

# Mothers' Experiences in Milk Management Out of the Hospital: a Qualitative Study

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## Research Article

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# Abstract

## Background

Human milk(HM) is important for the health and development of preterm infants. China's neonatal intensive care units have adopted a closed management system of maternal–infant separation. A prerequisite for feeding human milk to preterm infants in hospitals is to have sufficient and safe human milk. Therefore, out-of-hospital human milk management is crucial. Little is known about mothers' opinions on out-of-hospital human milk management. This study aimed to explore the experiences of Chinese mothers providing their newborns in the neonatal intensive care units with human milk expressed outside of the hospital.

## Methods

Semi-structured interviews were conducted with 23 participants who transferred their human milk to the hospital human milk bank during the hospitalization of their preterm infants. This study adopted a qualitative research approach with thematic analysis.

## Results

Three main themes were identified: 1) human milk management awareness; 2) lack of standardization regarding expressing, storing, and transporting expressed HM; and 3) external support. Theme 2 additionally has three sub-themes: I) differentiation of preparations before human milk expression; II) differentiation of devices for human milk expression; and III) insufficient knowledge and understanding.

## Conclusions

In this study, all participants who received health education showed enthusiasm for participating in out-of-hospital human milk management. However, most participants had questions during the implementation process. Medical staff should provide professional and continuous external support to support mothers in implementing HM management.

## Background

HM is the ideal food for infants [1, 2]. International health organizations, including the World Health Organization (WHO), the United Nations Children's Fund (UNICEF), the American Academy of Pediatrics, and the Japan Pediatric Society actively advocate HM feeding in NICUs to reduce the incidence of complications of preterm infants [3, 4, 5]. HM has become the preferred choice for NICU-hospitalized infants due to its benefits [6]. Breast-fed infants perform better on intelligence tests, have a lower risk of being overweight or obese, and are less likely to develop diabetes in the future [7, 8, 9]. The European Society for Paediatric Gastroenterology, Hepatology, and Nutrition also recommends that preterm formula should be used only when human milk (HM) is not available [10]. Furthermore, mothers who breastfeed also have a reduced risk of ovarian or breast cancer [11, 12]. There is increasing evidence that HM can

reduce the incidence of complications—for example, necrotizing enterocolitis—in preterm infants [13, 14, 15] and promote the establishment and development of the gut microbiome [16].

In the first three months of lactation, fresh HM (within four hours of expression) contains higher caloric, lipid and lactoferrin content than frozen HM [17]. Lactoferrin is the dominant protein in HM and has anti-inflammatory and anti-microbial activity in the neonatal gut. Therefore, the use of fresh HM is more beneficial to preterm infants [18]. In China's neonatal intensive care units (NICUs), where maternal–infant separation is implemented, priority is given to fresh HM for preterm infants who are receiving HM. However, HM is not sterile, it may also be a pathogen, causing nosocomial infections—for example, streptococcus, pseudomonas aeruginosa, and staphylococcus aureus [19, 20, 21, 22].

Environmental factors and the manner in which HM is handled can affect HM's composition [23]. During the storage and processing of expressed HM, there are risks of bacterial contamination, decreased immunological activity, and reduced nutritional potential [24]. The Sri Lankan health agency strongly recommends against the use of pumps to express human milk. One hygiene concern is that pumps are considered a potential source of harmful bacteria [25]. In a survey in Melbourne, Australia, it was found that only 54% of mothers correctly understood the information on the refrigeration times of expressed HM [25]. Improper expression can bring hidden dangers to HM safety [26].

In 2018, Chinese researchers found that most hospitals (66.0%) had no milk expression rooms, and mothers of infants could only express milk at home. Human milk was then transported to the hospital via milk storage bags or bottles for the infants. Many NICUs (81.1%) did not provide hospital-grade milk pumps or disposable milk storage bags [27]. Fresh HM received and used by NICU is managed by the infants' families in the out-of-hospital environment, including its expression, transportation, storage, and processing. This poses challenges to the HM feeding and management of hospitalized preterm infants [28, 29]. Paying attention to out-of-hospital HM management is not only positive for ensuring the quality of HM during the hospitalization of preterm infants, but it is also important for mothers who have to express HM as well as their families. There is currently no relevant research on out-of-hospital HM management.

