

Breastfeeding: The Essential Principles

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Objectives After completing this article, readers should be able to:

1. Understand the physiology of lactation.
2. Discuss the biologic specificity of human milk.
3. Delineate the benefits of breastfeeding for the infant, the mother, and the community.
4. Know relative and absolute contraindications to breastfeeding.
5. Describe current recommendations for breastfeeding.

Introduction

Breastfeeding practice is the biologic norm for *Homo sapiens* and dates back some 40,000 years. Until the last several decades, breastfeeding was the norm, and wet-nursing was the only alternative to allow infants to survive. Although pediatricians overwhelmingly agree that breastfeeding is best for babies, in the United States today, only 68% of all new mothers even attempt it, and at least 50% abandon it quickly. The United States Public Health Service Healthy People 2010 Initiative calls for an increase in the rate of breastfeeding to 75% at birth, 50% at age 6 months, and 25% at 1 year of age (Figure). The presence or absence of breastfeeding affects the economics of the family and the community. Multiple studies confirm that the annual cost to the United States health care system from women not breastfeeding is several billion dollars. Promoting breastfeeding can decrease costs for public health programs such as The Special Supplemental Nutrition Program for Women, Infants, and Children, parental employee absenteeism as a result of decreased infant illness, environmental burden for disposal of formula cans and bottles, and energy demands for production and transport of artificial feeding products.

Physiology of Lactation

During pregnancy, the breast grows larger, the diameter of the areola increases, pigmentation increases, the nipples become more erect, and the veins become more prominent. Various hormones stimulate breast growth: prolactin and placental lactogen stimulate nipple and areolar growth; estrogen facilitates the proliferation and differentiation of the ductal system; and progesterone promotes an increase in size of the lobes, lobules, and alveoli. During the first half of pregnancy, the ductal tree grows and proliferates, and additional lobules form. The second half of pregnancy is characterized by acceleration of secretory activity and distention of alveoli from accumulating colostrum. After 16 weeks of pregnancy, lactation occurs, even if the pregnancy does not progress.

The volume of milk secreted by the mammary cells remains small until after the infant is born. After delivery of the placenta, serum progesterone and estrogen concentrations fall, and negative feedback by these hormones on pituitary prolactin release is lost. Prolactin concentrations rise, leading to increased milk synthesis. When the neonate begins suckling, the posterior pituitary hormone oxytocin is released. Oxytocin causes the milk-ejection reflex or letdown, a contraction of the myoepithelial cells surrounding the alveoli necessary for the ejection of milk.

The rate of milk synthesis after each breastfeeding episode varies and is related to the degree of emptiness or fullness of the breast; an emptier breast makes milk faster than a fuller one. Thus, breastfeeding is not a major factor for the initiation of lactation, but it is essential for the continuation of lactation. Lactogenesis also is susceptible to outside

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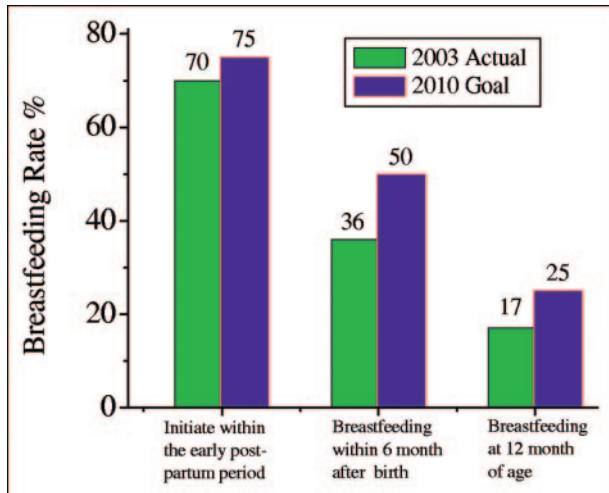


Figure. Breastfeeding rates in 2003 and United States Healthy People 2010 breastfeeding objectives. From Centers for Disease Control and Prevention breastfeeding national immunization data.

influence. Certain conditions, such as type 1 diabetes mellitus, obesity, polycystic ovary syndrome, placental retention, and stress, can delay or diminish lactogenesis. The reasons for this delay are not clear. Human milk production is related to an infant's demand. Infants have the ability to self-regulate their milk intake.

