

Infant Nutrition *and* Feeding



*A Guide for Use in the WIC
and CSF Programs*

United States Department of Agriculture
Food and Nutrition Service • Special Supplemental Food Programs

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Note to the Reader on Using This Handbook

This handbook is for staff that provide nutrition education and counseling to the parents and guardians (termed “caregivers” in the text) of at-risk infants who participate in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and the Commodity Supplemental Food Program (CSFP). This publication provides an overview of basic subjects related to infant nutrition and feeding and answers some common questions on the nutritional needs of infants; the development of feeding skills; breastfeeding; formula feeding; the introduction of complementary foods; infant feeding practices; food selection, preparation, sanitation, and storage; oral health; vegetarian nutrition; common gastrointestinal problems; obesity; and physical activity/motor skill development.

Since this publication primarily focuses on nutrition for the healthy full-term infant, the reader is advised to consult with other trained health professionals or textbooks on pediatrics or pediatric nutrition for more detailed or advanced technical information on particular aspects of infant nutrition; assessment of an infant’s nutritional status (including growth and development); and nutrition care for preterm, low-birth-weight or special needs infants, or those with medical conditions. Note that the term “health care provider” in the text refers to the physician, dentist, nurse practitioner, registered nurse, or other health professional providing medical or dental care to the infant.

This handbook can assist staff in disseminating appropriate and accurate information to

participants. It is a resource for planning individual counseling sessions, group classes, and staff in-service training sessions. Chapter 8 summarizes key points taken from the whole text. Reference citations throughout the text are cited in full at the end of each chapter. A list of resources is provided in the appendix for additional references on infant nutrition, food safety, and other related topics. For quick reference to topics, refer to the detailed index at the end of this handbook.

Every effort has been made to ensure the accuracy of the information in this handbook. The recommendations in this handbook are not designed to serve as an exclusive nutrition care plan or program for all infants. It is the responsibility of each staff person providing nutrition education to caregivers of infants to evaluate the appropriateness of nutrition recommendations in the context of an infant’s nutritional and health status, lifestyle and other factors affecting that status, and any new developments in infant nutrition. If you have a question or are unsure about the appropriateness of a particular nutrition recommendation for a particular infant, consult with the infant’s health care provider or a professional with additional expertise in pediatric nutrition before making the recommendation.

We are interested in your comments on this handbook. Please help us by completing the **READER RESPONSE** on the last page of this handbook.



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CHAPTER 1: NUTRITIONAL NEEDS OF INFANTS

Introduction

Good nutrition is essential for the growth and development that occurs during an infant's first year of life. When developing infants are fed the appropriate types and amounts of foods, their health is promoted. Positive and supportive feeding attitudes and techniques demonstrated by the caregiver help infants develop healthy attitudes toward foods, themselves, and others.

Throughout the first year, many physiological changes occur that allow infants to consume foods of varying composition and texture. As an infant's mouth, tongue, and digestive tract mature, the infant shifts from being able to only suckle, swallow, and take in liquid foods, such as breast milk or infant formula, to being able to chew and receive a wide variety of complementary foods. See Chapter 5, page 101, for more information regarding complementary foods. At the same time, infants progress from needing to be fed to feeding themselves. As infants mature, their food and feeding patterns must continually change.

For proper growth and development, an infant must obtain an adequate amount of essential nutrients by consuming appropriate quantities and types of foods. During infancy, a period of rapid growth, nutrient requirements per pound of body weight are proportionally higher than at any other time in the life cycle. Although there are many nutrients known to be needed by humans, requirements have been estimated for only a limited number of these.

This chapter includes sections on nutrition assessment, the Dietary Reference Intakes (DRIs), and background information on important nutrients needed during infancy. Counseling points that relate to the information presented in this chapter are found in Chapter 8, pages 157–158.

Nutrition Assessment

To determine an infant's nutritional needs and develop a nutrition care plan, an accurate assessment of the infant's nutritional status must be performed. The nutrition assessment provides the nutritionist or health counselor with important feeding practices and other information pertinent to an infant's health. Nutrition education sessions can then be designed to encourage positive, appropriate feeding practices and, if necessary, recommend strategies to correct inappropriate practices. By communicating periodically with a caregiver about an infant's nutritional needs in the first year of life, better care for the infant is assured.