Identifying the experiences of mothers who are conducting human milk management outside the hospital is important for providing support for the continuation of human milk expression. This study aimed to explore the experiences of Chinese mothers providing their newborns in the NICU with HM expressed outside the hospital.

## **Methods**

### **Design**

This was a descriptive qualitative study. This research design enabled us to explore the experiences of Chinese mothers providing their newborns in the NICU with human milk expressed outside of the hospital.

### **Setting**

The study was conducted in the Level 3 NICU preterm infant ward of a Baby-Friendly Hospital (full details will be provided after the manuscript has been reviewed) in China that has its own HM bank, 105 beds, and a staff of more than 100 pediatricians and nurses.

In 2017, China issued expert recommendations for the operation and management of HM banks in mainland China that included guidance for mothers' education [30]. Lactation support providers, also NICU nurses, will provide HM management education when preterm infants are admitted to the hospital.

## **Participants**

The inclusion criteria of participants were mothers whose infants were hospitalized in the NICU and were willing to express and transfer HM to the NICU. The exclusion criteria were mothers with contraindications to breastfeeding and those with mental disorders, speech disorders, and visual or hearing impairment.

In order to attempt to maximize differences and obtain the required information, purposive sampling with a maximum variation sampling strategy was used, so we tried to include participants with different situations, including but not limited to maternal age, delivery method, gestational age, infant birth weight. A total of 23 interviews were conducted, and the recruitment of participants continued until no new information was obtained.

## **Data collection**

Participants were recruited from June 2020 to November 2020. After obtaining the participants' written consent, the researcher collected baseline demographic information from the participants and conducted semi-structured, private interviews, using the interview guide and making audio recordings of the interviews. The research team comprised the principal investigator, NICU head nurse, and two doctoral students. Before commencing the study, the team members reviewed the principles of qualitative study and received systematic training in the theories of patient safety culture, aiming to establish a trusting relationship with participants and ensuring the smooth collection of data. Each participant was interviewed once. The interview guide was originally formulated by one researcher and reviewed and revised by the other two researchers, and mock interviews were conducted to limit question bias. The interviews varied from 35 minutes to 50 minutes and were conducted in a small conference room provided by the NICU human milk bank.

## **Data analysis**

The interviewer transcribed the recordings verbatim within 48 hours after the interview. A memo and reflection diary were written when necessary to adjust the next interview strategy and improve the authenticity and accuracy of the data. Thematic analysis was applied to the data. A systematic process was used to search across the dataset to identify, analyze, and report repeated patterns [31]. The data were analyzed by two researchers, who followed a six-stage analysis [32]: 1) familiarizing themselves with the data; 2) generating initial codes; 3) searching for themes; 4) reviewing themes; 5) defining and naming themes; and 6) producing the report.

The two researchers read and familiarized themselves with the transcribed text, and codes were generated for the latent and manifest content. Themes were identified among the codes (Table 1), and when there were different opinions, discussions were held until agreement was reached. After transcribing and coding 20 recordings, they agreed that theme saturation might have been reached. They conducted 3 more interviews and found that no new codes or themes appeared, thus verifying theme saturation. Peer exchanges were conducted throughout the study process to ensure the reliability of the study results. A researcher was invited to analyze the audit trail maintained by the study researchers. Two researchers participated in the entire process of data analysis. A researcher with a senior title re-conducted an independent theme review and the themes definition process; the findings were also shared with this researcher, who was invited to give feedback for validity checking.

Table 1  
Data Analysis Structure.

