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Maternal and Infant Health Benefits Related to Infantile Feeding Methods

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Abstract
Human breast milk is known to provide the most complete nutrition to growing infants. There may be more gained from breastfeeding than simply nutritional fulfillment—recent research has uncovered benefits related to the development and health of infants. Breastfeeding has been shown to stimulate immune system development by exposing the infant to bacteria and antibodies from the mother. Breastfeeding may also benefit nursing mothers by improving insulin sensitivity and glucose tolerance as well as decreasing postpartum weight gain. In place of breastfeeding, formulas are able to provide an infant with necessary nutrition. Many infant formulas have been enriched with probiotics and prebiotics to provide formula-fed infants with similar immune system benefits. Research on these formulas is inconclusive at this time, though hydrolyzed formulas have the potential to prevent autoimmune diseases and food allergies. Research has found many differences between breastfed and formula-fed infants. For instance, children who had been exclusively breastfed for more than three months showed significantly higher cardiovascular fitness levels than those who were formula-fed. Additionally, at 6 months of age, breastfed infants were found to have a lower protein intake and leaner body mass compared to formula-fed infants. The microbiome of breastfed infants also differs from formula-fed infants, with breastfed infants having higher concentrations of beneficial Bifidobacterium species (spp.) and formula-fed infants hosting a wide range of potentially pathogenic bacteria including Clostridium spp., Streptococcus spp., Staphylococcus spp. and Enterobacteriaceae family. Pharmacists can play a vital role by providing breastfeeding-related services to patients including education, breast pump or infant formula selection, and counseling regarding medication use during lactation.

Key Terms
Autoimmune; Breastfeeding; Gastrointestinal Microbiome; Growth; Immune System; Infant; Infant Formula; Maternal Health; Prebiotic; Probiotic

Introduction
Breastfeeding has been the primary means for feeding infants since the beginning of human existence. Yet, early man did not realize that breast milk was not just a food source but also a key factor in child development on the microscop ic level. The advent of modern technology has allowed scientists and researchers to look more closely at the role breastfeeding may play in early development and the possible lasting effects it may produce on children as they age. Technology has also provided parents with other options for feeding children, as a plethora of infant formulas are marketed to meet the nutritional needs of a growing child.

Recent research suggests that differences may exist between the development of breastfed and formula-fed infants, specifically in areas of cardiovascular health, growth, gastrointestinal flora composition and immune system function. Studies have been conducted to examine these effects, and this article will explore some of the facts gleaned from research. Effects on the mother and infant with regard to weight gain, cardiovascular health, infant microbiome and immune development and function will be discussed as well as the role of the community pharmacist in providing breastfeeding-related services to patients.

Health Benefits
In general, public health programs across America have marketed that breastfeeding can benefit a child and mother in a variety of ways, including cardiovascular fitness. Studies suggest that the more cardiovascular exercise children complete, the less likely they are to become overweight and the more likely they are to maintain an active lifestyle as they grow. Labayen et al. looked at exclusive breastfeeding duration and cardiorespiratory fitness in 1,996 children and adolescents. Cardiovascular fitness of each participant was measured on a cycle ergometer and adjusted for country, sex, age, pubertal status and body mass index (BMI). Children who were exclusively breastfed for longer than three months as infants displayed significantly higher fitness levels than children who were formula-fed (p<0.001). With increasing duration of breastfeeding, there was a corresponding increase in the cardiovascular fitness level.

To examine the relation of breastfeeding to maternal cardiovascular health, the HUNT-study was conducted in Norway, the nation with the highest rate of breastfeeding in the world. The study followed 21,368 women aged 20 to 85 years, focusing on their duration of lactation and cardiovascular risk factors. Worsening cardiovascular health can lead to a greater risk of developing diseases such as type 2 diabetes. It was found that breastfeeding is most beneficial when women are 50 years of age or younger from a cardiovascular health perspective. The HUNT-study also concluded that breastfeeding can improve insulin sensitivity and glucose tolerance, which is beneficial for the prevention of type 2 diabetes.

