

Human Milk Banking: An Ounce of Liquid Gold to Save a Life

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Abstract: Did you know that just one ounce of milk provides up to THREE feedings for premature and/or medically fragile babies? There's a reason they call it liquid gold. The best alternative to mother's own milk is donated human milk and to provide donated human milk, we need human milk banks. For fragile babies, human milk is lifesaving medicine. It's something that a mother, even with all the money in the world, may not be able to provide her baby without someone else's generosity. **Materials and Methods:** Several electronic databases, including PubMed, Wiley, Springer, Google Scholar, Web of Science, WHO, Wikipedia, Research Gate, Forbes, Medline, Healthline were searched for this article.

Keywords: Human milk banking, ounce, liquid gold, save a life.

1. Introduction

“If you have an oversupply, consider donating to a milk bank”

A Health Technology Assessment (HTA) report entitled ‘Breastfeeding promotion for infants in neonatal units: a systematic review and economic analyses was published in 2009. This report used systematic review methodology and health economic modelling to assess which interventions, including the availability of donor breast milk, effectively promote the initiation and duration of breastfeeding in neonatal, special and intensive care settings. The authors noted that in the UK, donor breast milk is neither widely nor readily available in the majority of units; this was reflected through modelling the use of donor breast milk by

availability, not need. They concluded that if mechanisms by which donor milk is provided were improved, donor milk would become cost effective compared with using formula. This was based on a significant improvement in the operation of milk banking, and suggested models include setting up a national donor milk banking system similar to that for blood¹.

2. Methodology

The following article is based on data searched/collected from a wide source of books, National & International journals, Internet sources (Including WHO, Wikipedia, Biomed Central, Healthline) and various databases including PubMed, Google Scholar, Wiley, Research Gate, Springer etc.



What's breast milk made of?

- 1) Millions of live cells. These include immune-boosting white blood cells, as well as stem cells, which may help organs develop and heal.
- 2) More than 1,000 proteins³ that help your baby grow and develop, activate their immune system, and develop and protect neurons in the brain.
- 3) All that breast milk protein is made up of amino acids. There are more than 20 of these compounds in your

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milk. Some of them, called nucleotides, increase at night and scientists think they may induce sleep.

- 4) Over 200 complex sugars called oligosaccharides⁶ that act as prebiotics, feeding 'good bacteria' in your baby's gut. They also prevent infections entering the bloodstream and lower the risk of brain inflammation.
- 5) More than 40 enzymes.⁷ Enzymes are catalysts that speed up chemical reactions in the body. The ones in your milk have jobs such as aiding your baby's digestion and immune system, as well as helping her absorb iron.
- 6) Growth factors that support healthy development.¹ These affect many parts of your baby's body, including the intestines, blood vessels, nervous system, and glands, which secrete hormones.
- 7) On the subject of hormones, your breast milk contains lots of them!⁷ These clever chemicals send messages between tissues and organs to ensure they work properly. Some help regulate your baby's appetite and sleep patterns, and even aid the bond between you.
- 8) Vitamins and minerals – nutrients that support healthy growth and organ function, as well as help build your baby's teeth and bones.
- 9) Antibodies, also known as immunoglobulins. There are five basic forms of antibodies and all of them can be found in your milk.⁸ They protect your baby against illnesses and infections by neutralising bacteria and viruses.
- 10) You may have heard of long-chain fatty acids because they play a pivotal part in building your baby's nervous system, as well as aid healthy brain and eye development.⁹ And, you've guessed it, there are several of these in your milk too!
- 11) 1,400 microRNAs, which are thought to regulate gene expression, as well as help prevent or halt disease development, support your baby's immune system, and play a role in remodelling the breast³.

Benefits of Breastmilk

1) Healthy nutrients

Compared with formula, the nutrients in breastmilk are better absorbed and used by your baby. These include sugar (carbohydrate) and protein. Breastmilk has the nutrients that are best for your baby's brain growth and nervous system development. Studies of breastfed babies have found that they do better on intelligence tests when they grow older. A breastfed baby's eyes also work better. This is mostly because of certain types of fat in breastmilk.