<b>Theme</b>	<b>Theme Definition</b>	<b>Category</b>	<b>Category Definition</b>
HM management awareness	This theme describes the participants' perceptions and attitudes toward HM management out of the hospital.	<ol style="list-style-type: none"> <li>1. Perceptions of HM management</li> <li>2. Attitudes toward HM management</li> </ol>	<ol style="list-style-type: none"> <li>1. Descriptions of objective information related to HM management</li> <li>2. Descriptions of the subjective evaluation of HM management and the resulting behavioral tendencies</li> </ol>
The lack of standardization regarding expressing, storing, and transporting expressed HM	This theme relates to the participants' experiences in expressing, storing, and transporting expressed HM.	<ol style="list-style-type: none"> <li>1. Preparations before HM expression</li> <li>2. Devices for expressing HM</li> <li>3. Knowledge and understanding</li> </ol>	<ol style="list-style-type: none"> <li>1. Descriptions of cleaning and preparation before HM expression</li> <li>2. Descriptions of milk expression equipment and milk storage devices</li> <li>3. Descriptions of any knowledge related to the HM management process</li> </ol>
External support	This theme describes the sources of support and need for more external support	<ol style="list-style-type: none"> <li>1. Descriptions of the sources of external support</li> <li>2. Descriptions of hoping to receive more external support</li> </ol>	<ol style="list-style-type: none"> <li>1. Descriptions of sources that provided helpful information or action</li> <li>2. Descriptions of desired information and action</li> </ol>

## Ethics

The study was approved by the ethics committee (full details will be provided after the manuscript has been reviewed). Participation in the study was voluntary. The head nurse of the NICU checked the information of preterm infants and their mothers upon hospital admission to screen the mothers' eligibility and then provided details about the study to the mothers. The researcher provided a full explanation to the potential participants after obtaining mothers' consent through their provision of their contact information to the researcher. All information provided by the participants to the researcher were stored on an encrypted hard disk, which was placed in a safe, separate location. All names in the study were pseudonyms.

## Results

A total of 23 participants (labeled A–W), aged 24–42, participated in the study, and the gestational age of preterm infants ranged from 29<sup>+3</sup> weeks to 35<sup>+5</sup> weeks. The demographic characteristics of participants and preterm infants were shown in Tables 2 and 3.

Table 2  
Demographic Characteristics of Participants (N = 23)

<b>Characteristic</b>	<b>n (%)</b>
Maternal age	
≤ 30 years	10 (43.5%)
31–35 years	7 (30.4%)
36 – 40 years	4 (17.4%)
> 40 years	2 (8.7%)
Delivery mode	
Caesarean	17 (73.9%)
Vaginal	6 (26.1%)
Parity	
First	13 (56.5%)
Second	7 (30.5%)
≥ Third	3 (13.0%)
Place of residence	
Village/town	5 (21.7%)
City	18 (78.3%)
Educational level	
High school	1 (4.3%)
Postsecondary qualification	6 (26.1%)
Bachelor’s degree or above	16 (69.6%)
Note. None of the participants had a Grade 9 or lower education.	

Table 3  
Demographic Characteristics of Participants' infants (N = 25)

Characteristic	n (%)
Gestational age	
≤ 30 weeks	2 (8.0%)
30 <sup>+</sup> 1 – 32 weeks	6 (24.0%)
32 <sup>+</sup> 1 – 34 weeks	14 (56.0%)
> 34 weeks	3 (12%)
Birth weight of infants	
≤ 1500g	6 (24.0%)
1501–2000g	16 (64.0%)
> 2000g	3 (12.0%)
Singleton/ Multiparity	
Singleton	21 (84.0%)
Multiparity	4 (16.0%)
Note. N = 25 infants due to two multiple births.	

Three main themes regarding out-of-hospital HM management were identified: 1) HM management awareness; 2) the lack of standardization regarding expressing, storing, and transporting expressed HM; and 3) external support.

### Theme 1: HM management awareness

All participants said that they recognized that HM is the most ideal food for infants. They indicated their willingness to “do the best” to provide HM for their infants. Preterm infants are separated from their mothers after birth, which has a certain impact on mothers providing HM—for example, delayed lactogenesis and having difficulties in initiating and maintaining adequate milk production [33,34].

Two participants described the increased awareness of HM expression as follows:

*“I had never wanted to breastfeed. This is not because the baby is hospitalized. I heard from the doctors and nurses that the colostrum is particularly good. The human milk for the seven days before the birth of the baby is colostrum. I want to feed the colostrum to my baby. I hope the baby will recover faster.” (H)*

*“At first, I didn't want to provide human milk. It was too troublesome, but the mothers in the WeChat group said that human milk is good. If we have any questions we don't understand, just ask in the group and see what others do. Then I started collecting and providing human milk.” (D)*

## **Theme 2: Lack of standardization regarding expressing, storing, and transporting expressed HM**

Many participants experienced a lack of standardization in the implementation of expressing, storing, and transporting expressed HM.