A study by McClure et al. found that the lactation method is a predictor of future risk of developing diabetes, hypertension and cardiovascular disease. This study focused on maternal visceral adiposity in post-breastfeeding mothers. A total of 351 women aged 45 to 58 years were included. The researchers determined that maternal BMI is influenced by the mother's choice to formula-feed or breastfeed her infant. Mothers who breastfed consistently gained less weight and
visceral adiposity over an eight-year period postpartum as compared to mothers who formula-fed. “Women who had never breastfed had 28 percent greater visceral adiposity (95 percent confidence interval (CI): 11.49, p = 0.001), 4.7 percent greater waist-to-hip ratio (95 percent CI: 1.97-7.4, p<0.001) and 6.49 cm greater waist circumference (95 percent CI: 3.71-9.26, p<0.001) than mothers who breastfed all of their children for three months or greater”. The study adjusted for age, parity and years since last birth as well as socioeconomic, lifestyle and family history variables. The more visceral adiposity a woman has, the higher the risk of developing diabetes, hyperlipidemia or coronary artery disease. This information was true only for women who were not obese during pregnancy. Women who were obese during pregnancy showed no difference in these health risks whether they formula-fed or breastfed their infants.

Researchers have conducted numerous studies on breastfed and formula-fed infant growth. The study by Prentice et al. is the largest report describing human milk macronutrient contents and was the first extensive report to discover the relationship between macronutrients and infancy growth. The main factor contributing to the difference of infant growth in breastfed versus formula-fed infants is the amount of protein intake. Human milk was found to have lower percentage of protein compared to formula (7.3 percent in human milk, 8.3 percent in formula milk, p<0.05). The percent of protein content was found to be positively related to BMI, which can have an effect for years after infancy. At about 6 months of age, breastfed infants are leaner than formula-fed infants, most likely because of the increased caloric load in the formula compared to breast milk. The human milk contains 58.7 kcal per 100 mL compared to formula which contains 62.6 kcal per 100 mL. In summary, research indicates that breastfeeding may positively impact cardiovascular health and contribute to maintenance of a healthy weight in both infants and mothers.

**Microbiome**

The gastrointestinal (GI) flora composition is important in the digestion of complex starches along with other food products. Gastrointestinal bacteria are also a source of vitamins K and B12 which are both essential for functions such as clotting and healthy nerve function. Additionally, infants need gut bacteria to develop immune activity. The gut is first colonized by bacteria provided by the mother through a vaginal birth, contact with skin and the mother’s GI tract. A child who is delivered vaginally, compared to cesarean delivery, is exposed to bacteria from the mother’s vagina, feces and skin. These bacteria can be ingested through the mouth to enter the infant’s GI. After birth, the gut microbiome is further developed through the ingestion of either formula or breast milk.

In breastfed infants, the microbiome is dominated by the presence of Bifidobacteriaceae, a gram positive family of bacteria that is typically composed of anaerobes and is located in the GI tract, among other lactic acid bacteria. Bifidobacteriaceae have the capability to prevent pathogenic GI infections and also have anticarcinogen characteristics. Bifidobacteriaceae are also increased in infants who were delivered naturally at full term. Formula-fed infants have an entirely different and diverse group of bacteria which dominate the microbiome. These bacteria include Bifidobacteriaceae family as well as Bacteroides spp., Clostridium spp., Staphylococci spp., Streptococci spp. and Enterobacteriaceae. These additional bacteria are more likely to cause pathogenic infections, such as Clostridium difficile, than the Bifidobacteriaceae which predominate in breastfed infants.

Additionally, human milk contains natural antimicrobial agents which help to combat infections from GI flora. Formula, however, does not have antimicrobial properties like those of breast milk. Also, the infant formula of today is unable to be made sterile per current processing methods. Thus, the microbial agents present in the formula have increased growth potential if the formula is not stored properly.

