.
Preterm infants have a weaker immune system, including fewer immune cells and a less effective inflammatory response, in comparison with full-term infants. Breast milk, containing a variety of immune elements, including antimicrobial proteins, maternal leukocytes, immunoglobulins, cytokines and chemokines, oligosaccharides, gangliosides, nucleotides and long-chain polyunsaturated fatty acids, can provide preterm infants with various protective immunologic benefits. Preterm infants who are fed with breast milk tend to experience lower incidence of adverse outcomes, such as necrotizing enterocolitis (NEC), late-onset sepsis and retinopathy of prematurity. In addition to improved health outcomes, feeding preterm infants with breast milk has economic benefits secondary to the reduction of healthcare costs associated with NEC and other diseases.

Due to the vulnerability of preterm infants, especially low and very low birth weight infants, they are likely to be admitted into neonatal ICU (NICU) after birth. This means that many preterm infants are separated from their mothers, which prohibits direct breastfeeding. In China specifically, where healthcare resources are relatively limited due to the large population, mothers are usually not allowed to enter the NICU to feed their babies. In addition, the immaturity of preterm infants’ sucking skills makes direct breastfeeding challenging. In this circumstance, breast milk expression is helpful. Breast milk expression, a process to remove breast milk from the breast without an infant’s direct sucking at the mother’s nipple, has been identified as an important element of breastfeeding. Different methods of expression could be used, including hand expression, breast pumping using either an electrical pump or a hand pump, and hands-on pumping combining hand expression and breast pumping. Regardless of the means of expression, early initiation of breast milk expression in the first 6h following delivery, or sooner, has been considered to be effective in the promotion of breastfeeding and supply of breast milk to infants who are unable to be directly breastfed. Expression of breast milk also helps mothers of preterm infants feel less guilty about their premature birth, and can be regarded as a means to connect with their infants. Mothers believed that their milk can provide their infants with healing function, reducing the effects of complications and keeping their infants healthy.

Although the benefits of expressed breast milk for preterm infants and mothers have been identified, the rate of breast milk provision remains low. A cross-sectional analysis including 6997 infants in NICU in the USA indicated that the majority of very low birth weight infants (52%) were on formula milk only upon discharge, and only 6% of infants were discharged on exclusive human milk. A national representative survey in China involving 14,458 children younger than 2 years revealed that the weighted exclusive breastfeeding rate was only 18.6% for children under 6 months.

While many mothers realized that expression of breast milk was necessary to meet their infants’ feeding needs, some of them reported that pumping milk was expensive, time-consuming and unpleasant compared with direct breastfeeding. These perceptions may hinder the practice of breast milk expression. In addition, mothers who lacked knowledge about the benefits of breast milk and had an unfavourable attitude towards breastfeeding were more likely to stop breast milk expression. Another barrier to early expression was the lack of nursing time and nursing personnel to assist mothers with breast milk expression. Researchers indicated that education for family members on how to help with breast milk expression may be beneficial. A Cochrane systematic review indicated that healthcare professional-led education could improve the rates of breastfeeding initiation. Education to mothers and training to healthcare professionals have also been effective in promoting the expression of breast milk and increasing the breast milk feeding rate for preterm infants.

The Obstetrics and Gynecology Hospital of Fudan University, also known as Shanghai Red House Obstetrics & Gynecology Hospital, is the first women and children’s hospital in Shanghai, China. It has been accredited by the Baby Friendly Hospital Initiative since 1992. There are six obstetric wards with a total of 172 beds, and one NICU with around 15–25 beds in the Yangpu location of the hospital. Approximately 800 babies are born every month in the Yangpu location. Annually, there are about 350 preterm infants admitted in the NICU in the Yangpu location. These preterm infants are separated from their mothers immediately after they are born, and mothers are usually not allowed to see their babies until they are about to be discharged from the hospital. This means that direct breastfeeding is unlikely when the baby is in the hospital and therefore expression of breast milk is necessary to sustain lactation during the separation period.

Best practice recommendations for expression of milk for preterm infants (see Appendix I, http://link-s.lww.com/UEBH/A30) highlighted the importance of early and frequent expression of breast milk for mothers of newborn premature infants. They also emphasized that relevant healthcare practitioners should provide education to mothers and encourage fathers to provide practical support to their partners during breastfeeding/milk expression.
Despite the existence of best practice recommendations, the practice in a clinical setting may not adhere to the available evidence. There is evidence to suggest that the knowledge of healthcare professionals regarding breastfeeding for preterm infants was limited. Anecdotal evidence suggests that breast milk expression among mothers of pre-term infants in the Yangpu location of the Obstetrics and Gynecology Hospital of Fudan University is not ideal. Therefore, a best implementation project regarding the promotion of early breast milk expression among mothers of preterm infants in the NICU was conducted between June 2018 and October 2018.