### ***Sub-theme I: Differentiation of preparations before HM expression***

All participants knew that they needed to conduct self-cleaning and breast pump-cleaning before expressing HM, but their processes differed. Some participants mentioned how they conduct self-cleaning.

*“I wash my hands every time before expression, sometimes with tap water, sometimes with soap.” (F).*

*“Sometimes my breasts are wiped with water, sometimes not.” (D)*

*“I do some cleaning work first, wash my hands and wipe the nipples with the ethanol cotton ball bought from a pharmacy, and then wipe it with clean water.” (M)*

Some participants mentioned how they conduct equipment-cleaning.

*“I sterilize the breast pump with a sterilizer.” (P).*

*“I sterilize the breast pump in boiling water.” (E)*

### ***Sub-theme II: Differentiation of devices for expressing HM***

The NICU ward and HM bank did not provide mothers with HM expression devices. All participants had to purchase milk expression equipment, complete HM expression at home, and then transfer the expressed HM to the hospital for use by the infant. Participants often chose breast pumps and milk storage devices based on their personal needs.

*“I bought a single-sided breast pump, and I don't need to use my hands to express milk. Manually, it is too inconvenient. The electric frequency can also be adjusted. It is more convenient and flexible to use.” (L)*

*“I chose a bilateral breast pump, otherwise it's a pity that I'm expressing one side while the other is idle. Milking both breasts at the same time, how fast.” (S)*

### ***Sub-theme III: Insufficient knowledge and understanding.***

Several participants did not have much knowledge about HM expression—for example, not knowing when milk collection starts:

*"I don't know when to start the expression or collection. I didn't have human milk and couldn't express milk for the first two or three days. I waited until the fourth day when I felt a little swelling in my breasts before I started expression." (T)*

Their knowledge about the frequency of milk expression was insufficient, and one participant did not express milk at night and another participant suspended expressing in the first few days.

*"I usually collect six times a day, about 15 minutes at a time. I don't collect human milk at night because I don't feel bloated." (L)*

*"My breasts didn't feel 'full' and I could express a little milk in the first few days, but then I lost milk. I stopped expressing milk." (A)*

Participants were not sure whether their own management measures could guarantee the quality of their milk.

*"I put the human milk in a plastic bag with some ice cubes in it. My home is next to the hospital. Just send it over, there should be no problem." (T).*

*"Based on the hospital's request, I bought the milk storage bag, but after the milk storage bag was filled with human milk, the air was not expelled. No one told me what to do, and I don't know if this is feasible." (H)*

### **Theme 3: External support**

Participants expected to receive professional guidance and help from medical staff to maintain HM management awareness and enhance human milk management practices.

*"I don't know what kind of human milk storage bag is suitable, where to buy it, how long can human milk be stored, and I don't know if the baby will have other problems with this kind of human milk. I just do it depending on what others do, but I still hope to get professional guidance." (Q)*

Participants received education on out-of-hospital HM management mainly from hospitals, the Internet, books, and communication among themselves.

*"After I had a baby, the nurse told me what to do. I also bought a few baby-care books to read. Occasionally I encounter problems I don't know, I just Baidu (a search engine commonly used in China) it." (E)*

In China, the first month after giving birth is known as the *sitting month*; it is usually recommended that women stay in bed for the majority of this period. Due to this traditional custom, participants needed support from family members with their HM management.

*"I want to transfer human milk, but my home is really far away from hospital. It took several bus rides back and forth to get to the hospital, and my family members are very busy. I am 'sitting the month' at home and can only deliver it occasionally, and I hope someone in the family can help me deliver human milk regularly." (M)*

## Discussion

This study explored how mothers manage HM out of the hospital, which revealed their ideas on management through three themes. Australian researchers found that the surface temperature of refrigerated fresh HM transferred to the NICU was higher than the temperature (1°C–4°C) recommended by the hospital, and some mothers did not put refrigerated HM in insulated food containers, resulting in the temperature of these samples of HM being higher than the temperature in the insulated food container [25]. Changes in temperature may reduce the biologically active factors as well as the nutritional and microbiological value of fresh HM [35, 36]. At least 52% of mothers had at least one stage of ineffective sterilization of breast pump collection kits [37]. This may increase the potential risk of bacterial contamination of the breast pump [26].