Schwartz et al. performed a study to evaluate the microbiome of infants. In this study, the feces of six breastfed infants and six formula-fed infants were evaluated. Messenger ribonucleic acid (RNA) and gut epithelial cells were extracted from the collected feces. It was found that the formula-fed infants had a lower overall number of bacterial genes expressed in comparison to breastfed infants. Breastfed infants also had genes specific to promoting gut motility, such as tachykinin receptor 1, as well as genes that are involved in reactive oxygen species homeostasis, thus preventing damage to the body by free radicals. However, genes that promote mucosal inflammation, such as vascular adhesion protein 1 and interleukin 1 alpha, were downregulated in breastfed infants compared to formula-fed infants. Therefore, a higher potential GI inflammation in formula-fed infants is expected. Additionally, the higher number of genes expressed in breastfed infants is viewed as advantageous because the bacteria promote a more developed and diverse microbiome.

The current trend of using probiotics to increase gut health has consequently led to the inclusion of probiotics in infant formula. Several studies have been performed to evaluate the effects of probiotics in formulas. Costeloe and colleagues performed a multicenter, randomized, controlled trial to compare the effect of Bifidobacterium (a probiotic) to placebo. All infants included in the study were preterm (gestational age of 23 to 30 weeks and 6 days), with 650 infants in the probiotic group and 660 infants in the placebo group. The primary outcome included three main events: an episode of necrotizing enterocolitis, sepsis or death before discharge. Sepsis was defined as a positive blood culture of an organism outside the realm of normal skin flora and was drawn more than three days after birth and before 46 weeks postmenstrual age or discharge if sooner. The postmenstrual age is defined by the gestational age plus the conceptional age (time since birth) of the infant. None of the primary outcomes were found to be significantly different between the probiotic and placebo groups. The following are the specific results for the primary outcomes of the probiotic and place-
bo group, respectively: necrotizing enterocolitis 9 percent, 10 percent (95 percent CI of 0.68 to 1.27), sepsis 11 percent, 12 percent (CI 0.73 to 1.29), and death 8 percent, 9 percent (CI 0.67 to 1.30). Therefore, this study found that probiotics had no benefit in preventing necrotizing enterocolitis, sepsis or death in preterm infants. One of the limitations of this study is the choice of primary outcome since the prevention of serious conditions is not the primary goal of most mothers who would be interested in using a probiotic-enhanced formula.

Indrio and colleagues also performed a study to examine prebiotics and probiotics in preterm newborns. The 49 infants studied were split into four groups, 17 infants in the breastfed group, 10 in the probiotic group, 10 in the prebiotic group and 12 in the placebo group. The prebiotics used were short chain galacto-oligosaccharides and long chain fructo-oligosaccharides, which are nondigestible food products that stimulate the growth of gut bacteria. The probiotic used was Lactobacillus reuteri, which differs from the prebiotic because it is a microorganism which replenishes the gut flora. The primary outcome was the percentage of electro-gastroscopy (EGG), a way to measure the electrical signals which travel through the stomach muscles, measuring contraction and gastric emptying rate. The probiotic, prebiotic and breastfed groups all showed statistically significant results for the primary outcome, demonstrating that feeding of preterm infants with prebiotic or probiotic-supplemented formulas improves gastric emptying and the maturation of EGG activity, and does so in a way that closely mimics the effects of breast milk.

Cekola and colleagues evaluated much more practical primary outcomes, such as mean weight gained (in grams/day). This study was a randomized, controlled trial which was double-blinded and multicentered. It included infants 14 days old (+/- three days) who were administered either a probiotic enriched formula or a placebo formula until day 112 (+/- three days). The probiotic Lactobacillus reuteri was administered to 60 infants, and the placebo was administered to 62 infants. The weight of the infant was measured at the first visit (14 days) and at the fourth visit (day 112). Secondary outcomes of head circumference and length were also evaluated. There was no statistically significant difference in the mean weight gain between the probiotic and placebo groups (p>0.5). Mean weight gains were 29.4 g/d and 30.7 g/d for probiotic and placebo groups, respectively. Additionally, the length and head circumference were also not statistically significant.