2) Preventing infections

Breastmilk has many disease-fighting factors. They help prevent mild to severe infections and hospitalization. Breastfed babies have far fewer digestive, lung, and ear infections. Babies born early (premature) who are breastfed are also less likely to get a serious infection of the intestines called NEC (necrotizing enterocolitis). If your baby gets an infection when breastfeeding, the infection is likely to be less severe.

3) Preventing other conditions

Breastfeeding helps protect babies from many serious health problems. And it keeps on offering protection as they

get older. Breastfed babies have a lower risk for SIDS (sudden infant death syndrome) than babies who are not breastfed, a lower risk of getting asthma and skin problems related to allergies. Formula-fed babies are more likely to have milk allergies, less diarrhoea and a lowered chance of getting some digestive conditions. Formula can actually change healthy bacteria in a baby's intestines, the bacteria help with digestion and fighting disease. A lower risk of developing leukaemia, fewer long-term health problems as they grow up. These include diabetes and obesity⁴.

Human Milk Bank

A human milk bank, breast milk bank or lactarium is a service that collects, screens, processes, pasteurizes, and dispenses by prescription human milk donated by nursing mothers who are not biologically related to the recipient infant. The optimum nutrition for new born infants is breast milk for at least the first 6 months of life⁵. For women who are unable to breast feed or produce enough milk, pasteurized donor breast milk may be an effective approach to feeding. Breast milk supplied by a woman other than the baby's mother that is not pasteurized and informal breast milk sharing is associated with a risk of transmitting bacteria and viruses from the donor mother to the baby and is not considered a safe alternative. If pasteurized donor breast milk is not available, commercial formula is suggested as a second alternative⁶.

History

Donating breast milk can be traced back to the practice of wet nursing. The first record of regulations regarding the sharing of breastmilk are found in the Babylonian Code of Hammurabi (1800 BCE). These regulations were motivated by the long-held belief that infants inherit the nurse's traits through their breast milk. By the 11th-century European culture considered breastfeeding indecent, which led wet nursing to become common practice among royalty and aristocracy of Europe. The practice of wet nursing declined by the 19th century due to concerns regarding unhealthy lifestyles among nurses. Consequently, the medical community began researching the effects of alternative nutrition on neonates. Theodor Escherich of the University of Vienna conducted studies from 1902 to 1911 investigating different sources of nutrition and their effect on neonates. His studies demonstrated that breastfed neonate's intestinal bacteria was significantly different compared to neonates fed by other means⁷.

In 1980, the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) released a joint statement supporting the use of human donor milk as the first alternative if the biological mother was unable to breastfeed. Other organizations released similar recommendations for the use of human donor milk and established regulations for human milk banks. Human milk banks provide the service of selecting, collecting, screening, storing, and distributing donated human milk to meet the specific needs of individuals for whom human milk is prescribed by healthcare providers. In 2010, the European Milk Bank Association (EMBA) was established to promote breastfeeding and milk banking and to encourage international cooperation between human milk banks throughout Europe. The EMBA has working groups to

develop European guidelines for donor milk banks, as well as to assess best practices for the processing and fortification of human milk. Currently, Holder pasteurization and standard fortification (i.e., addition of a fixed, recommended amount of multicomponent human milk fortifier to a certain volume of human milk) are the most widely used methods; however, these methods may not provide optimal nutrition, particularly in preterm infants^{8,9}.