Composition of Human Milk

Human milk is unique and species-specific. All substitute feeding preparations differ markedly from it, making human milk superior for infant feeding. Human milk is rich in proteins, nonprotein nitrogen compounds, lipids, oligosaccharides, vitamins, and minerals. In addition, it contains hormones, enzymes, growth factors, and many types of protective agents.

Colostrum

The first milk secreted by the postpartum woman is colostrum. Human colostrum differs from mature milk. The energy value is about 67 kcal/100 mL compared with the 75 kcal/100 mL for mature milk. The volume varies with the parity of the mother and the number of feedings. The concentrations of sodium, potassium, and chloride are greater than those of mature milk. Protein, fat-soluble vitamins, and minerals are present in greater percentages than in transitional and mature milk. The high level of antibodies may provide protection against the bacteria and viruses that are present in the birth canal. Colostrum facilitates the passage of meconium and es-

tablishment of *Lactobacillus bifidus* flora in the infant's gut.

Mature Milk

Mature human milk contains fat, carbohydrates, and protein as substrates for infant nutrition. The fat of human milk provides about 50% of its calories. Triglycerides are the primary constituents of the fat. The lipid fraction provides essential fatty acids. Human milk is rich in long-chain polyunsaturated fatty acids, including docosahexanoic acid and arachidonic acid, which are associated with higher visual acuity and cognitive ability in the infant. The fats of human milk and cow milk are qualitatively different, with human milk containing more of the absorbable triglyceride olein and cow milk containing more volatile fatty acids (butyric, capric, caproic, and caprylic). These differences may result in the preterm or sick infant possibly developing steatorrhea after ingesting cow milk.

Lactose is the primary carbohydrate in human milk, although small quantities of galactose and fructose also are present. Lactose enhances calcium absorption and is metabolized readily to galactose and glucose, which supply energy to the infant. Human milk consists predominantly of whey proteins; cow milk mostly has casein. Whey protein is composed of five major components: alpha-lactalbumin, serum albumin, lactoferrin, immunoglobulins, and lysozyme. The latter three elements play important roles in immunologic defense. Human milk also contains free amino acids, including essential amino acids, as well as nucleotides. Table 1 lists comparisons between human milk, cow milk, and some infant formulas. About one third of infants who are allergic to cow milk protein may be allergic to soy protein, as well; in such cases, protein hydrolysate formulas are used. The standard caloric content for all formulas is 20 kcal/oz.

The amount of vitamins and micronutrients in human milk varies, depending on the diet and genetic differences of mothers. Generally, as lactation progresses, the level of water-soluble vitamins in human milk increases and the level of fat-soluble vitamins declines. Human milk is a good source of vitamin A and vitamin E, but has very little fat-soluble vitamin D. The risk of vitamin D deficiency rickets is greatest for dark-skinned children living in inner-city areas and for infants of solely breast-feeding mothers eating strict vegetarian diets. All breast-fed infants should receive 200 IU of oral vitamin D drops daily. (1)

Human milk contains small amounts of vitamin K. A few days after birth, enteric bacteria produce sufficient quantities of the vitamin, but until ingestion of copious

Table 1. Composition of Human Milk, Cow Milk, and Infant Formulas

Ingredients	Human Milk	Cow Milk	Cow Milk Protein-based Formula	Soy Protein-based Formula	Protein Hydrolysate Formula
Carbohydrate (g/dL)	Lactose 7.0	Lactose 4.8	Lactose Corn syrup 3.6 to 3.7	Sucrose Corn syrup 3.6	Sucrose Corn syrup 3.4 to 3.7
Protein (g/dL)	Human milk protein, whey: casein ratio of 75:25 Total: 1.1	Cow milk protein, whey: casein ratio of 22:78 Total: 3.3	Nonfat milk Deminerlized whey 1.4	Soy isolate Methionine 1.8 to 2.0	Cow milk protein hydrolyzed to reduce allergenicity 1.9
Fat (g/dL)	Human milk fat Contains more absorbable triglyceride 3.8	Butterfat Contains more volatile fatty acids 3.7	Soy oil Coconut oil Palm oil 3.6 to 3.7	Palm olein Soy oil Coconut oil 3.6 to 3.7	Medium-chain triglyceride oil Soy oil Coconut oil 3.4 to 3.7
Calcium (mg/L)	280	1,226	530	710	640 to 710
Phosphorus (mg/L)	147	956	284 to 360	507 to 560	430 to 507
Iron (mg/L)	Vitamin C and lactose facilitate absorption 0.4	0.5	5.0	12	12
Suggested uses	Preferred for all infants	Children older than 1 year of age who have normal gastrointestinal tract	Infants who have normal gastrointestinal tract but cannot be breastfed	Infants who have cow milk allergy (30% may have cross-reactivity), lactose malabsorption, galactosemia	Infants who have food allergies or underlying gastrointestinal damage

