

Attachment to 411: Justification and References

Inappropriate Nutrition Practices for Infants

Justification

411.1 Routinely using a substitute(s) for human milk or for FDA approved iron-fortified formula as the primary nutrient source during the first year of life.

During the first year of life, breastfeeding is the preferred method of infant feeding. The American Academy of Pediatrics (AAP) recommends human milk for the first 12 months of life because of its acknowledged benefits to infant nutrition, gastrointestinal function, host defense, and psychological well-being (1). For infants fed infant formula, iron-fortified formula is generally recommended as a substitute for breastfeeding (1- 4). Rapid growth and increased physical activity significantly increase the need for iron and utilize iron stores (1). Body stores are insufficient to meet the increased iron needs making it necessary for the infant to receive a dependable source of iron to prevent iron deficiency anemia (1). Iron deficiency anemia is associated with cognitive and psychomotor impairments that may be irreversible, and with decreased immune function, apathy, short attention span, and irritability (1, 5). Feeding of low-iron infant formula can compromise an infant's iron stores and lead to iron deficiency anemia. Cow's milk has insufficient and inappropriate amounts of nutrients and can cause occult blood loss that can lead to iron deficiency, stress on the kidneys from a high renal solute load, and allergic reactions (1, 3, 5-8). Sweetened condensed milk has an abundance of sugar that displaces other nutrients or causes over-consumption of calories (9). Homemade formulas prepared with canned evaporated milk do not contain optimal kinds and amounts of nutrients infants need (1, 5, 8, 9). Goat's milk, sheep's milk, imitation milks, and substitute milks do not contain nutrients in amounts appropriate for infants (1, 3, 5, 10, 11).

411.2 Routinely using nursing bottles or cups improperly.

Dental caries is a major health problem in U.S. preschool children, especially in low-income populations (12). Eating and feeding habits that affect tooth decay and are started during infancy may continue into early childhood. Most implicated in this disease process is prolonged use of baby bottles during the day or night, containing fermentable sugars, (e.g., fruit juice, soda, and other sweetened drinks), pacifiers dipped in sweet agents such as sugar, honey or syrups, or other high frequency sugar exposures (13). The AAP and the American Academy of Pedodontics recommend that juice should be offered to infants in a cup, not a bottle, and that infants not be put to bed with a bottle in their mouths (14, 15). While sleeping with a bottle in his or her mouth, an infant's swallowing and salivary flow decreases, thus creating a pooling of liquid around the teeth (16). The practice of allowing infants to carry or drink from a bottle or training cup of juice for periods throughout the day leads to excessive exposure of the teeth to fermentable carbohydrates, which promotes the development of dental caries (14).

Allowing infants to sleep with a nursing bottle containing fermentable carbohydrates or to use it unsupervised during waking hours provides an almost constant supply of carbohydrates and sugars (1). This leads to rapid demineralization of tooth enamel and an increase in the risk of dental caries due to prolonged contact between cariogenic bacteria on the susceptible tooth surface and the sugars in the consumed liquid (1, 17). The sugars in the liquid pool around the infant's teeth and gums, feed the bacteria there, and decay is the result (18). The process may start before the teeth are even fully erupted. Upper incisors (upper front teeth) are particularly vulnerable; the lower incisors are generally protected by the

tongue (18). The damage begins as white lesions and progresses to brown or black discoloration typical of caries (18). When early childhood caries is severe, the decayed crowns may break off and the permanent teeth developing below may be damaged (18). Undiagnosed dental caries and other oral pain may contribute to feeding problems and failure to thrive in young children (18).

Unrestricted use of a bottle containing fermentable carbohydrates is a risk because the more times an infant consumes solid or liquid food, the higher the caries risk (1). Feeding behaviors such as unrestricted use of the bottle and frequent snacking can be habit forming in later infancy and may carry over into toddler-hood. Frequent cariogenic snacks eaten between meals place the toddler at high risk for caries development; this includes the habit of continually sipping from cups (or bottles) containing cariogenic liquids (juice, milk, soda, or sweetened liquid) (18). If inappropriate use of the bottle persists, the child is at risk of toothaches, costly dental treatment, loss of primary teeth, and developmental lags on eating and chewing. If this continues beyond the usual weaning period, there is a risk of decay to permanent teeth.

Propping the bottle deprives infants of vital human contact and nurturing which makes them feel secure. It can also cause ear infections because of fluid entering the middle ear and not draining properly; choking from liquid flowing into the lungs; and tooth decay from prolonged exposure to carbohydrate-containing liquids (19).

Adding solid food to a nursing bottle results in force-feeding, inappropriately increases the energy and nutrient composition of the formula, deprives the infant of experiences important in the development of feeding behavior, and could cause an infant to choke (1, 10, 20, 21).