Today, there are ~500 human milk banks operating in more than 37 countries worldwide. In Europe, there are 210 active human milk banks, with France, Italy, and Sweden having the largest number of banks (Fig. 1); the number of human milk banks is continuously increasing. At the end of 2017, 36 human milk banks were operating in Italy, and their activity is coordinated by the Italian Association of Human Milk Banks (AIBLUD). In 2010, AIBLUD published guidelines on the establishment and operation of human milk banks. AIBLUD recently collaborated with the Italian Ministry of Health to develop the "Italian National Recommendations for the Organization and Management of Human Milk Banks as a Tool for the Protection, Promotion and Support of Breastfeeding." The recommendations aim to define uniform criteria for the establishment of human milk banks, define essential requirements for service and quality standards, and set control criteria for the monitoring of milk bank activities¹⁰.

Donor Requirement

A donor must:

- Be healthy
- Be in the process of lactation
- Undertake a chest x-ray or tine test
- Have a negative VDRL
- Have no evidence of hepatitis
- Be HIV negative¹¹.

Health Benefits of Human Milk Banks

Human milk banks offer families a chance to provide their child with reliable and healthy milk from other mothers. Human milk banks are needed as they offer milk which mostly is consumed by children whose mothers are not able to provide them with reliable milk¹².

Milk Banking Process

Each free-standing milk bank must have a medical director and a governing board that includes physicians, dieticians, lactation consultants, nursing and infection control representatives. This board must meet regularly to review milk banking processes and policies. The daily operation of the milk bank is under the governance of lactation consultants. They may also employ dietary technicians and clerical support staff.

All donor mothers donate their milk for altruistic reasons. All mothers must undergo rigorous screening before donation including an interview, medical approval and serology, which must be repeated every six months. Mothers are not accepted if they are taking medications, smoke or drink. They are temporarily excluded during periods of over-the-counter medication use. Once accepted as a donor, a mother is taught the techniques for safe collection and

storage of her milk. She may express one extra feeding or multiple feeds per day, as in the case of a bereaved mother, to donate to the milk bank. This milk is then frozen, stored and transported to the milk bank.

At the milk bank, the milk is batched from up to four different mothers to blend constituent variations. The milk is then thawed, and a bacterial culture is taken. The milk then undergoes Holder pasteurization (62.5°C for 30 min) in an industrial grade pasteurizer, and is re-cultured. Any milk that is culture positive for any pathogen or for greater than 104 colony-forming units/mL of skin flora before pasteurization or any positive culture after pasteurization is discarded. The milk is again frozen while awaiting final culture results. When an order for human milk is received at the milk bank, the milk is transported, thawed and dispensed as required¹³.

Location of Human Milk Banks

Human milk banks are primarily focused to provide donor milk to high-risk newborns admitted in the neonatal unit. Therefore, a location in close proximity even inside the boundaries of neonatal unit is desirable. This also helps in administrative supervision by medical staff. Presence of human milk banks in the neonatal unit is associated with elevated rates of exclusive breastfeeding rates in VLBW babies¹⁴.

Equipments Used in Milk Banks

- 1) **Pasteurizer/Shaker-water bath:** It is essential to have a device to carry out heat treatment of donor milk at the recommended temperature of 62.5°C for a period of 30 minutes (Pretoria Holder pasteurization method) prior to its use. A conventional pasteurizer is expensive and generally of dairy-industry size and is often not suitable for the quantity of milk to be pasteurized in a human milk bank. A well accepted alternative is the use of a shaker water bath with a micro-processor-controlled temperature regulator, an electronic timer device and a shaker speed controller. The milk in the container is boiled through the steam and hot water in the water shaker bath. To avoid coagulation of the milk and to distribute heat evenly, the tray on which the milk containers are placed is shaken / wobbled. This shaker water bath should be double walled and made of steel. Its size varies according to the need of the milk bank, with the tray capacity varying from 9 to 24 containers of 200 to 400 mL capacity^{15,16}.
- 2) **Deep freezer:** A deep freezer to store the milk at -200C is essential in the milk bank. It is desirable to order a deep freezer with a digital display of the temperature inside it with an alarm setting. It is desirable to have two deep freezers for processed milk. First for storage of the milk till the post-pasteurization milk culture reports are available. This freezer should be locked at all times with access only to the technician, so that no milk is accidentally used till the culture reports are available. The second deep freezer is used for storage of the pasteurized milk once the culture reports are negative and the milk is considered safe for disbursement.
- 3) **Refrigerators:** These are required to store the milk till the whole day's collection is over and the milk is ready

to be mixed and pooled for further processing. It is also required for thawing the milk before being dispatched. Preferably two different units should be used for these purposes. If not possible, then strictly earmarked areas should be kept in one unit for each purpose.