Table 2. Major Protective and Anti-inflammatory Factors in Human Milk

Factors	Function
Immunoglobulins Secretory IgA, IgM, IgG	Generate immune response to specific antigens
Lactoferrin	Antibacterial effect, especially against <i>Escherichia coli</i> , inhibition of complement, carries iron
Lysozyme	Bactericidal and anti-inflammatory
Casein	Inhibits microbial adhesion to mucosal membranes
Lipids	Protect against enveloped viruses, anti-infective efforts
Prostaglandins	Cytoprotective
Cytokines	Activate the immune system
Glycoconjugates	Antiviral, antibacterial protection
Phagocytes	Absorb pathogens, release IgA
Lymphocytes	Essential for cell-mediated immunity; antiviral activity
Prolactin	Memory T cells give long-term protection Enhances development of B and T lymphocytes Stimulates proliferation of intestinal mucosa
Human growth factors	Mucosal barrier to antigens

amounts of human milk promotes gastrointestinal (GI) bacterial colonization, neonates are susceptible to vitamin K deficiency-induced hemorrhagic disease. To prevent this condition, 1 mg of vitamin K is administered routinely intramuscularly to infants immediately after birth. Mothers consuming strictly vegan diets may produce milk that is deficient in vitamin B12, as well. The total mineral content in human milk is higher in the first days after birth and slowly decreases throughout lactation. Although human milk has only a small amount of iron, breastfed babies rarely develop iron deficiency because iron absorption is facilitated by the high lactose and vitamin C concentrations of human milk.

Several anti-inflammatory and protective factors have been identified in human milk and their functions delineated (Table 2).

Benefits of Breastfeeding

Child Health Benefits

Human milk provides optimal nutrition to the infant, facilitating adequate growth and development. Research studies among term and preterm infants have shown significant improvements in developmental outcomes of breastfed infants compared with formula-fed infants. In addition, growing evidence suggests small, but significant, cognitive benefits for breastfeeding. When tested at 7 to 8 years of age, children who were breastfed as infants for 8 months or longer had mean verbal intelligence quotient (IQ) scores 6 points higher and performance

IQ scores nearly 4 points higher than those who did not receive human milk, after statistical control of social and perinatal factors associated with breastfeeding such as birthweight, multiplicity, gestational age, maternal age, education, and family income. (2)

Anti-infective Properties of Human Milk

Human milk provides protection against disease. The high concentrations of secretory immunoglobulin (Ig)A, enzymes, other Ig's, and leukocytes provide broad-spectrum protection against infections and chronic conditions. Breastfeeding helps to prevent infantile diarrhea and other GI infections. It is now well established that ingested antibodies from human milk can pro-

vide local GI immunity against specific enteric pathogens, including *Campylobacter jejuni*, *Clostridium difficile*, *Escherichia coli*, *Giardia lamblia*, rotavirus, *Salmonella typhimurium*, *Shigella* sp, and *Vibrio cholerae*. The degree of protection is related to the amount of human milk an infant receives; exclusive breastfeeding is associated with greater protection.

Studies of the protective effects of breastfeeding against respiratory tract infections offer conflicting results. Several studies suggest that breastfeeding helps to prevent respiratory illnesses; (3) others indicate little protection. There is, however, strong evidence that human milk protects against respiratory syncytial virus infection. (4) Similar protection has been established against *Haemophilus influenzae* bacteremia and meningitis as well as pneumonia caused by *Streptococcus pneumoniae*. Breastfeeding also provides protection against ear infections and atopic disorders.

Protection from Chronic Disease

Breastfeeding contributes to the prevention of diabetes, celiac disease, childhood cancer, sudden infant death syndrome, obesity, and many other health problems. The longer the duration of breastfeeding, the greater is its protective effect. The protection by human milk against illness extends beyond infancy to childhood and adulthood. Exclusive breastfeeding during the first months after birth is associated with lower asthma rates

during childhood. (5) Human milk also may protect preterm infants against necrotizing enterocolitis.

