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LACTACARE-RESOLVING CULTURAL BARRIERS AND SYSTEM FRAGMENTATION IN HUMAN MILK BANKING

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Abstract
Breast milk provides essential nutrition to premature and low-birth-weight infants because it delivers life-saving protection against serious infections and other medical problems. India faces a human milk banking system challenge because the country experiences more than 3.5 million preterm births yearly while milk banks operate through decentralized manual systems of which 90 banks function throughout India. The current system causes delays in providing donor milk which affects 30 to 50 percent of newborns who require advanced neonatal care thus creating a critical supply-demand imbalance. The low utilization of milk banks in India is further linked to several social and systemic challenges which include limited public awareness and cultural beliefs about milk donation and weak healthcare infrastructure and lack of strong policy support and low community participation. The current situation requires more than building physical facilities because it needs comprehensive policy reinforcement together with improved hospital systems and public awareness initiatives which promote donation and support newborn health. The study presents LactaCare as a digital platform which connects all milk banking activities throughout the country. The platform enables donor registration, medical screening, appointment booking, and real-time tracking of milk collection and distribution. LactaCare ensures clear traceability from donation to delivery and assigns milk based on medical urgency. The system enables users to make voluntary financial donations which help to build stronger milk banks instead of depending on government funds. The implementation of a digital system through LactaCare will replace existing paper-based processes and provide two primary benefits which include faster decision-making and decreased operational costs while enabling future development of AI-based forecasting capabilities. This approach motivates community participation, promotes fair milk distribution, and improves neonatal health outcomes across India.

Keywords: Human Milk Bank, Neonatal Care, Infant Survival, Digital Platform, Breast Milk Donation, Donor Awareness, Milk Supply Management.

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[1] Introduction

Neonatal care is one of the most critical aspects of public health, particularly for infants born prematurely or with low birth weight. These newborns have immature organs and underdeveloped immune systems, making them highly susceptible to serious complications such as infections, respiratory distress, feeding difficulties, and necrotizing enterocolitis (NEC). Optimal nutrition in the early stages of life is essential, as it can improve survival rates, promote healthy growth, and

reduce long-term health risks [1]. Breast milk is universally recognized as the ideal source of nutrition for infants, especially preterm babies. It provides essential nutrients, antibodies, enzymes, and growth factors that enhance immunity, aid digestion, and support overall development. Clinical evidence suggests that infants who receive human milk have lower incidences of NEC, reduced rates of severe infections, and better long-term health outcomes compared to formula-fed infants [2][3].

However, not all mothers are able to produce sufficient milk due to medical complications, stress, or premature delivery. In such cases, donor human milk becomes a vital alternative, offering immunological protection similar to maternal milk, reducing the risk of complications, and helping lower neonatal mortality in intensive care units. This need is particularly urgent in India, which records a substantial number of premature births annually [4].

Human milk banking in India has a history dating back to 1989, when the first milk bank was established at Lokmanya Tilak Municipal General Hospital (Sion Hospital), Mumbai. This initiative laid the foundation for organized milk donation and distribution in the country and is often recognized as Asia's first human milk bank [5]. Over the years, the number of milk-banking centres in India has risen; by 2021, there were reportedly over 90 functional human milk banks across different states [3].

Despite this growth, the milk-banking system in India continues to face several challenges. Many banks struggle with manual record-keeping, inefficient screening procedures, limited cold-chain infrastructure, and delays in milk allocation, all of which compromise timely access to donor milk for infants in need [6]. Cultural and social factors further hinder donor recruitment and milk donation; myths, lack of awareness, and societal stigma often discourage mothers from donating milk [7]. In addition, policy and regulatory limitations, including inconsistent guidelines, insufficient funding, and uneven distribution of milk banks, contribute to inequitable access, especially in rural or underserved regions [3].