Aim and objectives
The aim of this best practice implementation project was to promote early breast milk expression among mothers of preterm infants in the NICU in an obstetrics and gynaecology hospital, with the specific objectives stated as follows:

(1) To assess baseline compliance with evidence-based best practice regarding promotion of early breast milk expression among mothers of preterm infants in the NICU.
(2) To identify barriers and develop and implement strategies to improve compliance with best practice regarding promotion of early breast milk expression for preterm infants in the NICU.
(3) To assess the change in compliance with evidence-based best practice after implementation of strategies.

Methods
The JBI Practical Application of Clinical Evidence System (PACES) and Getting Research into Practice (GRiP) audit and feedback tool were used in this best practice implementation project. Three phases were involved:

(1) A project team was established and a baseline audit was undertaken using the JBI PACES to determine the current compliance to evidence-based practice recommendations;
(2) Barriers to compliance were identified and strategies to address these barriers were designed and implemented using the JBI GRiP framework;
(3) A follow-up audit was conducted to evaluate changes in compliance to evidence-based practice recommendations following implementation, and issues to be addressed in subsequent audits were identified.

The project was registered as a quality improvement activity within the hospital, and therefore ethical approval was not required. Written informed consent was obtained from all participants.

Phase 1: Team establishment and baseline audit
A project team was established in June 2018. The team consisted of the Director of Nursing Department of the hospital, the head nurse in charge of the whole obstetric nursing department, the head nurse of the NICU, a nurse specialist of breastfeeding who was registered as an International Board Certified Lactation Consultant (IBCLC), and two nursing researchers. A face-to-face meeting was held to plan the project, and identify audit criteria based on evidence-based recommendations, sample and methods for measuring the compliance with best practice. The criteria were based on the evidence summary and the WHO’s 10 steps to successful breastfeeding (revised 2018).

The audit criteria used in this project for both baseline and follow-up audit are shown in Table 1. The sample and methods used to measure the compliance with audit criteria are also outlined in Table 1.

The baseline audit was conducted between 2 July 2018 and 13 August 2018. In the baseline audit, documents of the hospital were reviewed for criterion 1. Healthcare professionals, including the nurses working in the obstetric wards and NICU, midwives working in the delivery rooms, and doctors working in the NICU participated for the audit of criterion 2. Mothers who delivered preterm infants (gestation <37 weeks) admitted into the NICU were recruited for the audit of criteria 3–7. Those who had diseases that prohibited breast milk expression were excluded. A convenience sample of 146 healthcare professionals and 30 mothers were chosen. Questionnaires for healthcare professionals and mothers consisting of demographic information and questions concerning the audit criteria were developed by the research team after the first team meeting. A breast milk expression diary was also designed to record the time, frequency, volume, method, and other issues relevant to breast milk expression; the diary was completed by nurses in the baseline audit and by mothers in the follow-up audit.

Phase 2: design and implementation of strategies to improve practice (Getting Research into Practice)
The project team held two face-to-face meetings during the project period to discuss the baseline audit results, identify barriers to successful implementation of best
practice recommendations, propose strategies to overcome the barriers, and determine resources required for successful implementation. A WeChat group including the team members was also established to facilitate regular communication, and online discussions were conducted when a face-to-face meeting was impossible. The barriers, strategies and resources identified were documented in GRiP; the GRiP report was shared within the project team and relevant staff to engage key stakeholders, gather opinion/feedback to facilitate the project and encourage the involvement of related healthcare professionals.

Phase 3: follow-up audit post implementation of change strategy

The same evidence-based audit criteria, sample size and methods as in the baseline audit were used in the follow-up audit, which was undertaken from 14 August 2018 to 2 September 2018. The results were shared within the project team in a face-to-face meeting.