Benefits for the Mother

Breastfeeding and lactation decrease postpartum bleeding and promote more rapid uterine involution. They decrease the risk of breast and ovarian cancer and possibly decrease the risk of hip fractures and osteoporosis in the postmenopausal period. They definitely promote development of bonding and attachment between the mother and the infant.

Contraindications to Breastfeeding

Medical Disorders

Breastfeeding is optimal for infants, but there are a few conditions when breastfeeding is not in the baby's best interest. Breastfeeding is contraindicated for infants who have classic galactosemia, an autosomal-recessive disorder in which the liver enzyme galactose-1-phosphate uridylyltransferase is absent. Affected infants are unable to metabolize lactose or galactose, leading to liver failure and mental retardation. When this diagnosis is suspected, abrupt weaning from breastfeeding is necessary.

Mothers who have active untreated tuberculosis disease should be separated from their infants and advised to suspend breastfeeding until the mother and infant are receiving appropriate antituberculosis therapy. The mother should wear a mask and adhere to infection control measures. Separation is no longer necessary once the infant is started on isoniazid. However, if multidrug-resistant tuberculosis is suspected, the infant should remain separated from the mother even after he or she is started on isoniazid. (6)

Viruses

Human milk can transmit certain viral diseases. The viruses that can be identified in human milk and their impact on breastfeeding are listed in Table 3.

The World Health Organization recommends avoidance of all breastfeeding by human immunodeficiency virus (HIV)-infected mothers when replacement feeding is acceptable, feasible, affordable, sustainable, and safe. Women in developed countries who are HIV-positive should not breastfeed their offspring, but in the developing world when replacement feeding is not feasible or

Table 3. Viruses Identified in Breast Milk and Impact on Breastfeeding

Virus	Impact on Breastfeeding
HIV-1, HIV-2	Contraindicated
HTLV-1, HTLV-2	Contraindicated
Hepatitis B virus (HBV)	Not contraindicated, especially if infant receives HBV vaccine and HBV immune globulin
Hepatitis C virus	Not contraindicated. Nipple cracks or fissures may pose a risk for transmission.
Herpes simplex virus	Contraindicated only if active breast lesions are present
Cytomegalovirus	Not contraindicated. Some experts recommend stopping breastfeeding of preterm and immunosuppressed infants if mother becomes infected during lactation.
Rubella virus	Not contraindicated
West Nile virus	Not contraindicated

HIV=human immunodeficiency virus, HTLV=human T-cell lymphoma/leukemia virus

safe, exclusive breastfeeding is recommended during the first postnatal months. (7) The exact risk of transmission is unknown, but risk is probably higher in mothers who have higher viral loads.

The human lymphotropic virus HTLV-1, associated with adult T-cell leukemia and lymphoma, is uncommon in the United States. HTLV-2 is a related retrovirus. Mothers who are HTLV-1- or -2-positive should not breastfeed.

Women who have herpetic lesions on their breasts should refrain from breastfeeding. In the absence of breast lesions, the newborn can breastfeed and room-in, but scrupulous hand washing and covering of any lesions is recommended to prevent possible cross-contamination.

Medications

Almost all drugs are excreted into human milk to some degree, but only a very few are unsafe for the infant. Table 4 lists medications that are contraindicated when breastfeeding. Mothers who are receiving radioactive isotopes, antimetabolites, or chemotherapeutic agents should not breastfeed until the medications no longer are excreted in the milk. Individual drugs that preclude breastfeeding include lithium, atropine, chloramphenicol, cyclosporine, bromocriptine, ergot alkaloids, and iodides. Long-term maternal ingestion of drugs that have sedative effects can cause sedation in breastfeeding infants and withdrawal symptoms on interruption of breastfeeding. (8) Although most drugs can be used safely by breastfeeding women, physicians should make a

Table 4. Medications Contraindicated During Breastfeeding

Drug/Class	Possible Adverse Effects in Infant
Antineoplastic agents	Fetal death, congenital anomalies, organ system toxicity
Immunosuppressants	Potential suppression of the immune system
Lithium	High potential for toxicity
Chloramphenicol	Blood dyscrasias, aplastic anemia
Ergot alkaloids	Ergotism poisoning
Radiopharmaceuticals	Potential toxicity; brief to full interruption of breastfeeding recommended
Bromocriptine	Suppresses prolactin secretion; hyperprolactinemic mothers taking drug can breastfeed successfully
Iodides	Thyroid suppression

risk versus benefit assessment prior to the use of any drugs during lactation. (8)

Conditions That Are Not Contraindications to Breastfeeding

Breastfeeding is not contraindicated for infants born to mothers who are hepatitis B surface antigen-positive. All such infants should receive hepatitis B immunoglobulin (HBIG) and hepatitis B virus (HBV) vaccine within 12 hours after birth. Multiple studies have shown that breastfeeding does not appear to increase the rate of infection among neonates; moreover, in areas of high HBV prevalence, lack of breastfeeding places the infant at greater risk of contracting the disease.