Given these gaps and the high demand for safe donor milk, particularly for preterm and low-birth-weight infants, there is a compelling need for a coordinated, technology-driven solution. In light of this, the present study proposes LactaCare, a unified digital platform designed to modernize India's human milk banking ecosystem. LactaCare aims to streamline donor registration, medical screening, milk collection, inventory management, and distribution scheduling while ensuring transparency, traceability, and equitable access. Through this intervention, the platform seeks to enhance donor participation, optimize supply-demand matching, and ultimately improve neonatal survival and health outcomes across the country.

[2] Existing System

2.1 How Milk Banks Operate

Fig. 1: Human Milk Banking Process

The human milk banks assert that the acquired milk is up to the standard, adequately processed, and supplied to babies, particularly the ones who are born prematurely or have health issues. Hence, the babies get benefits. The candidates for milk donation are put through very rigorous scrutiny. Extensive screening is conducted to determine their medical condition and lifestyle to determine their eligibility, the procedure includes blood tests for such infections as HIV and hepatitis. Most of the milk comes from the donor's pumping and is stored in freezers at -18 °C (0 °F) or cooled and then transported to the milk bank securely. After the milk has been received, it undergoes treatment using the holder pasteurization method wherein it is raised to 62.5 °C (144.5 °F) for thirty minutes, thus killing the toxic germs and at the same time preserving the vital nutrients and antibodies. The milk is subjected to bacterial safety tests and nutritional content tests after processing, frozen at -20°C (-4°F), and stored for a maximum of six months. The first supply of the milk is given to the most critical infants, for example, those in neonatal intensive care units, and there are very strict regulations for transportation and usage [15][18].

2.2 Gaps in the Current System

Human milk banks still face many difficulties:

Operational Issues: Many milk banks do not have enough trained staff, and maintaining the cold chain during storage and transport becomes difficult, and all records are on paper, which slows down the entire process, which can lead to delays in providing milk when it is urgently needed.

Cultural Challenges: In our society, many people do not have enough awareness about breast milk donation. People have doubts about breast milk sharing because they believe false information. Because of this, many mothers are not willing to donate their breast milk to the needy neonates.

Policy Gaps: Some banks receive proper support while other banks experience staff and resource shortages. The absence of a central monitoring system causes milk banks to operate their facilities in different ways throughout their locations.

Technological Limitations: Many milk banks continue to use paper documentation for their donation and inventory management. This makes it difficult to keep track of milk inventory, donor details, etc.

[3] Problem Statement

1. **Manual Procedures:** Milk banks depend on paper systems to register donors and screen them and maintain records which results in slow and inaccurate processing.
2. **Absence of Unified System:** The organization needs a digital system which can centralize operations to enable instant data sharing and efficient milk distribution.
3. **Supply Demand Discrepancy:** Milk banks need to monitor milk inventory because they face difficulties matching available milk with infants who require it.
4. **Limited Donor Awareness:** Mothers do not donate their milk because they lack knowledge about the donation process which results from cultural differences and insufficient information.
5. **Variable Operational Standards:** Milk banks apply guidelines in different ways which leads to inconsistent safety standards and service quality throughout the organization.
6. **Inadequate Traceability:** The entire procedure lacks proper systems which allow tracking of milk from its donor point to the receiving hospital thereby creating challenges for both accountability and safety verification.
7. **Scarce Resources:** Many milk banks face operational difficulties because they lack sufficient staff and essential equipment and they have insufficient financial resources.
8. **Inadequate Community Involvement:** The organization needs a dedicated system which can educate donors and schedule their appointments and track milk donation requests in real time and support their voluntary donations.

The existing difficulties demonstrate that organizations need to build a digital system which unifies operations and creates efficient coordination systems to improve their milk bank processes and increase donor participation and maintain safety standards and fulfill infants nutritional requirements.

[4] Rationale of the Study (Demand–Supply Analysis)

India has a very high number of premature births every year around 3.5 million babies. Many of these newborns cannot get enough milk from their mothers immediately after birth. For such infants, donor human milk becomes extremely important because it protects them from infections and supports healthy growth [8]. There are approximately 90 milk banks in the whole country and each can produce only a limited amount of donor milk. As a result many babies who need donor milk do not receive it on time [8].