Results

Phase 1: baseline audit

The results of the baseline audit are shown in Fig. 1. As can be seen from Fig. 1, a protocol describing the benefits of breast milk and the principles of milk expression was available and thus a 100% compliance was observed for criterion 1. For criterion 2, only 71% of healthcare professionals (n = 104) reported that they had received education about breastfeeding. For criterion 3, 0% compliance was detected; six mothers (20%) reported that although they received education during the antenatal period, no repeat sessions were provided. Most mothers (n = 26) received education in the immediate post-partum period, and thus a compliance of 87% was identified for criterion 4. Although 26 mothers were educated to use a breast pump, only 18 mothers had access to an appropriate breast pump; therefore, the compliance for criterion 5 was 60%. A compliance of 23% was achieved for criterion 6, with only seven mothers able to express breast milk within 6 h after delivery. The average time to initiate expression of breast milk was 13.43 ± 8.91 h. The compliance for criterion 7 was 0%, as none of the mothers was able to express milk 8–12 times in the first 48 h and only two mothers (6.7%) met the criterion for the second 24 h. The average number of expressions of breast milk in the first 24 h was 2.73 ± 1.82 ml, with the number increased to 4.80 ± 2.14 ml in the following 24 h.

### Table 1. Audit criteria, sample and methods used to measure compliance

<table>
<thead>
<tr>
<th>Audit criterion</th>
<th>Sample</th>
<th>Method used to measure % compliance with best practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. A protocol that describes the benefits of breast milk and the principles of milk expression is in place for all expectant mothers during the antenatal period</td>
<td>1 Protocol</td>
<td>Review of documents in the hospital to check if the protocol is available</td>
</tr>
<tr>
<td>2. Healthcare professionals involved in the care of the preterm infant have received education about breastfeeding, including strategies to successfully support early, frequent and effective expression of breast milk</td>
<td>146 Healthcare professionals (including 90 nurses, 42 midwives, 14 doctors)</td>
<td>Questionnaire survey, including demographic data and questions of whether or not education had been received, when, and how</td>
</tr>
<tr>
<td>3. Mothers of preterm infants have received education about the importance and value of breastfeeding, during the antenatal period and re-emphasized when premature delivery is likely</td>
<td>30 Mothers</td>
<td>Questionnaire survey, including demographic data and the questions of whether or not education had been received, when, and how</td>
</tr>
<tr>
<td>4. In the immediate post-partum period, mothers of pre-term infants have received detailed information and instructions about early, frequent and effective milk expression</td>
<td>30 Mothers</td>
<td>Questionnaire survey, including questions about whether or not they have received an appropriate breast pump and support about how to effectively use it</td>
</tr>
<tr>
<td>5. Mothers of preterm infants have been given access to an appropriate breast pump, including support on how to effectively use it</td>
<td>30 Mothers</td>
<td>Interview and breast milk expression diary that records time and frequency of expression</td>
</tr>
<tr>
<td>6. Mothers of preterm infants have expressed milk within 6 h following delivery</td>
<td>30 Mothers</td>
<td></td>
</tr>
<tr>
<td>7. Mothers of preterm infants have expressed milk 8 to 12 times daily in the first 48 h following delivery</td>
<td>30 Mothers</td>
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</table>
Phase 2: strategies for Getting Research into Practice

Four barriers to compliance with best practice recommendations were identified; corresponding strategies and resources were developed to address these barriers (listed in Table 2). First, healthcare professionals were found to have inadequate knowledge about breastfeeding, especially for preterm infants. Therefore, PowerPoint slides about information related to breastfeeding for preterm infants and expression of breast milk were developed by the project team and were used in the face-to-face training for relevant healthcare professionals. Three sessions of similar training were provided to healthcare professionals by the nurse specialist, and an attendance sheet was completed for each training session. Extra training sessions were provided by head nurses in each ward to those who were unable to attend the training sessions of the nurse specialist.

Second, mothers of preterm infants lacked information about breastfeeding, as many did not attend the classes during the antenatal period due to premature delivery and long distance between their houses and the hospital. In addition, the importance of breastfeeding was not regularly re-emphasized to mothers for whom premature delivery was likely. To overcome the difficulties in educating mothers during the antenatal period,
### Table 2. Getting Research into Practice matrix

