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Review Article

Breaking the Stigma: Normalizing Human Milk Donation and Banking

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A B S T R A C T

Breastmilk is universally acknowledged as the optimal source of nutrition for infants, offering essential nutrients and immunological protection, particularly for preterm and low birth weight infants. In situations where a mother's own milk is unavailable, pasteurized donor human milk (PDHM) is the recommended alternative, highlighting the critical role of Human Milk Banks (HMBs). These banks systematically collect, screen, pasteurize, and distribute breast milk from healthy donors to meet the nutritional needs of vulnerable neonates. In India, where neonatal mortality and morbidity are high due to the large population of low-birth-weight infants, the establishment and expansion of HMBs, including government-led initiatives like the Amrutha Hare Human Milk Bank in Karnataka, mark significant progress. Despite these advancements, awareness and acceptance of human milk banking remain limited among mothers and healthcare providers, often due to cultural and informational barriers. Globally, over 700 HMBs operate, yet disparities in access and a lack of standardized guidelines persist, especially in low- and middle-income countries. The future of human milk banking lies in improving awareness, standardizing practices, integrating technologies, and expanding accessibility. With growing recognition of its benefits and increased institutional support, HMBs are poised to play a transformative role in neonatal healthcare and child survival strategies worldwide.

Keywords: Human Milk Bank (HMB), Donor Human Milk (DHM), Pasteurized Donor Human Milk (PDHM), Breastfeeding, Neonatal Nutrition, Infant Feeding

Introduction

Breastmilk is the ideal food for infants. It is safe, clean and contains antibodies which help protect against many common childhood illnesses. Breastmilk provides all the energy and nutrients that the infant needs for the first months of life, and it continues to provide up to half or more of a child's nutritional needs during the second half of the first year, and up to one third during the second year of life.[1]

All mothers should be encouraged to breast-feed their infants. When a mother, for some reason, is unable to feed her infant directly, her breastmilk should be expressed and fed to the infant. If mother's own milk is unavailable or insufficient, the next best option is to use pasteurized donor human milk (PDHM). India faces its own unique challenges, having the highest number of low-birth-weight babies, and significant mortality and morbidity in very low birth weight (VLBW) population.[2] A human milk bank is a centre to collect, screen, test, and store donor milk

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collected from healthy lactating mothers. The primary objective of a human milk bank is to make sure that every baby receives human milk as early as possible, especially those who are born weak.[3]

Human milk banking is a growing field in India, with several centres (also known as Comprehensive Lactation Management Centres - CLMCs) operating across the country. The Human Milk Banking Association of India is a national network of healthcare providers working to advance the field of human milk banking in India.[4] Asia's first human milk bank was established at SION hospital in Mumbai on November 27, 1989 by Dr. Armida Fernandez, the pioneer of milk banking in India. Approximately 3000 to 5000 newborns receive assistance from this milk bank annually.

History of Human Milk Banking

Mother's milk is the optimal nutrition for infants, and when unavailable, supplemental donor human milk is preferred, especially for low birthweight infants to reduce morbidity. Human milk banking has a long history, but faced setbacks in the 1980s due to HIV concerns. Recently, with improved safety, the use of donor human milk has surged.[5] Various countries and organizations have published guidelines for milk banking, emphasizing quality control measures such as donor screening, safe collection, transport, storage, pasteurization, and testing. Operational aspects, including staff training and equipment maintenance, are also crucial. While there is a consensus on these measures, adaptations are needed for low- and middle-income countries to avoid making milk banking prohibitive.[6]

Moro, 2018 The practice of donor human milk banking has its roots in ancient wet nursing, with regulations dating back to the Babylonian Code of Hammurabi and Greco-Roman texts emphasizing the importance of selecting wet nurses. By the 11th century, wet nursing was prevalent among European aristocracy, while breastfeeding was viewed negatively. The infant mortality rate in 18th century Paris was high, with most infants relying on wet nurses. However, concerns about the morality of wet nurses and the introduction of alternative milk sources led to a decline in this practice in the 19th century. Theodor Escherich's studies in the early 20th century highlighted the benefits of breastfeeding, leading to the establishment of the first human milk bank in Vienna in 1909, followed by others in the U.S. and Europe. In 1980, WHO and UNICEF endorsed human donor milk as a primary alternative for infants whose mothers cannot breastfeed, prompting the formation of regulations for milk banks.[7]

Importance of Human Milk Banks

Human milk banking is a vital process that involves the systematic collection, meticulous screening, and careful pasteurization of breast milk, intended for use in hospitals or by mothers who are unable to breastfeed their infants. Human milk is widely regarded as the optimal source of nutrition for newborns, particularly for those who are preterm, have low birth weight, or are battling health challenges. It is especially crucial for vulnerable infants in neonatal intensive care units (NICUs), where the need for specialized nutrition is paramount.