Another study of similar design, performed by Maldonado and colleagues, included a three-year follow up of an earlier study. The original study included infants in a probiotic group who were administered Lactobacillus fermentum and breastfed infants. The study lasted five months, and the primary outcome was the safety and efficacy of the probiotic. Once safety and efficacy were established, a three-year follow up was done to evaluate the primary outcome of growth in children (including weight, length and head circumference). Secondary outcomes included incidence of infectious and noninfectious diseases or disorders that were related to intestinal function. For these outcomes, a portion of the infants from the original study were evaluated (45 in the probiotic group and 46 in the control group). The weights of both groups were in the 75th percentile of the World Health Organization (WHO) child growth standards. Since neither the primary nor secondary outcomes were significant, it cannot be concluded that early administration of probiotics helps increase infant weight or decrease rate of infection. The probiotic was only administered for five months, a short period in comparison to an infant in a practical setting which would be breastfed for much longer, thus rendering a weakness to the study. However, it is understandable to have a short duration within the original study due to the primary outcome being safety and efficacy.

Breastfed infants naturally receive more advantageous gut flora from their mothers, helping them form a healthy gut microbiome. Because all mothers are not able to breastfeed, these studies have been conducted to evaluate the addition of prebiotics and probiotics to help supplement the formulas available. Although the evidence is contradicting at times, and therefore cannot definitively be deemed beneficial, the use of these supplements is safe in infants.

Autoimmune Disease Development

Thus far, the benefits of breastfeeding infants have been displayed through exploring cardiovascular health outcomes, postpartum maternal well-being, infant growth, GI development of the infant and prevention of life-altering infections in infants. An infant's gut microbiota contributes to immune system development and may impact the development of autoimmune diseases. Breast milk contains regulatory cytokine transforming growth factor-b (TGF-b), secretory immunoglobulin A (IgA) antibodies and the innate immune receptor soluble CD14, all of which help to build an infant's immune defenses. However, it is unclear if these bioactive factors alone are enough to combat the development of autoimmune diseases. Formula-fed infants and breastfed infants develop different gut microbiomes. The combination of an infant's environmentally decided microbiome with the infant's genetic predisposition to develop certain diseases influences the development of type 1 diabetes mellitus (T1DM), rheumatoid arthritis (RA) and atopic eczema/dermatitis syndrome (AEDS).

Type 1 Diabetes Mellitus (T1DM)

Type 1 diabetes mellitus develops when pancreatic islet β-cells do not produce enough insulin due to autoimmune destruction. While biological factors, such as the presence of the human leukocyte antigen (HLA) complex gene, do contribute to risk of T1DM, environmental factors such as infant nutrition are also instrumental in determining if the disease will develop. Breastfed infants have a decreased gut permeability to enterovirus infections in comparison to formula-fed infants. Since enterovirus infections can trigger the development of β-cell autoimmunity, breastfeeding may help prevent T1DM. To investigate the relationship between infantile feeding patterns and the development of T1DM in infants with...
Breastfeeding for 12 months or longer predicted a lower risk of progression from islet autoimmunity to T1DM with a hazard ratio of 0.35 (95 percent CI [0.13-0.94]). Similarly, Rabiei investigated the duration of exclusive breastfeeding in 100 Iranian children diagnosed with T1DM and 200 non-diabetic Iranian children. Children who were breastfed for fewer than four months were found to have higher instances of T1DM (p<0.008). Although Rabiei did not control for genetic contributions to the development of disease, these results suggest that exclusive breastfeeding for at least four months may have a preventive effect on the development of T1DM.