The assessment should include an examination of:

- **Health and medical information** – Information gathered through chart review, caregiver interview, health care provider referral form(s), or other sources that may include history of chronic or acute illnesses or medical conditions, birth history, developmental disabilities, a clinical assessment identifying signs of nutritional deficiencies, and other pertinent information (e.g. immunization record);^{1, 2}
- **Dietary intake data:**^{1, 3}
 - *Feeding history* – Eating behaviors, feeding techniques, feeding problems, and environment;
 - *Appetite and intake* – Usual appetite, factors affecting intake such as preferences, allergies, intolerances, chewing/swallowing problems, feeding skills;
 - *Diet history* – Breastfed and/or infant formula-fed; frequency and duration of breastfeeding; frequency and amount of infant formula or complementary foods fed; age at introduction of complementary foods; variety of complementary foods provided; vitamin/mineral or other

supplements given; and problems such as vomiting, diarrhea, constipation, or colic; and

- *Socioeconomic background* – Primary and other caregivers, food preparation and storage facilities, use of supplemental feeding and financial assistance programs, access to health care, and ethnic and/or cultural influences on the diet.¹
- **Anthropometric Data** – Anthropometric measurements, i.e., weight for age, length for age, weight for length, and head circumference for age;¹ and
- **Biochemical Data** – Data used to diagnose or confirm nutritional deficiencies or excesses;^{1,4} in the WIC Program, hemoglobin, hematocrit, or other hematological tests are performed to screen for iron deficiency anemia.

Dietary Reference Intakes (DRIs)

The Dietary Reference Intakes (DRIs), developed by the Institute of Medicine's Food and Nutrition Board, are four nutrient-based reference values intended for planning and assessing diets. They include the Estimated Average Requirement (EAR), the Recommended Dietary Allowance (RDA), the Adequate Intake (AI), and the Tolerable Upper Intake Level (UL).⁵

Recommendations for feeding infants, from infant formula to complementary foods, are based primarily on the DRIs. The DRIs for infants are

based on the nutrient content of foods consumed by healthy infants with normal growth patterns, the nutrient content of breast milk, investigative research, and metabolic studies. It is difficult to define precise nutrient requirements applicable to all infants because each infant is unique. Infants differ in the amount of nutrients ingested and stored, body composition, growth rates, and physical activity levels. Also infants with medical problems or special nutritional needs (such as metabolic disorders, chronic diseases, injuries, premature birth, birth defects, other medical conditions, or being on drug therapies) may have different nutritional needs than healthy infants. The DRIs for vitamins, minerals, and protein are set at levels thought to be high enough to meet the nutrient needs of most healthy infants, while energy allowances, referred to as Estimated Energy Requirement (EER), are based on average requirements for infants. See page 15 for more information regarding EER.

See Appendix A, pages 180–182, for a complete table of DRIs for infants.

Important Nutrients

The following sections include information on the food sources, functions, and concerns regarding major nutrients and nutrients considered to be of public health significance to infants in the United States.

For additional information on the function, deficiency and toxicity symptoms, and major food sources of the nutrients discussed below, as well as

- EAR is the median usual intake that is estimated to meet the requirement of half of the healthy population for age and gender. At this level of intake, half the individuals will have their nutrient needs met. The EAR is used to establish the RDA and evaluate the diet of a population.
- RDA is the average dietary intake level sufficient to meet the nutrient requirement of nearly all (97–98 percent) healthy individuals. If there is not enough scientific evidence to establish an EAR and set the RDA, an AI is derived.
- AI represents an approximation of intake by a group of healthy individuals maintaining a defined nutritional status. It is a value set as a goal for individual intake of nutrients that do not have a RDA.
- UL is the highest level of ongoing daily intake of a nutrient that is estimated to pose no risk in the majority of the population. ULs are not intended to be recommended levels of intake, but they can be used as guides to limiting intakes of specific nutrients.

other nutrients not discussed, refer to Appendix C: Nutrient Chart: Function, Deficiency and Toxicity Symptoms, and Major Food Sources of Nutrients, pages 190–194.

Energy

Energy Needs

Infants need energy from food for activity, growth, and normal development. Energy comes from foods containing carbohydrate, protein, or fat. The number of kilocalories (often termed “calories”) needed per unit of a person’s body weight expresses energy needs. A kilocalorie is a measure of how much energy a food supplies to the body and is technically defined as the quantity of heat required to raise the temperature of 1 kilogram of water 1 degree Celsius. An infant’s energy or caloric requirement depends on many factors, including body size and composition, metabolic rate (the energy the body expends at rest), physical activity, size at birth, age, sex, genetic factors, energy intake, medical conditions, ambient temperature, and growth rate. Infants are capable of regulating their intake of food to consume the amount of kilocalories they need. Thus, caregivers are generally advised to watch their infants’ hunger and satiety cues in making decisions about when and how much to feed. See Table 2, page 46; Figure 1, page 42; page 59; page 87; and page 123 for more information regarding hunger and satiety cues.