411.3 Routinely offering complementary foods or other substances that are inappropriate in type or timing.

Infants, especially those living in poverty, are at high risk for developing early childhood caries (12). Most implicated in this disease process are: prolonged use of baby bottles containing fermentable sugars, (e.g., fruit juice, soda, and other sweetened drinks) during the day or night; pacifiers dipped in sweet agents such as sugar, honey or syrups; or other high frequency sugar exposures (13).

Feeding solid foods too early (i.e., before 4-6 months of age) by, for example, adding diluted cereal or other solid foods to bottles deprives infants of the opportunity to learn to feed themselves (3, 10, 20, 22). The major objection to the introduction of solids before age 4 months of age is based on the possibility that it may interfere with establishing sound eating habits and may contribute to overfeeding (5,23). Before 4 months of age, the infant possesses an extrusion reflex that enables him/her to swallow only liquid foods (1, 12, 24). The extrusion reflex is toned down at four months (20). Breast milk or iron-fortified infant formula is all the infant needs. Gastric secretions, digestive capacity, renal capacity and enzymatic secretions are low, which makes digestion of solids inefficient and potentially harmful (5, 20, 23, 24). Furthermore, there is the potential for antigens to be developed against solid foods, due to the undigested proteins that may permeate the gut; however, the potential for developing allergic reactions may primarily be in infants with a strong family history of atopy (5, 23). If solid foods are introduced before the infant is developmentally ready, breast milk or iron-fortified formula necessary for optimum growth is displaced (1, 20, 24). Around 4 months of age, the infant is developmentally ready for solid foods when: the infant is better able to express certain feeding cues such as turning head to indicate satiation; oral and gross motor skills begin to develop that help the infant to take solid foods; the extrusion reflex disappears; and the infant begins to sit upright and maintain balance (1, 5, 20, 23, 24).

Offering juice before solid foods are introduced into the diet could risk having juice replace breast milk or infant formula in the diet (14). This can result in reduced intake of protein, fat, vitamins, and minerals such as iron, calcium, and zinc (25). It is prudent to give juice only to infants who can drink from a cup (14).

411.4 Routinely using feeding practices that disregard the developmental needs or stage of the infant.

Infants held to rigid feeding schedules are often underfed or overfed. Caregivers insensitive to signs of hunger and satiety, or who over-manage feeding may inappropriately restrict or encourage excessive intake. Findings show that these practices may promote negative or unpleasant associations with eating that may continue into later life, and may also contribute to obesity. Infrequent breastfeeding can result in lactation insufficiency and infant failure-to-thrive. Infants should be fed foods with a texture appropriate to their developmental level. (3, 5, 10, 12, 20, 22)

411.5 Feeding foods to an infant that could be contaminated with harmful microorganisms or toxins.

Only pasteurized juice is safe for infants, children, and adolescents (14). Pasteurized fruit juices are free of microorganisms (14). Unpasteurized juice may contain pathogens, such as *Escherichia coli*, *Salmonella*, and *Cryptosporidium* organisms (14, 26). These organisms can cause serious disease, such as hemolytic-uremic syndrome, and should never be fed to infants and children (14). Unpasteurized juice must contain a warning on the label that the product may contain harmful bacteria (14, 27). Infants or young children should not eat raw or unpasteurized milk or cheeses (1)—unpasteurized dairy products could contain harmful bacteria, such as *Brucella* species, that could cause young children to contract a dangerous food borne illness. The AAP also recommends that young children should not eat soft cheeses such as feta, Brie, Camembert, blue-veined, and Mexican-style cheese—these foods could contain *Listeria* bacteria (1). Hard cheeses, processed cheeses, cream cheese, cottage cheese, and yogurt need not be avoided (1).

Honey has been implicated as the primary food source of *Clostridium botulinum* during infancy. These spores are extremely resistant to heat, including pasteurization, and are not destroyed by present methods of processing honey. Botulism in infancy is caused by ingestion of the spores, which germinate into the toxin in the lumen of the bowel (9, 10, 20, 28, 29).

Infants or young children should not eat raw or undercooked meat or poultry, raw fish or shellfish, including oysters, clams, mussels, and scallops (1)—these foods may contain harmful bacteria or parasites that could cause children to contract a dangerous food-borne illness.

According to the AAP, to prevent food-borne illness, the foods listed below should not be fed to infants or young children (1). All of the foods have been implicated in selected outbreaks of food-borne illness, including in children. Background information regarding foods that could be contaminated with harmful microorganisms is also included below:

- Raw vegetable sprouts (alfalfa, clover, bean, and radish)--Sprouts can cause potentially dangerous *Salmonella* and *E. coli* O157 infection. Sprouts grown under clean conditions in the home also present a risk because bacteria may be present in the seeds. Cook sprouts to reduce the risk of illness significantly (30).
- Deli meats, hot dogs, and processed meats (avoid unless heated until steaming hot) --These foods have been found to be contaminated with *Listeria monocytogenes*; if adequately cooked, this bacteria is destroyed.