Furthermore, a case-control, retrospective study performed in the Czech Republic by Malcova et al. obtained questionnaire data from 868 parents of children with T1DM and 1,466 parents of children who had not been diagnosed with T1DM. Survey questions gathered information about infant feeding patterns including duration of breastfeeding, timing of introduction to formula and supplementation with vitamin D. Statistical analysis displayed a correlation between a lack of breastfeeding and a risk of developing T1DM (OR=1.93). Moreover, extending breastfeeding to 12 months or longer appeared to have a negative correlation with the development of T1DM (OR=0.42). A similar case-control study was performed in Brazil by Alves et al., but the control subjects were the siblings of children diagnosed with T1DM. Overall, 123 children with T1DM, along with their respective siblings, were assessed based on rates and duration of breastfeeding as an infant. Although children with T1DM and their non-diabetic siblings had similar rates of breastfeeding, children who developed the disease were breastfed for shorter durations (3.3 versus 4.6 months, p<0.001).

This possible connection between breastfeeding and the development of T1DM has caught the attention of a global audience. Due to this widespread interest, the Trial to Reduce Insulin-Dependent Diabetes Mellitus in the Genetically at Risk (TRIGR) study was initiated in 77 centers across 15 countries. The TRIGR project is a randomized, double-blind, controlled intervention trial designed to explore the question of whether weaning to an extensively hydrolyzed formula in infancy will decrease the risk of T1DM in later childhood. Researchers recruited 5,606 newborns with family members affected by T1DM and 2,159 carrying the HLA genotype for this study. The TRIGR study will not be completed until 2017, but it seeks to provide uniform data regarding the benefits and consequences of supplementing infants at a higher genetic risk with hydrolyzed formula to prevent T1DM.

Rheumatoid Arthritis (RA)
Rheumatoid arthritis is a chronic, inflammatory, autoimmune disease that causes pain and deformity of the joints. For postpartum women with RA, breastfeeding for at least 13 months has been associated with decreasing signs and symptoms of the disease. In addition, recent studies have explored the positive protective benefits of breastfeeding for the infant who may genetically be at risk of developing RA secondary to the mother's diagnosis. Parents of 688 of the 1,386 children involved with Diabetes Autoimmunity Study in the Young (DAISY) consented to have the child's blood tested for rheumatoid factor (RF) to evaluate the risk of RA development. Children who were HLA genotype negative (not genetically at risk for T1DM) but RF positive were less likely to have been breastfed for longer than three months (OR=0.18). This statistic suggests that breastfeeding could have a protective effect against the development of RA. However, none of the children in this study developed RA, nor were they physically examined.

In contrast, Simard et al. retrospectively examined how long adults with RA were breastfed as infants. This study was a subgroup analysis of women with confirmed RA who had taken part in the Nurses' Health Study (NHS) and the Nurses' Health Study II (NHSII). While breastfeeding for longer than nine months seemed to be protective against RF-negative RA in the NHS cohort (RR=0.6), no other breastfeeding duration appeared to be significantly associated with RF-negative or RF-positive RA. Furthermore, having been breastfed was not associated with RA in either cohort, resulting in a combined RR of 1.0. These results suggest that infants who lack a genetic risk for RA may experience protective benefits of breastfeeding.

Ultimately, research findings discussing the benefits of breastfeeding and their effect on RA are inconsistent. This may be due to multiple confounding factors, such as tobacco smoke exposure, birth weight, maternal diet or simply an inability to accurately recall breastfeeding lengths. Moreover, RA may not develop until much later in life which makes correlating the effects of breastfeeding as an infant with the prevention of this disease a difficult task.