Maternal hepatitis C virus (HCV) infection is not a contraindication for breastfeeding. (1) The overall rate of maternal-infant HCV transmission among breastfed infants is similar to that of formula-fed infants. It has been suggested, but not shown, that the presence of cracks or fissures in the nipple poses a risk for transmission of HCV. Some experts believe that mothers should be counseled about potential risks.

Although transmission of cytomegalovirus (CMV) through breastfeeding has been established, no serious illness or clinical symptoms in neonates fed CMV-positive human milk have been reported. Breastfeeding is not contraindicated for healthy term infants whose mothers have CMV infection. However, decisions about breastfeeding of preterm and immunosuppressed infants should be made with consideration of the potential benefits of human milk versus the risk of CMV transmission. Freezing and pasteurization can decrease the CMV viral load in milk significantly.

Maternal tobacco smoking is not a contraindication to breastfeeding. Clinicians, however, should advise

mothers to avoid smoking within the home and to make every effort to wean themselves from tobacco. Women who have a history of breast reduction are at risk of insufficient lactation. Those diagnosed with breast cancer can continue breastfeeding. However, when chemotherapy begins, the infant must be weaned. Inverted nipples should not impede breastfeeding. Usually the degree of inversion lessens as breastfeeding continues. Women who have acute mastitis should continue frequent breastfeedings.

Breastfeeding Considerations in Normal and Special Situations

American Academy of Pediatrics (AAP) Recommendations on Breastfeeding for Healthy Term Infants

In its most recent recommendations, the AAP has taken a very strong position on promoting breastfeeding. (1) Recommendations include exclusive breastfeeding for the first 6 postnatal months and continuation of breastfeeding for at least the first year and beyond, as long as desired by mother and child. Complementary foods rich in iron and supplementary fluoride should be introduced beginning around 6 months of age. The AAP suggests enthusiastic support of breastfeeding by all health-care professionals as well as recognition and sensitivity to cultural differences regarding breastfeeding attitudes and practices. Pediatricians should recommend human milk for all infants in whom breastfeeding is not contraindicated. When direct breastfeeding is not possible, expressed human milk should be provided. Education of both parents before and after delivery is an essential component of successful breastfeeding.

Healthy infants should be in direct skin-to-skin contact with their mothers immediately after birth. After the recovery period, mother and infant should sleep in proximity to each other to facilitate breastfeeding. Water and other fluids should not be given to breastfeeding infants unless specifically ordered by the physician.

During the first weeks of breastfeeding, the infant should have 8 to 12 feedings every 24 hours. After breastfeeding is well established, the frequency of feeding may decline to about eight times per 24 hours. The mother should offer both breasts at each feeding for as long as the infant remains at the breast. In the early weeks after birth, infants should be aroused to feed if 4 hours

Table 5. Markers of Successful Breastfeeding

- 7% or less weight loss in first few days after birth
- Return to birthweight by at least 2 weeks
- Weight gain per day of 20 to 30 g during first 3 postnatal months
- Lactation established in mother by 2 to 4 days after birth
- At least eight breastfeeding events every 24 hours
- Baby is latching onto breast easily
- Three to six stools and four to six voids by 5 to 7 days of age

have passed since the last feeding. It is recommended that trained medical personnel in the hospital evaluate breastfeeding at least twice daily, including observation of position, latch, and milk transfer.

Follow-up of breastfeeding infants after hospital discharge is critically important. The AAP recommends early follow-up within 2 days of discharge for any infant sent home when he or she is younger than 72 hours of age. An infant who has many risk factors might need to be seen earlier (within 24 h of discharge). The health-care professional should evaluate the infant's weight, hydration status, and the presence or absence of jaundice. Markers of successful breastfeeding are listed in Table 5. The next ambulatory visit can be scheduled at 2 to 3 weeks of age so the physician can monitor weight gain and provide additional support. Exclusive breastfeeding is one of several risk factors for worsening hyperbilirubinemia in the infant.