Recommended Energy Allowances

*The World Health Organization’s (WHO) expert report on energy and protein requirements states:*⁶

The energy requirement of an individual is a level of energy intake from food that will balance energy expenditure when the individual has a body size and composition and level of physical activity, consistent with long-term good health; and that would allow for the maintenance of economically necessary and socially desirable physical activity. In children and pregnant or lactating women the energy requirement includes the energy needs associated with the deposition of tissues or the secretion of milk at rates consistent with good health.

Using this rationale, the Institute of Medicine Food and Nutrition Board has determined that the EER for infants should balance energy expenditure at a level of physical activity consistent with normal development and allow for deposition of tissues at a rate consistent with health. See Table 1, page 15, for the EER, reference weights, and reference lengths for infants. Modification of these requirements may be required based on individual needs and growth patterns.⁷ The kilocalories needed per unit of body weight decrease over the first year because infants older than 6 months grow more slowly.

Energy Intake and Growth Rate

A general indicator of whether an infant is consuming an adequate number of kilocalories per day is the infant’s growth rate in length, weight, and head circumference. However, physical growth is a complex process that can be influenced by size and gestational age at birth, environmental and genetic factors, and medical conditions, in addition to dietary intake. An infant’s growth rate can be assessed by periodically plotting the infant’s weight, length, and head circumference for age and weight for length on Centers for Disease Control (CDC) growth charts throughout the first year of life. See Appendix B: Use and Interpretation of CDC Growth Charts, pages 183–189. Appendix B includes basic instructions on how to collect, record, and interpret weight, length, and head circumference measures and the CDC WIC growth charts for infants. Refer to Kleinman,⁸ Lucas,⁹ National Center for Chronic Disease Prevention and Health Promotion,¹⁰ and reference textbooks on pediatric nutrition or nutrition assessment for more detailed information on the anthropometric assessment of infants.

In general, most healthy infants double their birth weight by 6 months of age and triple it by 12 months of age.¹¹ However, keep in mind that there are normal differences in growth between healthy breastfed and formula-fed infants during the first year of life. After 3 months of age, the rate of weight gain in the breastfed infant may be lower than that of formula-fed infants, but

differences are generally not reported between these infants for length and head circumference.¹² Ultimately, each infant's growth must be individually assessed.

In addition to health and medical information, anthropometric data, and biochemical data, the nutrition assessment of an infant should include an evaluation of breastfeeding frequency and duration, infant formula dilution and intake, appropriate amount and types of complementary foods, and feeding skill development. For more information regarding nutrition assessment see pages 11–12. Assessing this dietary intake data will be helpful in determining which factors are influencing the growth rate if an infant's growth per the CDC growth charts appears to be abnormally slow or rapid. For infants with an abnormal rate of growth, assess the feeding relationship for negative interactions associated with feeding that may be contributing. For more information on the feeding relationship refer to page 45. Infants with abnormally slow or rapid growth rates or recent weight loss should be referred to a health care provider for assessment.

Carbohydrates

AI for Infants

0–6 months	60 g/day of carbohydrate
7–12 months	95 g/day of carbohydrate

Carbohydrates fall into these major categories: simple sugars or monosaccharides (e.g., glucose, galactose, fructose, and mannose), double sugars or disaccharides (e.g., sucrose, lactose, and maltose), and complex carbohydrates or polysaccharides (e.g., starch, dextrans, glycogen, and indigestible complex carbohydrates such as pectin, lignin, gums, and cellulose). Dietary fiber is another name for indigestible complex carbohydrates of plant origin (these are not broken down by intestinal digestive enzymes). Sugar alcohols, including sorbitol and mannitol, are also important to consider for infants.

Functions

Carbohydrates are necessary in the infant's diet because they:

- Supply food energy for growth, body functions, and activity;
- Allow protein in the diet to be used efficiently for building new tissue;
- Allow for the normal use of fats in the body; and
- Provide the building blocks for some essential body compounds.

Carbohydrates serve as primary sources of energy to fuel bodily activities while protein and fat are needed for other essential functions in the body, such as building and repairing tissues.