<table>
<thead>
<tr>
<th>Barrier</th>
<th>Strategy</th>
<th>Resources</th>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequate knowledge of best practice:</td>
<td>(1) Three face-to-face training sessions by nurse specialist in breastfeeding and an attendance sheet was completed for each training session</td>
<td>PowerPoint slides for training</td>
<td>All relevant healthcare professionals were trained</td>
</tr>
<tr>
<td>healthcare professionals</td>
<td>(2) Provided individual training to those who did not attend the face-to-face training by head nurses in each ward</td>
<td>Education brochure for mothers</td>
<td>All mothers received education after delivery, and most received education during antenatal period and re-emphasized when delivery was likely</td>
</tr>
<tr>
<td></td>
<td>(3) Provided training resources</td>
<td>Online information notification through WeChat public account</td>
<td></td>
</tr>
<tr>
<td>Inadequate knowledge of best practice:</td>
<td>(1) Provided mothers with an education brochure specifically designed for mothers of preterm infants</td>
<td>Bilateral electric breast pump</td>
<td></td>
</tr>
<tr>
<td>mothers</td>
<td>(2) Added education about expression of breast milk for preterm infants to the antenatal classes and re-emphasized when premature delivery was likely by midwives</td>
<td></td>
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<tr>
<td></td>
<td>(3) Provided one-to-one education before and after delivery by the nurse specialist</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(4) Provided one-to-one education by nurses on duty when the nurse specialist was not available and provided re-education by the nurse specialist</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(5) Online information notification was sent to mothers before and after delivery via WeChat public account</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Some mothers did not have access to a</td>
<td>(1) Provided one bilateral electric breast pump in each ward and provided sterilization (for free)</td>
<td>Breast milk expression diary template</td>
<td>All mothers had been given access to breast pumps</td>
</tr>
<tr>
<td>breast pump, especially in the first day after delivery</td>
<td>(2) Encouraged mothers to bring the breast pump with them if available when they were admitted to the hospital</td>
<td>Syringes</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3) Provided fathers with education and encouraged fathers to support mothers</td>
<td>WeChat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(4) Provided mothers with photos when preterm infants were fed with breast milk or were provided with oral care with breast milk in the NICU, via WeChat</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(5) Asked doctors and nurses in NICU to encourage the expression of breast milk</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(6) The nurse specialist helped with expression of breast milk and transferred the breast milk to NICU twice a day if possible</td>
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</table>

NICU, neonatal ICU.
the project team designed an education brochure for mothers of preterm infants, including information about the ingredients of preterm breast milk, the benefit of breast milk for preterm infants, the expression of breast milk, and the storage and transfer of breast milk. The related information was added to antenatal classes. The relevant information was also sent to mothers via WeChat public account notification, which meant that even when mothers did not attend the antenatal classes, they had access to and were reminded to read the information online. The nurse specialist in breastfeeding provided one-to-one education before and after the delivery when the mothers were admitted in the obstetric wards. When the nurse specialist was unavailable on weekends, the nurses on duty in the wards took over the responsibility, and the mothers would be re-educated by the nurse specialist if necessary. The related information was re-emphasized by the midwives when mothers were transferred into the delivery rooms.

Third, some mothers did not have access to an appropriate breast pump, mainly because they forgot to bring the pump with them. Therefore, one bilateral electric breast pump and sterilization was provided for free in each ward and mothers were encouraged to use the pump if necessary. Mothers were also reminded to bring their breast pump when they were admitted to the hospital.

Finally, mothers lacked the support and encouragement to express breast milk when they were separated from their babies. Some strategies were adopted to motivate the mothers. A breast milk expression diary template was provided and printed to mothers for them to record the time, frequency, volume, method, and issues of each expression. Photos when preterm infants were fed with breast milk in the NICU were sent to mothers via WeChat. Fathers were also educated and encouraged to provide practical support to mothers. Doctors and nurses in the NICU were also asked to encourage the expression of breast milk. The nurse specialist helped with expression of breast milk and transferred the milk to the NICU twice a day if possible.

The tools used to collect data, and resources used for education, were all provided in Chinese language. The corresponding author can be contacted for more details.

Phase 3: follow-up audit(s)
The compliance with best practice audit criteria in follow-up audit with comparison with baseline audit is demonstrated in Fig. 2. As shown in the figure, the compliance with criterion 1 remained as 100% and the compliance with the other six criteria increased, although 100% compliance was not observed for all criteria in the follow-up audit. Specifically, the compliance with criteria 2, 4, and 5 improved to 100%, which meant that all healthcare professionals received education and all mothers were educated immediately following delivery. In addition, all mothers were able to access an appropriate breast pump and received support on how to use it.

A considerable increase from 0 to 77% was found for compliance to criterion 3. This indicated that following implementation of the best practice, 23 mothers received education during pregnancy and the information was re-emphasized when premature delivery was likely; however, there were still five mothers who were not educated during the antenatal period and another two mothers did not receive repeat information sessions before delivery. Moreover, the compliance to criterion 6 increased remarkably from 23 to 87%, indicating that in the follow-up audit, 26 mothers expressed breast milk within 6 h after delivery. The average time to the first expression of breast milk reduced significantly from 13.43 ± 8.91 to 4.90 ± 5.26 h.