Atopic Eczema/Dermatitis Syndrome (AEDS)
When discussing the role of breastfeeding in the prevention or development of atopic disease, literature findings have been inconsistent. However, AEDS is often associated with an increased occurrence of food hypersensitivities. Hypothetically, the levels of IgA and IgE within breast milk mediate the development of AEDS as well as several food allergies. Thus, AEDS development can be controlled through infant feeding habits and there is a possibility that allergy development could be prevented. Schoetzau et al. randomly assigned 1,172 study subjects into one of four cohorts to investigate the relationship between style of feeding and the development of AEDS. The cohorts included the following: exclusively breastfed, cow's milk formula-fed, partially bottle-fed and exclusively bottle-fed. At 1 year of age, the infants who were exclusively breastfed were 47 percent less likely to develop
The children of these women were evaluated at age 2 years for the presence of AEDS. Dotterud et al. ultimately found a Lactobacillus acidophilus La-5 and Bifidobacterium animalis. the supplemented milk were Lactobacillus rhamnosus GG, et al. enrolled 415 pregnant women in a randomized, double-blind trial in which the participants consumed either probiotic-infused milk or a placebo from 36 weeks of gestation to 7 years of age. This study discovered that the prevalence of AEDS increased with each year of life (OR = 1.05) and with each year of breastfeeding (OR = 1.03). Unlike Schoetzau et al. and Chiu et al., Bergmann et al. focused on parental history and its relationship to the development of AEDS in high risk infants (OR = 2.06). Similarly, Schoetzau et al. and Chiu et al. found that breastfeeding for longer than six months was associated with an increased risk of eczema at 1 year of age (p = 0.046) and 2 years of age (p = 0.006).

A limitation of these two studies by Schoetzau et al. and Chiu et al. is that they only investigated the effect of breastfeeding on AEDS development in the first one to two years of life. However, Bergmann et al. performed a cohort study including 1,314 infants who were followed from birth to 7 years of age. This study discovered that the prevalence of AEDS increased with each year of life (OR = 1.05) and with each year of breastfeeding (OR = 1.03). Unlike Schoetzau et al. and Chiu et al., Bergmann et al. focused on parental history and its relationship to the development of AEDS in high risk infants (OR = 2.06). Similarly, Ito and Fujiwara studied 38,757 infants from birth to age 42 months using questionnaires which surveyed pattern and duration of infant feeding and the development of AEDS. Results from these questionnaires indicated a significant correlation between longer exclusive breastfeeding and the development of AEDS (p < 0.001). This further supports the findings of Bergmann et al., suggesting that a prolonged period of breastfeeding increases an infant’s risk of developing AEDS. Schoetzau et al. and Chiu et al.’s findings contradict Bergmann et al. and Ito et al.’s findings in that, with longer duration of breastfeeding in infancy, the risk of developing AEDS is increased with increased age. Further confounding this debate, Jelsema-Dannendam et al. evaluated 335 children with asthmatic mothers for risk factors of AEDS (increased IgE levels and skin prick results) and correlated these factors with the duration of breastfeeding. Results from this study found no significant association between exclusive breastfeeding and the development of eczema in the genetically at-risk children within the first six years of life.

Ultimately, the correlation between AEDS and breastfeeding is highly controversial with several confounding factors such as parental smoking, genetic risk, timing of introduction of solid foods and having domestic pets in the household. From these conflicting results, it is difficult to make an absolute conclusion regarding the effects of breastfeeding on the development of AEDS. With inconclusive information regarding breastfeeding’s direct impact on the development of AEDS, several researchers moved to evaluate the effectiveness of probiotics in reducing the occurrences of AEDS. Dotterud et al. enrolled 415 pregnant women in a randomized, double-blind trial in which the participants consumed either probiotic-infused milk or a placebo from 36 weeks of gestation until three months postpartum. The probiotics included in the supplemented milk were Lactobacillus rhamnosus GG, Lactobacillus acidophilus La-5 and Bifidobacterium animalis. The children of these women were evaluated at age 2 years for the presence of AEDS. Dotterud et al. ultimately found a correlation between probiotic use in the mothers and a decreased incidence of AEDS (p = 0.015). Supplementing the mother with probiotics thus supplemented her breast milk and her nursing child.