- 4) **Hot air oven/Autoclave:** A hot air oven / autoclave in the milk bank or centralized sterile service department is essential for sterilizing the containers used for collection from donors, containers for pasteurization and the test tubes needed for sending milk culture samples to the microbiology laboratory. **Breastmilk pumps:** For milk banking, hospital grade electric pumps are preferred as they result in better volumes of expressed milks and are relatively painless and comfortable to use. There is no major difference in the types of electrical breast pumps¹⁷. Manually operated breastmilk pumps designed to operate more physiologically by simulating the infant's compressive action on the areola during breastfeeding can be used with lower cost implications¹⁸. They can be reused with chemical disinfection/sterilization. Breast pumps can be a source of infection¹⁹, and hence they should be cleaned properly²⁰. Pump and its parts should be sterilized/disinfected as per manufacturer's instructions. **Containers:** For collection and storing the milk, single use hard plastic containers of polycarbonates, pyrex or propylene are used across the world. However, in Indian experience, cylindrical, wide-mouthed stainless-steel containers of about 200 ml capacity with tight fitting/screwed caps are equally effective. They are easily available, and are durable, easy to clean and autoclave. There is no significant decrease in nutrient composition on storage; however, cellular components are reduced. Polythene milk bags are not suitable as they are fragile, associated with loss of lipids and vitamins and there is a risk of contamination, although some studies have challenged the loss of lipids²¹. **Generator/Uninterrupted power supply:** Every milk bank should have a dedicated centralized source of uninterrupted power supply backup to run the deep freezers and refrigerators in case of electricity failure. **Milk analyser:** It is desirable to have macronutrient analysis of breastmilk to estimate the calorie, protein and fat of a milk sample, using infra-red spectroscopy technology, in teaching hospitals as a step towards lacto-engineering.

3. Discussion

Breastfeeding is the best method of infant feeding because human milk continues to be the only milk which is tailor-made and uniquely suited to the human infant. 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. In our country, the burden of low-birth-weight

babies in various hospitals is about 20% with significant mortality and morbidities^{22,23}.

4. Conclusion

Breast milk donation is a way for babies to receive the health benefits of human milk, regardless of whether it comes from their own mothers. Most experts agree that a new born baby's mother's milk provides the best nutrition, however, donated milk still has many health benefits over traditional infant formula milk. The benefits of breast milk are numerous, and it remains the ideal milk for preterm babies and healthy babies alike. Experts recommend donated breast milk instead of formula because donated milk contains a range of different substances and nutrients that formula milk (which is derived from cow's milk) doesn't contain. Breast milk donors undergo careful screening before donating. Potential donors may include women who produce more milk than their babies need, leaving them with extra milk or those who have lost a baby but still produce sufficient milk. In the UK, breast milk donation is not paid – like blood donation, breast milk donors are giving their milk voluntarily to help babies who need it, which is why these donations are vital to help mothers, babies, and families who cannot breastfeed themselves. A milk bank typically receives donor breast milk frozen, which is thawed and undergoes a medical screening process. The milk is then pasteurised, cooled, and re-frozen. Samples are screened again after pasteurisation to make sure that bacteria haven't grown to dangerous levels during the process of defrosting and refreezing. While some nutritional value is lost during the pasteurisation process, it is not enough to affect the milk's nutritional value, and frozen milk is the most effective and least wasteful form of human milk banking and human milk storage²⁴.

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None

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Not required

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