411.6 Routinely feeding inappropriately diluted formula.

Over-dilution can result in water intoxication resulting in hyponatremia; irritability; coma; inadequate nutrient intake; failure to thrive; and/or poor growth (1, 3, 5, 10, 20, 31). Underdilution of formula increases calories, protein, and solutes presented to the kidney for excretion, and can result in hypernatremia, tetany, and obesity (3, 5, 10, 20, 31).

Dehydration and metabolic acidosis can occur with under-dilution of formula (3, 5, 10, 31). Powdered formulas vary in density so manufacturers' scoops are formula-specific to assure correct dilution (5, 20). One clue for staff to identify incorrect formula preparation is to determine if the parent/caregiver is using the correct manufacturer's scoop to prepare the formula.

411.7 Routinely limiting the frequency of nursing of the exclusively breastfed infant when human milk is the sole source of nutrients

Exclusive breastfeeding provides ideal nutrition to an infant and is sufficient to support optimal growth and development in the first 6 months of life (4). Frequent breastfeeding is critical to the establishment and maintenance of an adequate milk supply for the infant (4, 32-36). Inadequate frequency of breastfeeding may lead to lactation failure in the mother and dehydration, poor weight gain, diarrhea, and vomiting, illness, and malnourishment in the infant (4, 34, 37-42). Exclusive breastfeeding protects infants from early exposure to contaminated foods and liquids (40). In addition, infants who receive breast milk more than infant formulas have a lower risk of being overweight in childhood and adolescence (43, 44).

411.8 Routinely feeding a diet very low in calories and/or essential nutrients.

Highly restrictive diets prevent adequate intake of nutrients, interfere with growth and development, and may lead to other adverse physiological effects (3). Infants older than 6 months are potentially at the greatest risk for overt deficiency states related to inappropriate restrictions of the diet, although deficiencies of vitamins B12 and essential fatty acids may appear earlier (1, 45, 46). Infants are particularly vulnerable during the weaning period if fed a macrobiotic diet and may experience psychomotor delay in some instances (1, 47, 48). Well-balanced vegetarian diets with dairy products and eggs are generally associated with good health. However, strict vegan diets may be inadequate in calories, vitamin B12, vitamin D, calcium, iron, protein and essential amino acids needed for growth and development (49). The more limited the diet, the greater the health risk. Given the health and nutrition risks associated with highly restrictive diets, WIC can help the parent to assure that the infant consumes an adequate diet to optimize health during critical periods of growth as well as for the long term.

411.9 Routinely using inappropriate sanitation in preparation, handling, and storage of expressed human milk or formula.

Lack of sanitation in the preparation, handling and storage of expressed human milk or formula may cause gastrointestinal infection. The water used to prepare concentrated or powdered infant formula and prepare bottles and nipples (for formula and human milk) must be safe for consumption. Water contaminated with toxic substances (such as nitrates, lead, or pesticides) poses a hazard to an infant's health and should NOT be used (9). In addition, a heat source is necessary to sterilize bottles and other items used in the storage of both human milk and formula. Adequate refrigeration (40 Degrees Fahrenheit or below) is necessary to safely store human milk and prepared formula (9).

Human Milk

Published guidelines on the handling and storage of human milk may differ among pediatric nutrition authorities (1, 9, 50-53). However, there is consensus on the following human milk feeding, handling, and storage practices that are considered inappropriate and unsafe (9, 50, 54-56):

- Thawing frozen human milk in the microwave oven
- Refreezing human milk
- Adding freshly expressed unrefrigerated human milk to already frozen milk in a storage container*
- Feeding previously frozen human milk thawed in the refrigerator that has been refrigerated for more than 24 hours
- Saving human milk from a used bottle for another use at another feeding
- Failure to clean a breast pump per manufacturer's instruction

* The appropriate and safe practice is to add chilled freshly expressed human milk, in an amount that is smaller than the milk that has been frozen for no longer than 24 hours.

As stated above, there are variations in human milk storage guidelines among recognized entities, e.g., AAP and Academy of Breastfeeding Medicine (ABM) (1, 53). The ABM guidelines have longer refrigerated storage time than AAP and are cited for several organizations (1, 53). However, the ABM guidelines are for healthy term infants, and while they may be appropriate for a large percentage of the general population, the WIC population is considered an "at risk population". Therefore, it is not possible at this time to identify a clear cut-off to determine unsafe refrigeration limits for WIC risk determination.