Similarly, Viljanen et al. divided 230 infants into three different feeding groups and evaluated their genetic predisposition for developing AEDS. Group 1 consumed Lactobacillus rhamnosus within their formula while group 2 was supplemented with Lactobacillus rhamnosus, Bifidobacterium breve and Propionibacterium freudenreichii. Group 3 received placebo supplementation. Genetic predisposition was assessed through skin prick results and IgE levels. Infants were only included in the study if these findings indicated a risk for AEDS. Infants with elevated levels of IgE who were in group 1 displayed a decreased occurrence of AEDS symptoms in comparison to infants in the placebo group (p = 0.036). This statistical significance suggests that supplementing infants who are at risk for AEDS with Lactobacillus rhamnosus may reduce outbreaks of skin irritation. Similarly, Kukkonen et al. studied 1,223 pregnant women who either received a probiotic and placebo treatment or a placebo for two to four weeks prior to birth. Following birth, infants received the same combination treatment or placebo for six months. At a two year follow-up evaluation, infants with mothers who had received the treatment had a reduced incidence of AEDS (p = 0.025). The combination of these consistent results further reinforces the suggestion that altering the gut microbiota of infants at high-risk for developing AEDS by adding probiotics to the infants’ diets can prevent the development of this disease.

Role of the Pharmacist

Community pharmacists are easily accessible to the public and are, therefore, in a unique position to provide education and services related to breastfeeding. Providing patients with facts that have been discovered through scientific research will help patients make fully informed decisions about whether to breastfeed. However, studies show that while pharmacists are willing to educate patients about breastfeeding, pharmacists lack education on the subject themselves. It has been suggested that including breastfeeding in pharmacy school curriculums and providing information about breastfeeding to practicing pharmacists through continuing education can reduce this information gap.

Perhaps most pertinent to the pharmacist is the ability to counsel patients on medication use during lactation. It is important to note that U.S. Food and Drug Administration (FDA) pregnancy risk categories assigned to medications are not applicable to breastfeeding. It is always best to avoid medications or alternative medicines during lactation; however, if a medication is needed for the mother, the risks to the infant are minimal as the amount of drug in the breast milk is generally less than 10 percent of the maternal dose. For this reason most drugs are considered safe for use during breastfeeding, but each case should be evaluated for safety based on characteristics of the drug, infant age and weight, and whether the infant was premature or a low birth weight.
When choosing a medication for a nursing patient to treat a common ailment such as a cold or pain, drugs with short half-lives or high protein binding are preferred. It should be noted that the age and weight of the infant can play a role in possible harm from a drug. Older and heavier infants will be able to metabolize a drug excreted in breast milk with reduced risk of side effects or harm. Use of local topical agents, mediations for infant formula available, and, with the proper knowledge, a pharmacist is a great resource to assist parents in choosing a formula. Pharmacists can also help mothers choose an appropriate breast pump to meet their individual needs and can provide instructions for using the pump. Under the Affordable Care Act, most private health insurance plans are required to pay for breast pumps under the umbrella of women’s preventive health services, although this may not apply to grandfathered plans. Breast pumps may also be covered under some state Medicaid programs which will vary from state to state. Pharmacists may direct patients to contact their Medicaid provider to determine if breast pumps are covered by their state Medicaid program. If a patient is unable to get a breast pump through Medicaid, a pharmacist may suggest that the patient seek assistance through the Special Supplemental Nutrition Program for Women, Infants and Children (WIC).

Conclusion
Research has shown several differences between the health and development of breastfed infants compared to formula-fed infants. One difference is the composition of gut microbiota—breastfed infants have higher concentrations of beneficial bacteria, including Bifidobacterium spp., while formula-fed infants have more potentially pathogenic bacteria including Clostridium spp., Staphylococcus spp. and Enterobacteriaceae. Breastfeeding may have a positive impact on the development of a child’s immune system while formula feeding has been linked to increased incidence of allergies. However, hydrolyzed formulas and formulas fortified with prebiotics may have protective effects against food allergies. Additionally, breastfeeding has been shown to actively stimulate an infant’s immune system and can enhance the child’s response to vaccinations. Breastfeeding has also been shown to benefit the health of the nursing mother as well as the infant. Breastfeeding has been linked to higher fitness levels in infants as well as increased insulin sensitivity and reduced postpartum weight gain in mothers. Pharmacists can assist in educating patients about breastfeeding and preparing patients to make a fully informed choice about whether to breastfeed. Pharmacists are also able to help parents select an appropriate infant formula or breast pump as well as counsel parents on the safety of medication use during lactation.

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