While pasteurized donor breast milk serves as a valuable alternative, it is essential to acknowledge that it differs significantly from fresh breast milk in terms of its bioactive and immunological properties. The pasteurization process, while necessary to ensure safety and eliminate pathogens, can diminish certain beneficial components that contribute to the milk's protective effects. Human breast milk is rich in immunoglobulins and other bioactive constituents that play a critical role in bolstering an infant's immune system, reducing the risk of infections, and lowering the incidence of conditions such as necrotizing enterocolitis, cardiovascular diseases, and metabolic disorders.

In scenarios where a mother's own breast milk is not available, donor breast milk emerges as the second-best option. The promotion of breastfeeding and the establishment of donor milk banks are interconnected efforts aimed at enhancing infant nutrition. Providing accurate information and support to mothers about breastfeeding can significantly improve breastfeeding rates, thereby reducing neonatal mortality and morbidity on a global scale.

The primary consumers of human breast milk are premature infants, who often require this specialized nutrition to thrive. Additionally, infants with gastrointestinal or metabolic disorders may also benefit from donor breast milk. In cases where a mother is unable to produce her own milk, human breast milk serves as a crucial substitute for formula, ensuring that infants receive the essential nutrients they need for healthy development. Furthermore, human breast milk can also be administered to toddlers and children facing medical challenges, such as those undergoing chemotherapy for cancer or experiencing growth failure while on formula, highlighting its versatility and importance in paediatric care.[8]

The Global Status of Human Milk Banking

Human milk banking (HMB) is an increasingly recognized public health intervention aimed at providing pasteurized donor human milk to infants who lack access to their mother's milk, especially preterm, low birth weight, or medically fragile newborns. Over the past several decades, the practice of human milk banking has expanded significantly across continents, but its development, distribution, and regulation vary widely worldwide.

Historical and Regional Development

Human milk banking has its origins in the early 20th century, with the first milk banks established in Europe and North America. Currently, milk banks are most established in high-income countries, including the United States, Canada, and many European nations. For example, the Human Milk Banking Association of North America (HMBANA) oversees more than 30 milk banks across the U.S. and Canada.[1]

In Europe, countries like Italy, Germany, and Spain have well-organized milk bank networks integrated with national health systems. Australia and New Zealand also have established milk banks that serve neonatal intensive care units (NICUs).

Status in Low- and Middle-Income Countries (LMICs)

In contrast, many low- and middle-income countries have been slower to develop human milk banking infrastructure. However, recent years have seen growing interest and establishment of milk banks in countries such as India, Brazil, South Africa, Kenya, and China.

India has made significant strides, with over 30 milk banks across various states. The Government of India actively promotes donor milk banks as part of its national nutrition programs.

Brazil is a global leader in milk banking with a network of more than 200 milk banks coordinated through its national health system. Brazil's model is often cited as exemplary for integrating milk banks into public health.

South Africa and Kenya have also developed milk banks to support preterm infants, often linked with HIV prevention programs.[2]

However, many LMICs still face challenges such as lack of funding, infrastructure, trained personnel, and cultural barriers to milk donation.

Scale and Accessibility

Globally, there are estimated to be over 700 milk banks operational, but the distribution is uneven. The World Health Organization (WHO) and United Nations International Children's Emergency Fund (UNICEF) advocate for expanding milk banking as part of newborn care strategies.[3]

Access to donor milk remains limited in many rural or resource-poor areas, where infrastructure for collection, pasteurization, storage, and distribution is inadequate. Moreover, affordability and sustainability pose significant hurdles.

Regulation and Quality Standards

Countries vary in regulatory frameworks governing human milk banking. Some, like the U.S. and parts of Europe, have well-established guidelines covering donor screening, milk handling, and safety protocols.[4]

In contrast, many countries lack formal regulation, leading to variability in safety and quality. International bodies, including the Human Milk Banking Association of North America (HMBANA), European Milk Banking Association (EMBA), and the Global Milk Bank Network, work toward harmonizing standards.