Another consideration when recommending length of storage time is its effect on protective properties in human milk. There is evidence that after 48 hours of refrigeration, human milk significantly loses important antibacterial and antioxidant properties (57). These properties of human milk are specifically important for the prevention of necrotizing enterocolitis, retinopathy, and bronchopulmonary dysplasia of premature infants (57). Although some properties may be reduced with longer refrigerated storage, this does not diminish the overall superiority of human milk over formula, as formula does not contain these protective properties or many of the other benefits of human milk.

Participant circumstances (e.g., adequate refrigeration, safe water, heat source) as well as health of the infant need to be considered when recommending the length of time human milk may be stored in the refrigerator. Please see the WIC Works Resource System for handling and storage recommendations: http://www.nal.usda.gov/wicworks/WIC_Learning_Online/support/job_aids/safety.pdf. These recommendations are based on the AAP's guidelines for the safe handling and storage of human milk.

If the breastfeeding mother uses a breast pump, it is essential for her to fully understand the importance of and the specific manufacturer's instructions for cleaning the breast pump. Improper cleaning of breast pumps and pump parts can increase the risk of expressed human milk contamination (56).

Formula

Formula must be properly prepared in a sanitary manner to be safe for consumption. Furthermore, prepared infant formula is a perishable food, and must be handled and stored properly in order to be safe for consumption (3, 9, 20).

Most babies who are hospitalized for vomiting and diarrhea are bottle fed. This has often been attributed to the improper handling of formula rather than sensitivities to the formula. During the manufacturing process, powdered formulas can become contaminated with harmful bacteria. In rare cases, the contaminated powdered formulas may cause infections in preterm or immune compromised infants. To reduce the risk of infection in infants it is important that formulas be carefully prepared and handled. Instructions for the sanitary preparation of formulas can be obtained from the WIC Works Resource System at: http://www.nal.usda.gov/wicworks/WIC_Learning_Online/support/job_aids/formula.pdf and from the World Health Organization at: http://www.who.int/foodsafety/publications/micro/pif_guidelines.pdf. It is generally recommended to boil the water used for infant formula preparation during the first 3 months of life (9). Caregivers should consider the safety of their water source and the health status of the infant in addition to consulting with their health care provider regarding whether to continue boiling the water when preparing infant formula for the infant older than 3 months.

Manufacturers' instructions vary, depending on the product, in the length of time it is considered safe to store prepared infant formula without refrigeration before bacterial growth accelerates to an extent that the infant is placed at risk (1, 9, 20). Published guidelines on the handling and storage of infant formula indicate that it is unsafe to use prepared formula which (1, 9):

- Has been held at room temperature longer than 1 hour or longer than recommended by the manufacturer
- Has been held in the refrigerator longer than the safe storage time indicated by the manufacturer
- Remains in a bottle one hour after the start of feeding
- Remains in a bottle from an earlier feeding
- Is fed using improperly cleaned baby bottles

411.10 Feeding dietary supplements with potentially harmful consequences.

An infant consuming inappropriate or excessive amounts of single or multivitamin or mineral or herbal remedy not prescribed by a physician is at risk for a variety of adverse effects including harmful nutrient interactions, toxicity, and teratogenicity (1, 58). While some herbal teas may be safe, some have undesirable effects, particularly on infants who are fed herbal teas or who receive breast milk from mothers who have ingested herbal teas (59). Examples of teas with potentially harmful effects to infants and children include: licorice, comfrey leaves, sassafras, senna, buckhorn bark, cinnamon, wormwood, woodruff, valerian, foxglove, pokeweed, periwinkle, nutmeg, catnip, hydrangea, juniper, Mormon tea, thorn apple, yohimbe bark, lobelia, oleander, Mat e, kola nut or gotu cola, and chamomile (59-61). Like drugs, herbal or botanical preparations have chemical and biological activity, may have side effects, and may interact with certain medications--these interactions can cause problems and can even be dangerous (62). Botanical supplements are not necessarily safe because the safety of a botanical depends on many things, such as its chemical makeup, how it works in the body, how it is prepared, and the dose used (62).

411.11 Routinely not providing dietary supplements recognized as essential by national public health policy when an infant's diet alone cannot meet nutrient requirements.

Depending on an infant's specific needs and environmental circumstances, certain dietary supplements may be recommended by the infant's health care provider to ensure health. For example, fluoride supplements may be of benefit in reducing dental decay for children living in fluoride-deficient areas (1, 63).

To prevent rickets and vitamin D deficiency in healthy infants and children, the AAP recommends a supplement of 400 IU per day for the following (4,64):

1. All breastfed and partially breastfed infants unless they are weaned to at least 1 liter (or 1 quart) per day of vitamin D-fortified formula.
2. All nonbreastfed infants who are ingesting less than 1 liter (or 1 quart) per day of vitamin D-fortified formula.

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