Nursing While Pregnant

Pregnancy can occur while lactating. There is no need to wean the first infant from the breast. It is possible to lactate throughout pregnancy and to have both infants at the breast postpartum. This feeding pattern can be used without any apparent ill effects on the nourishment of the new infant. The mother should be provided with psychological support as well as adequate rest and nourishment.

Breastfeeding Newborns Who Have Special Needs

PRETERM OR ILL INFANTS. In this situation, breastfeeding may be delayed for days or weeks. Medical personnel should advise mothers to begin expressing milk within hours of giving birth. Mother-infant skin-to-skin contact and direct breastfeeding should be encouraged as

early as possible. If the respiratory status of the infant precludes direct breastfeeding, gavage feedings with expressed human milk may be considered. Fortified human milk is recommended for many low-birthweight infants. Banked human milk can be a suitable alternative for infants whose mothers are unable or unwilling to breastfeed.

MULTIPLE INFANTS. Most mothers of multiple infants are capable of producing most or all of the milk required for two to four infants. These mothers need substantial help and support with early feedings. Simultaneous feeding saves time, but it is important to assess each infant initially at the breast separately.

DOWN SYNDROME. Hypotonia, abnormal anatomic structure of the oral cavity, and significant congenital heart disease may affect breastfeeding of infants who have Down syndrome. Large, flattened tongues cause difficulty latching on. In addition, affected infants may have difficulty swallowing and are at increased risk of pulmonary aspiration. Feeding usually improves as the infant's muscle tone improves. Despite these challenges, the prevalence of breastfeeding among patients who have Down syndrome is similar to that of the general population. Very close monitoring of growth and development is imperative for children who have Down syndrome and are breastfed exclusively.

CLEFT LIP AND PALATE. Studies reveal that approximately 25% of infants who have cleft lip and palate have early feeding problems, leading to poor weight gain over the first few postnatal months. Patients who have isolated cleft lip have better feeding records and faster weight gain compared with those who have isolated cleft palate. Common feeding problems include inability to generate negative sucking pressure in the oral cavity, excessive air intake, nasal regurgitation, and fatigue. However, for patients who have cleft lip/palate, breastfeeding offers several benefits over bottle-feeding. It allows a better seal due to pliability of the human breast, promotes development of oral and facial muscles, and decreases the risk of ear and respiratory infections. After repair of the cleft, experts recommend resumption of nursing as early as possible, if not in the immediate postoperative period.

Practical Issues in Breastfeeding

Guidelines for Collection and Storage of Expressed Human Milk

It is very important to maintain cleanliness to minimize bacterial contamination in the process of collection. The

mother should be instructed in washing her hands, her breasts, and pumping equipment. Many hospitals, pharmacies, and local rental companies have electric pumps that are very time-efficient. Human milk can be stored in either glass or plastic containers. Glass or flexible bottles (polypropylene containers) have significant advantages in maintaining the stability of the components of human milk, particularly IgA.

Freshly expressed human milk can be used safely for up to 8 hours at room temperature, but the potential for contamination is greater when milk is not refrigerated. Various studies support storing milk in a refrigerator ($4^{\circ}\text{C}/39^{\circ}\text{F}$) for up to 5 days without increasing the risk of bacterial contamination and to facilitate retaining some cell viability. Because refrigerated milk separates, the container should be shaken vigorously before feeding the baby. Milk can be kept for 3 months in a self-defrosting freezer and for 12 months in a freezer that has no defrost cycle that maintains a temperature of 0°F (-20°C). The milk should be thawed in the refrigerator and used within 24 hours. Defrosting in the microwave is not recommended.

Banking Human Milk

The Human Milk Banking Association of North America was established in 1985. It supervises collection, screening, processing, storing, and distribution of donated human milk for infants who are prescribed human milk. Donors are screened carefully and are taught how to express their milk by using sanitary collecting methods. Donated milk is treated by heat to destroy any bacteria or viruses. Common reasons for prescribing donor milk include allergies and formula intolerance, prematurity, failure to thrive, immunologic deficiencies, and postoperative nutrition.