In contrast to other criteria, the compliance with criterion 7 remained low, and only 50% (n = 15) of mothers were able to express 8–12 times daily in the first 48 h after the baby was born. The percentage increased to 70% (n = 21) in the second 24 h. Mothers expressed 6.77 ± 2.30 times on average in the first 24 h and the mean number of expressions increased to 7.47 ± 1.93 in the following 24 h.

In addition, the volume of breast milk expression in the first 24 h increased from 2.10 ± 5.45 to 7.72 ± 17.19 ml on average. In the following 24 h, the volume improved from 7.08 ± 12.98 to 43.77 ± 80.86 ml.

Discussion
The evidence implementation project intended to promote early expression of breast milk among mothers of preterm infants in the NICU. Following an initial audit, a series of strategies, including face-to-face counselling, online education, record of milk expression using a diary, and providing feedback to mothers using babies’ photos, were adopted to overcome the barriers identified in clinical practice. From the comparison between the baseline audit and follow-up audit, a remarkable improvement was observed in the education rate of healthcare professionals and mothers, mothers’ access to breast pumps, as well as the time and frequency of breast milk expression. The outcomes of the current project were similar to that of another JBI implementation project on the same topic that was undertaken in Australia. Using similar best practice recommendations, culture-specific strategies were utilized to improve clinical practice.
Specifically, the healthcare professionals-led education was emphasized in this project. The importance of providing education to mothers by their healthcare providers has been recognized in many studies. In this project, healthcare professionals, including nurses, midwives and doctors, were trained or retrained to provide education and support to mothers. The role of the nurse specialist in providing education about breastfeeding appeared to be critical in this project. The nurse specialist, who has the qualification of IBCLC, is armed with sufficient knowledge about breastfeeding and expression of breast milk. She has the ability and time to provide appropriate and individual education to mothers and fathers. This kind of one-to-one education was of

Figure 2. Compliance with audit criteria in follow-up audit compared with baseline audit (%).

Criteria Legend

1. A protocol that describes the benefits of breast milk and the principles of milk expression is in place for all expectant mothers during the antenatal period. (1 of 1 sample taken)

2. Healthcare professionals involved in the care of the pre-term infant have received education about breastfeeding, including strategies to successfully support early, frequent and effective expression of breast milk. (146 of 146 samples taken)

3. Mothers of pre-term infants have received education about the importance and value of breastfeeding, during the antenatal period and re-emphasised when premature delivery is likely. (30 of 30 samples taken)

4. In the immediate post-partum period, mothers of pre-term infants have received detailed information and instructions about early, frequent and effective milk expression. (30 of 30 samples taken)

5. Mothers of pre-term infants have been given access to an appropriate breast pump, including support on how to effectively use it. (30 of 30 samples taken)

6. Mothers of pre-term infants have expressed milk within six hours following delivery. (30 of 30 samples taken)

7. Mothers of pre-term infants have expressed milk 8 to 12 times daily in the first 48 hours following delivery. (30 of 30 samples taken)
The evidence suggested that women delivered by caesarean section (73% for baseline audit and 70% for follow-up audit). Caesarean section was reported to be a factor that prohibited early initiation of breastfeeding. Women delivered by caesarean section had to stay in the recovery room after delivery much longer than those who had natural delivery. This meant that it was difficult for them to express breast milk earlier. In addition, the pain caused by the wound and side effects caused by anaesthesia may make early expression of breast milk more challenging. In turn, the late initiation of expression is likely to lead to low frequency of expression. Furthermore, expressing 8–12 times daily meant that mothers had to express every 2–3 h. When babies are separated from mothers, it was more difficult for the mothers to have the motivation to express breast milk, especially during the night when mothers were having a sleep. Nonetheless, after the implementation of best practice, the frequency of expression had increased to close to eight times daily, suggesting that the strategies were effective.

There were some limitations to this project. First, the sample size of the mothers was small due to the limited time frame of the project. A further audit of larger sample size and longer time frame may be undertaken in the future. Second, this project only looked at the breast milk expression practice in the first 48 h when mothers were having a sleep. Nonetheless, after the implementation of best practice, the frequency of expression increased to close to eight times daily, suggesting that the strategies were effective.

**Conclusion**

In conclusion, this project has demonstrated that evidence-based early breast milk expression among mothers of preterm infants in the NICU can be facilitated by implementing multipronged strategies that are targeted to the identified barriers. The role of a nurse specialist in breastfeeding, involvement of multidisciplinary staff and utilization of online networking software were valuable in this project. Future audits should be undertaken to...
evaluate the long-term effect of these strategies, and involving larger sample size and longer time-frame for implementation.

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Conflicts of interest
The authors report no conflicts of interest.

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