To understand how serious this issue is, the table below compares the number of babies who need donor milk with the amount of milk that is actually available:

Table 1: Comparison of Donor Human Milk Demand and Current Supply in India

Parameter	Scenario 1 (30% need donor milk)	Scenario 2 (50% need donor milk)
Premature babies (per year)	3.5 million	3.5 million
Babies needing donor milk	1.05 million	1.75 million
Avg. donor milk needed per baby	4.2 L	10 L
Current Supply (approximately 90 banks × 65–100 L/month)	70,000 – 1,08,000 L/year	70,000 – 1,08,000 L/year
Total Demand (Litres/year)	4.41 million L	17.5 million L

The table illustrates the huge difference between the amount of milk banks can supply and the amount of donor milk newborns require. About 3.5 million preterm newborns are born in India each year. They need about 4.41 million liters, even though only 1.05 million of them (30%) need donor milk. The requirement increases to 17.5 million liters if 1.75 million newborns (or 50%) require it. In actuality, however, the nation's milk banks can only produce between 70,000 and 1,08,000 liters annually.

This wide gap between need and availability means that a large number of vulnerable infants especially those in neonatal intensive care are unable to receive donor milk at the time they need it most. As a result, many newborns miss out on the nutritional protection that could significantly improve their survival and long-term health outcomes.

[5] Objective of the Study

The key aim of this research work is to develop a centralized online platform named LactaCare that can manage and automate the processes of human milk banks. Presently, most of the human milk banks manage their donor registration, screening, and related records manually, using paper-based systems, which result in various issues. This online platform will help manage all related data in a proper, error-free, as well as efficient, manner. An important objective of this research work is to improve the match between the supply of milk and the needs of infants. With continuous monitoring of the infant and milk stocks, it becomes easy to make a forecast of shortage, avoid wastage, and even facilitate distribution so that every infant gets their needed nutrients. The study also aims to encourage donor awareness and participation. With easy-to-use interfaces, education, and knowledge of how the donating process works, this platform promotes donor participation among mothers, which will help to increase the pool of donors in sustaining a milk bank.

An important goal of this project would be to standardize the processing methodology of the milk banks. This would be accomplished by standardizing all procedural activities in order to provide a consistent level of quality. Another important aim of this technology is to increase traceability. With this technology, it becomes possible to trace where the milk comes from, from where it has been brought, until it reaches distribution. Furthermore, LactaCare also seeks to optimize resource management, including personnel, equipment, and finances, for effective milk bank management. Furthermore, community engagement will be enhanced with integrated functionality related to appointments, donor feedback, as well as voluntary donations. This will create a sense of community participation and also help to increase donor and patient trust.

Lastly, this platform aims to facilitate data-driven decision-making through data extraction, analysis, and visualization of operation as well as distribution data. This way, it becomes possible for milk bank administrators to make informed decisions about trends, which lead to enhanced, responsive, and effective milk banks.

[6] Proposed System: LactaCare Platform

The proposed system, LactaCare, will be a web-based platform for human milk management. This will make it easy for milk banks to manage, increase safety, and facilitate donor participation. This will also make it easy for donors, hospitals, as well as management, to manage their activities related to breast milk since it will be a centralized platform. LactaCare will simplify issues related to manual management, traceability, and lack of community awareness.

6.1 System Overview

LactaCare offers a comprehensive platform that encompasses:

- Donors can register, undergo automated health screenings, make appointments, and access their history of donations.
- Hospitals are also able to request for baby milk, offer medical information, and check status.
- The administrators manage appointments, approve requests for milk, handle inventories, monitor fulfillment of donations.
- The system also has public functionality like awareness pages, search for a milk bank by location, as well as donating funds, which promotes community involvement.

6.2 System Modules

1. Donor Module

- Registration & Login: Secure donor registration.
- Profile Management: Update personal information, contact, and lactation status.
- Smart Health Screening: The automated screening of eligibilities using questionnaires.
- Booking an Appointment
- Donation History & Dashboard: View past donations, status, and summary.