Conclusion

Breastfeeding ensures the best possible physical health as well as developmental and psychosocial outcomes for infants. Overwhelming evidence supports strong recommendations to increase and sustain breastfeeding in the population. The biologic and immunologic markers in human milk, such as the specific antibodies and cellular factors as listed in Table 2, are very important to infant health, as are the various nutrients. There are very few

absolute contraindications to breastfeeding. It is imperative that pediatricians and other medical care practitioners have an in-depth understanding of the innumerable benefits of breastfeeding. Breastfeeding should become a cultural norm among all women, regardless of education and socioeconomic status.

References

1. AAP Section on Breastfeeding Policy Statement. Breastfeeding and the use of human milk. *Pediatrics*. 2005;115:496–506
2. Horwood LJ, Darlow BA, Mogridge N. Breast milk feeding and cognitive ability at 7–8 years. *Arch Dis Child Fetal Neonatal Ed*. 2001;84:F23–F27
3. Lopez-Alarcon M, Villalpando S, Fajardo A. Breastfeeding lowers the frequency and duration of acute respiratory infection and diarrhea in infants under six months of age. *J Nutrition*. 1997;127:436–443
4. Holberg CJ, Wright AL, Martinez FD, Ray CG, Taussig LM, Lebowitz MD. Risk factors for respiratory syncytial virus-associated lower respiratory illnesses in the first year of life. *Am J Epidemiol*. 1991;133:1135–1151
5. Oddy WH, Peat JK, de Klerk NH. Maternal asthma, infant feeding and the risk of asthma in childhood. *J Allergy Clin Immunol*. 2002;110:65–67
6. American Academy of Pediatrics, Committee on Infectious Diseases. Management of newborn infant whose mother has tuberculosis. *2006 Red Book, Report of the Committee on Infectious Diseases*. 27th ed. Elk Grove Village, Ill: American Academy of Pediatrics; 2006:694–695
7. World Health Organization. New data on the prevention of mother to child transmission of HIV and their policy implications. Conclusions and recommendations. Technical consultation on behalf of the UNFPA/ UNICEF/WHO/UNADIS Inter-Agency Task Team on Mother-Child Transmission of HIV. Geneva, Switzerland: October 2000. Available at: http://www.who.int/reproductive-health/stis/mctc/kesho_bora.htm. Accessed 8/26/06
8. Hale T. *Medications and Mother's Milk*. 11th ed. Amarillo, Tex: Pharmasoft Publishing; 2004

Suggested Reading

- Cahill JB, Wagner CL. Challenges in breastfeeding. *Contemp Pediatr*. 2002;19:94–138
- Churchill RB, Pickering LK. The pros (many) and cons (a few) of breastfeeding. *Contemp Pediatr*. 1998;15:108–119
- Lawrence RA. *Breastfeeding: A Guide for the Medical Profession*. 5th ed. St Louis, Mo: Mosby-YearBook, Inc; 1999
- Philipp BL, Cadwell K. Fielding questions about breastfeeding. *Contemp Pediatr*. 1999;16:149–164
- Riordan J. *Breastfeeding and Human Lactation*. 3rd ed. Sudbury, Mass: Jones and Bartlett Publishers; 2005

PIR Quiz

Quiz also available at www.pedsinreview.org.

5. You are discussing the physiology of lactation with a medical student. Which of the following statements is true?
 - A. After delivery, the prolactin concentration drops, leading to increased milk synthesis.
 - B. Lactation does not occur if pregnancy does not progress beyond 20 weeks.
 - C. Obesity does not interfere with lactogenesis.
 - D. Oxytocin causes the milk-ejection reflex or letdown.
 - E. The rate of milk synthesis is not related to the degree of emptiness or fullness of the breast.
6. Compared with mature human milk, colostrum contains more:
 - A. Calories.
 - B. Carbohydrate.
 - C. Fat.
 - D. Protein.
 - E. Vitamin C.
7. Of the following pathogens, breastfeeding is *most* likely to protect against infection caused by:
 - A. *Escherichia coli*.
 - B. Hepatitis C virus.
 - C. Herpes simplex virus.
 - D. Human immunodeficiency virus.
 - E. *Mycobacterium tuberculosis*.
8. You are evaluating a healthy breastfed newborn. In which of the following conditions would you strongly advise against breastfeeding?
 - A. The mother has a history of positive purified protein derivative test with negative chest radiograph and is currently receiving isoniazid treatment.
 - B. The mother is a chronic hepatitis C carrier.
 - C. The mother is cytomegalovirus-positive.
 - D. The mother is hepatitis B surface antigen-positive.
 - E. The mother is receiving chemotherapeutic agents for breast cancer treatment.