The main information for 22% of mothers comes from unofficial sources—for example, websites—and these resources may not recommend the same methods as the official guidelines [25]. The Internet and peer instruction were also other important sources of knowledge for participants in this study, but the scientific nature of the information from these channels was not certain. Participants expressed their desire to receive more guidance from the hospital and help from family members to ensure the smooth implementation of HM management. This caused concerns, especially for those participants who wished to provide fresh HM to their preterm infants.

Guidance on HM management was provided by NICU nurses, the participants indicated that they received this guidance when their infants were admitted to NICU. Researchers of this study found that just having guidelines, or even educating mothers, did not guarantee that the recommendations were well communicated and implemented, indicating that only conducting out-of-hospital HM management education on admission was insufficient. We further found through our qualitative research approach that participants hope to receive more guidance from the hospital and help from their families to maintain the awareness of HM management and ensure its smooth implementation.

This expectation of lactation support should be better met to ensure that every mother receives accurate, comprehensive, evidence-based lactation support while separated from their infant. Using evidence-based science about human milk and disseminating this information to mothers and their families should become an established institutional culture. Continuous health education and supporting measures should be promoted. For example, a record book in the format of a collection diary can be provided to the mothers of preterm infants to help them regulate the frequency and volume of HM expression. The content of the record should include expression date, expression method, HM volume of each breast, and expression duration. The curriculum content of prenatal classes focuses on pregnant women who give

natural birth and on newborns. The breastfeeding chapter outlines methods to promote breastfeeding through contact between mother and infant. There are still deficiencies in the content with regard to out-of-hospital HM management, which can be added to prenatal education. Moreover, providing information on the importance of HM management after delivery should continue.

The presence of lactation support providers in the NICU increased the number of direct breastfeeding sessions on the day of discharge. Moreover, the breastfeeding rate after discharge from the hospital has been positively correlated with the participation of International Board-Certified Lactation Consultant (IBCLC) support [38]. More well-trained staff—for example, NICU nurses and IBCLCs—could continue to provide mothers and families with conflict-free (suggestions and appropriate advice and may improve the situation, which has a positive effect on maintaining breastfeeding. The type of guidance could be diversified, and services could be provided until the mother fully understands the information or no longer needs it.

### **Study limitations**

Although a maximum variation sampling strategy was used in this study, this study was only conducted in one NICU in China. Participants in this study were not fully representative of the general population, which may impact the generalizability of the study results. In addition, a single interview was conducted with each participant. Deeper and broader experiences might be shared if there were opportunities to establish a more trusting relationship between the participants and the researchers.

## **Conclusion**

In conclusion, this study showed that many mothers had questions about the implementation of out-of-hospital HM management and would welcome professional advice and guidance. These findings suggest the necessity of providing continuous out-of-hospital HM management guidance and providing direction for revising and developing current health education.

## **Abbreviations**

**HM:** Human milk

**WHO:** World Health Organisation

**NICU:** Neonatal Intensive Care

**UNICEF:** United Nations Children's Fund

**IBCLC:** International Board-Certified Lactation Consultant

## **Declarations**

## Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

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This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

## Contributions

RY: Study design, data collection, data interpretation, data analysis and major contributor in drafting the manuscript. DQC: Study design, data collection, data interpretation and data analysis. HW: Data collection and data analysis. XFX: Study design and critically revised the manuscript. All authors have read and approved the manuscript.

## Ethics declarations

### Ethics approval and consent to participate

This study was approved by ethics committee (full details will be provided after the manuscript has been reviewed). All participants were provided study information prior giving oral and written informed consent

### Consent for publication

Not applicable.

### Competing interests

The authors declare that they have no conflicts of interest.

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### Data sharing statement

No additional unpublished data are available.

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