Challenges and Barriers

- **Cultural and Social Factors:** Stigma and misconceptions about milk donation persist in many cultures, hindering donor recruitment.
- **Infrastructure and Logistics:** Lack of adequate refrigeration, transportation, and pasteurization equipment restricts operations.
- **Funding and Policy Support:** Insufficient government funding and absence of national policies limit expansion.
- **Awareness and Education:** Low awareness among health professionals and communities about the benefits of donor milk remains a challenge.[5]

Current Trends and Innovations

Increasing incorporation of milk banks into neonatal care guidelines globally.

Growing use of technology to improve donor screening and milk tracking.

Development of milk bank networks and sharing platforms to optimize supply.

Emphasis on community engagement to boost donor recruitment.

Knowledge of human milk banking

The knowledge of postnatal mothers regarding human milk banking is notably limited across various studies. Research indicates that a significant proportion of mothers possess poor to average knowledge about human milk banks, which are essential for providing donor milk to infants in need. This lack of awareness is compounded by cultural and safety concerns, affecting both the willingness to donate and accept donor milk. The following sections elaborate on key findings from the studies.

According to Archana, 2024 Human milk banks are essential for providing pasteurized donor milk to newborns, particularly those who cannot receive it from their mothers, thus promoting better nutrition and health for vulnerable infants. A study was conducted in Bangalore in 2024 to assess the knowledge of human milk banking among 204 nurses. The study revealed that 51.47% of participants were female, with a majority aged 31 and above. Most nurses were undergraduates, and many had 1-5 years of experience. The results indicated that 44.60% of the nurses had no awareness of human milk banking, while 50.98% had good knowledge about it. The study concluded that only half of the participants possessed good knowledge,

suggesting the need for further multicentre studies to explore this topic.[10]

Chauhan, 2022 A human milk bank is a service that collects, screens, processes, and dispenses donated human milk for infants. This study aimed to assess postnatal mothers' knowledge and attitudes towards human milk banking using a descriptive non-experimental design with 100 participants selected through purposive sampling. Results indicated that 48% of mothers had poor knowledge, 35% had average knowledge, and 17% had good knowledge about human milk banking. Additionally, 40% exhibited an unfavourable attitude. Significant associations were found between demographic variables (age and religion) and knowledge, as well as education and attitude, but not with other factors like occupation or family type. The conclusion emphasizes the need for health professionals to promote breastfeeding and increase awareness of human milk banking among mothers.[11]

A descriptive study assessed mothers' knowledge regarding Human Milk Banking, involving 60 mothers selected through purposive sampling at the Government Medical College and Hospital in Chandigarh. Data was collected using a reliable self-structured questionnaire, validated by experts. Results indicated that 48% of mothers had average knowledge, 40% had poor knowledge, and only 12% had good knowledge. The study found a statistically significant relationship between mothers' educational status and their knowledge level, while age, religion, source of knowledge, and participation showed no significant association. Education, occupation, and family income were statistically significant factors influencing knowledge levels.[12]

A human milk bank collects, screens, processes, stores, and distributes donated human milk. The study aimed to assess the knowledge and attitudes of postnatal lactating mothers regarding human milk banking and to explore biases about donating and accepting pasteurized breast milk. Conducted at YMCH hospital, the cross-sectional study surveyed 150 postnatal mothers using a pretested questionnaire. Results showed that most mothers, including those with NICU babies, were unwilling to donate or accept breast milk due to cultural and religious beliefs. Only 6.7% had heard of human milk banks, and just 17.3% believed they were necessary. The conclusion highlights a significant lack of awareness about human milk banking and a preference for formula milk over donor breast milk due to insufficient knowledge of its importance.[13]

Processing of Human milk

The processing of human milk in milk banks is crucial for ensuring the safety and nutritional quality of donor human milk (DHM) for vulnerable infants, particularly preterm babies. The primary method employed is Holder pasteurization (HoP), which, while effective in eliminating pathogens, can compromise some bioactive components of the milk. Recent advancements in processing techniques aim to enhance the preservation of these vital nutrients while maintaining safety standards.