2. Hospital Module

- Registration & Login: Hospitals get secure access.
- Milk Request Submission: This involves entering baby information, condition, prescription, as well as quantity needed.
- Request Tracking: Track pending, approved, rejected, or fulfilled requests.
- Request History and Dashboard: Recording and analysis of all requests.

3. Admin Module

- Dashboard Overview: A Donor, Hospitals, and Milk Inventory.
- Appointment Management: Approve/reject appointments and monitor collection status.
- Milk Request Management: Approve or deny hospital requests and manage delivery updates.
- Inventory Management: Track donations, stock of milk, expiration, and availability.
- Donation Fulfillment Tracking: Make traceability from donor to done feasible.

4. Public & Supportive Pages

- Home & Awareness Pages: Inform public on milk donation.
- Search Centers: Find nearest milk banks using your city, state, and GPS.
- Money Donation: Financial support for operating a milk bank.
- Contact Us: Ensure that a means of contacting for questions and support.

6.3 System Architecture

LactaCare has a three-tier client-server architecture Thus

1. Frontend: Web and mobile interfaces developed using HTML, CSS, JavaScript, and Bootstrap.
2. Backend: Java Server using Servlets, JSP, JDBC, and the Tomcat Server
3. Database: PostgreSQL, which would be used for storing data related to donors, hospitals, and inventories.

6.4 Data Flow

The LactaCare data flow guarantees seamless and secure transactions between donors, hospitals and administrators. The donors go to the platform, give their health data, and their eligibility is checked automatically. The donor who has been approved can schedule an appointment, and this is done by the administrators and follows their tracking. The moment the collection of milk takes place, information such as quantity, type, and expiry is entered into the inventory. The hospitals

together with the baby details send milk requests and the admin grants the request and keeps track of the fulfillment. The system pairs the milk that is available with what the hospitals want according to the quantity, type, and urgency, thus making the distribution very efficient. All the actions, such as donations, appointments, and deliveries are logged to maintain transparency and for traceability purposes. In addition, the awareness pages, milk bank search based on location and options for monetary donation facilitate the community engagement on the platform.

6.5 Strategies for Expanding Human Milk Banks Across India

- Increase Public Knowledge: Industry-wide campaigns to make women aware of the benefits of human milk.
- Improve Partnerships for Healthcare: Work in partnership with healthcare facilities and NGOs.
- Improve Infrastructure: Regional hubs for milk banks and better cold chain infrastructure.
- Make Use of Technology: Use technology in developing donor registration application software as well as donor tracking software.
- Engage Communities: Enhance local healthcare personnel and mobilize community leaders to make milk donation a community norm.
- Cultural concerns – Conduct outreach with a view to sharing success stories.
- Facilitate Expansion: Provide a helpline for information and use social media for outreach.
- Develop Mobile Milk Bank Units: Design mobile units and implement in remote areas along with health camps.
- Foster donor loyalty programs. Make use of recognition and referral programs for donors.
- Integration with other Health Services: Link milk banking with maternal and child nutrition programs.
- Academic Research Support: Offer scholarships for studies in human milk banking and publish research findings.
- Encourage Feedback: Feedback channels should be planned, and programs should be reviewed for improvement.

These approaches aim to make human milk banks more available and accepted, hence promoting a direct improvement in infant healthcare in India**.**

[7] Conclusion

The research demonstrates that existing human milk banking operations in India require immediate modernization because there exists a substantial shortage of donor milk which cannot meet current donor milk requirements. The milk banks provide essential medical services to protect endangered newborns, but their effectiveness remains restricted because of their dependency on outdated operation methods and their inability to reach the public. The proposed solution of LactaCare functions as a complete digital system which streamlines donor registration processes while enhancing breast milk traceability and facilitating better collaboration between hospitals and milk banks and promoting community involvement. The LactaCare system combines technology with awareness and system-level organization to create a solution which enables hospitals to achieve safe and fair access to donor human milk within required timeframes. The platform exists to protect all infants from losing access to human milk resources because of operational challenges or public knowledge deficiencies.

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