Milk delivered to Human Milk Banks (HMBs) should be pasteurized to inactivate viral and bacterial agents. Currently, a pasteurization process at 62.5°C for 30 min (Holder pasteurization, HoP) is recommended in all international HMBs guidelines. Studies have demonstrated that temperature cycle in HoP is not always controlled or calibrated. The most studied processing techniques include High-Temperature-Short-Time (HTST) pasteurization, High Pressure Processing (HPP), and Ultraviolet-C (UV-C) irradiation. HTST is a thermal process in which milk is forced between plates or pipes that are heated on the outside by hot water at a temperature of 72°C for 5-15 s. HPP is a non-thermal processing method that can be applied to solid and liquid foods. This technology inactivates pathogenic microorganisms by applying a high hydrostatic pressure (usually 300-800 MPa) during short-term treatments (<5-10 min). UV irradiation utilizes short-wavelength ultraviolet radiation in the UV-C region (200-280 nm), which is harmful to microorganisms. It is effective in destroying the nucleic acids in these organisms, so that their DNA is disrupted by UV radiation.[8]

Future of human milk banking

Human milk banking—the collection, screening, processing, and distribution of donor human milk—has gained significant recognition as a vital intervention to support the health and nutrition of vulnerable infants, especially preterm and low birth weight babies. The future of human milk banking is promising, shaped by advances in technology, expanding global networks, evolving policies, and increasing awareness of the benefits of donor milk.

Expansion and Global Integration

As evidence grows about the critical role of human milk in infant health, especially in reducing necrotizing enterocolitis (NEC), infections, and improving neurodevelopmental outcomes, the demand for donor milk is rising worldwide. The future will likely see expanded milk bank networks in low- and middle-income countries, improving equitable access to safe donor milk globally. International collaborations and standardized guidelines from organizations like the Human Milk Banking Association of North America (HMBANA) and the European Milk Banking Association (EMBA) will facilitate harmonization of quality standards.

Technological Innovations

Emerging technologies will enhance every stage of milk banking, from collection to pasteurization and storage. Novel pasteurization methods—such as high-temperature short-time (HTST) pasteurization and ultraviolet (UV)

treatment—may better preserve the nutritional and immunological qualities of donor milk compared to traditional Holder pasteurization.

Advances in microbiological screening, including rapid molecular testing, will improve the safety and traceability of donor milk. Additionally, digital platforms and blockchain technology can enhance transparency, donor tracking, and inventory management in milk banks.

Personalized Nutrition and Milk Fortification

Research into human milk composition is advancing, revealing variability based on maternal factors and infant needs. Future milk banking may incorporate personalized nutrition approaches by analyzing milk nutrient profiles and fortifying donor milk to meet the specific requirements of preterm or medically fragile infants. This precision approach could optimize growth and development outcomes.

Integration with Neonatal and Maternal Care

Human milk banks will increasingly be integrated into comprehensive maternal and neonatal healthcare systems, linking breastfeeding support, lactation counseling, and donor milk provision. This holistic approach ensures donor milk complements and encourages mother's own milk feeding rather than replacing it.

Policy Development and Advocacy

With growing evidence, more countries will develop national policies and regulatory frameworks to support human milk banking infrastructure and quality assurance. Governments and global health organizations are expected to advocate for donor milk use as part of neonatal nutrition strategies, particularly in resource-limited settings.

Community Engagement and Ethical Considerations

Sustaining milk donation requires community awareness, education, and trust. Future human milk banking initiatives will emphasize culturally sensitive outreach and ethical guidelines addressing donor consent, equitable distribution, and prioritization criteria for donor milk recipients.

Research and Innovation

Ongoing research into the bioactive components of human milk and their health effects will continue to inform milk banking practices. Innovations such as bioengineering human milk substitutes or synthesizing key immunological components might complement donor milk in the future, though natural human milk will remain the gold standard.

Global Expansion and Accessibility

Human milk banking supports infant nutrition and health benefits. Global standards for HMB operations are lacking, causing quality variations. Human milk banking plays a crucial role in promoting infant health, but the lack of awareness and misconceptions surrounding it can hinder its effectiveness. Educational initiatives are essential to improve knowledge among mothers and to address cultural and religious concerns regarding the acceptance of donor breast milk.

Human milk is crucial for infant nutrition and offers health benefits for both infants and mothers. When a mother's milk is unavailable, the World Health Organization recommends donor human milk (DHM) from human milk banks (HMBs). HMBs are responsible for screening donors, collecting, processing, storing, and distributing DHM. Since the establishment of the first HMB in 1909, over 700 have emerged worldwide, although gaps exist in regions like South Asia and Africa, and there are no global operational standards. Variations in community needs and resources lead to inconsistencies in DHM quality and HMB operations. The paper discusses the current state of human milk banking, suggests an interdisciplinary framework for HMB integration into health systems, identifies sustainability factors, outlines barriers to HMB expansion, and emphasizes the need for global guidance and standards to enhance newborn health.[14]

Standardization and Best Practices in Human Milk Banking

To ensure the safety, quality, and efficacy of donor human milk, global and national milk banks adhere to stringent protocols that encompass every step—from donor recruitment to milk distribution. The following are recognized best practices:

Donor Screening and Selection

Comprehensive screening of donors includes medical history, lifestyle factors, and serological testing to prevent transmission of infectious diseases (e.g., HIV, Hepatitis B and C, syphilis). Regular reassessment of donors helps maintain ongoing safety.

Milk Collection and Handling

Donors are educated on hygienic milk expression and storage techniques. Use of sterile containers and adherence to cold chain protocols during transportation and storage minimize contamination risk.

Processing and Pasteurization

Holder pasteurization (62.5°C for 30 minutes) is the widely accepted method to inactivate pathogens while preserving many bioactive components. Emerging technologies like HTST and UV treatment are being explored to improve nutrient retention.

Quality Control and Microbiological Testing

Post-pasteurization samples are routinely tested for microbial contamination. Milk not meeting safety criteria is

discarded. Traceability systems ensure each batch can be tracked back to donors.

Storage and Distribution

Milk is stored frozen (-20°C or lower) to maintain quality and distributed based on prioritized medical need, typically starting with preterm or sick infants.

Staff Training and Facility Standards

Personnel undergo continuous training, and milk bank facilities maintain hygiene and operational standards accredited by relevant regulatory bodies.

These standards are codified by organizations such as the Human Milk Banking Association of North America (HMBANA), the European Milk Banking Association (EMBA), and the International Milk Banking Initiative, fostering consistency and trust in milk banking practices worldwide.

Technological Integration

The future of human milk banking in India appears promising, with increasing acceptance in urban centres, addressing malnutrition and infant mortality, and potential for business development, despite challenges in donor recruitment and socio-cultural barriers.

Donated Human Milk Banking is emerging as a significant topic in healthcare management, presenting business development opportunities in developing countries. A Human Milk Bank is defined as a service that recruits breast milk donors, processes, screens, stores, and distributes milk to meet infants' health needs. While such practices date back to the early 2000s, private sector human milk banking has recently gained popularity. Historically, human milk banks existed in the USA during the 1990s but faced challenges due to the rise of specialty formulas, safety concerns regarding viral transmission, and insufficient clinical research. Recent advancements in clinical studies and collaboration with health authorities have improved public perception, fostering a favourable environment for private sector human milk banking. [16]

Conclusion

The primary and by far the largest group of consumers of human breast milk are premature babies. Infants with gastrointestinal disorders or metabolic disorders may also consume this form of milk as well. Human breast milk acts as a substitute, instead of formula, when a mother cannot provide her own milk. Human breast milk can also be fed to toddlers and children with medical conditions that include but are not limited to chemotherapy for cancer and growth failure while on formula.[17] HMBs have been associated with a significant decrease in conditions like necrotizing enterocolitis (NEC) and sepsis among neonates. For instance, one study reported a reduction in NEC from 9.4% to 1.76% after the establishment of an HMB. Mortality rates also declined, with one study noting a decrease from 30.2% to 19.5% in neonatal deaths post-HMB implementation. The rate of exclusive breastfeeding at discharge improved significantly, from 30.2% to 72.6%.[18] HMBs are considered a cost-effective solution for providing donor human milk, especially in developing countries, where they can significantly improve neonatal care.[19] While the benefits of HMBs are well-documented, challenges remain, such as the need for increased awareness and education among healthcare workers regarding the donation process and the importance of HMBs.[20] Addressing these issues can further enhance the effectiveness of human milk banking initiatives.

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