Sources

The major type of carbohydrate normally consumed by young infants is lactose, the carbohydrate source in breast milk and cow's milk-based infant formula. Lactose-free infant formulas, such as soy-based infant formulas, provide carbohydrates in the form of sucrose, corn syrup, or corn syrup solids. These infant formulas are prescribed to infants who cannot metabolize lactose or galactose, a component of lactose. Some specialty infant formulas contain other carbohydrates in the form of modified corn starch, tapioca dextrin, or tapioca starch.

In later infancy, infants derive carbohydrates from additional sources including cereal and other grain products, fruits, and vegetables. Infants who consume sufficient breast milk or infant formula and appropriate complementary foods later in infancy will meet their dietary needs for carbohydrates.

Carbohydrates in Fruit Juices

Some fruit juices, such as prune, apple, and pear, contain a significant amount of sorbitol and proportionally more fructose than glucose. Infants can absorb only a portion of the sorbitol (as little as 10 percent) and fructose in these juices.¹³ Unabsorbed carbohydrate is in these

**Table 1 - Estimated Energy Requirements (EER) of Infants
(Based on the 2000 Dietary Reference Intakes)**

Males

Age (mo)	Reference Weight (kg)	Reference Weight (lb)	Reference Length (cm)	Reference Length (in)	Estimated Energy Requirements (kcal/day)
1	4.4	9.7	54.7	21.5	472
2	5.3	11.7	58.1	22.9	567
3	6.0	13.2	60.8	23.9	572
4	6.7	14.8	63.1	24.8	548
5	7.3	16.1	65.2	25.7	596
6	7.9	17.4	67.0	26.4	645
7	8.4	18.5	68.7	27.0	668
8	8.9	19.6	70.2	27.6	710
9	9.3	20.5	71.6	28.2	746
10	9.7	21.4	73.0	28.7	793
11	10.0	22.0	74.3	29.3	817
12	10.3	22.7	75.5	29.7	844

Females

Age (mo)	Reference Weight (kg)	Reference Weight (lb)	Reference Length (cm)	Reference Length (in)	Estimated Energy Requirements (kcal/day)
1	4.2	9.3	53.5	21.1	438
2	4.9	10.8	56.7	22.3	500
3	5.5	12.1	59.3	23.2	521
4	6.1	13.4	61.5	24.2	508
5	6.7	14.8	63.5	25.0	553
6	7.2	15.9	65.3	25.7	593
7	7.7	17.0	66.9	26.3	608
8	8.1	17.8	68.4	26.9	643
9	8.5	18.7	69.9	27.5	678
10	8.9	19.6	71.3	28.1	717
11	9.2	20.3	72.6	28.6	742
12	9.5	20.9	73.8	29.1	768

juices.¹³ Unabsorbed carbohydrate is fermented in the lower intestine causing diarrhea, abdominal pain, or bloating. These symptoms are commonly reported in infants and toddlers who drink excessive amounts of juice. For this and other reasons, infants up to 6 months of age should not be offered fruit juice; infants over 6 months should be offered no more than 4 to 6 ounces daily of pasteurized, 100 percent juice from a cup.¹⁴ See pages 107–108 for more information regarding infants and fruit juice. Fermentable carbohydrates also contribute to the development of tooth decay. See pages 131–132 for information regarding the role of certain carbohydrates in tooth decay.

Fiber

Dietary fiber is found in legumes, whole-grain foods, fruits, and vegetables. Breast milk contains no dietary fiber, and infants generally consume no fiber in the first 6 months of life. As complementary foods are introduced to the diet, fiber intake increases; however, no AI for fiber has been established. It has been recommended that from 6 to 12 months whole-grain cereals, green vegetables, and legumes be gradually introduced to provide 5 grams of fiber per day by 1 year of age.¹⁵ See pages 136–141 for more information on vegetarian diets, where fiber intake may be high.

Protein

AI for Infants	
0–6 months	9.1 g/day of protein
RDA for older infants	
7–12 months	11 g/day of protein

All proteins are combinations of about 20 common amino acids. Some of these amino acids are manufactured in the body when adequate amounts of protein-rich foods are eaten. Nine amino acids that are not manufactured by the human body and must be supplied by the diet are called “essential” or “indispensable” amino acids. These include: histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, and valine. Two other amino acids, cystine and tyrosine, are considered essential

for the preterm and young term infant because enzyme activities involved in their synthesis are immature.¹⁶

Functions

Infants require high quality protein from breast milk, infant formula, and/or complementary foods that:

- Build, maintain, and repair new tissues, including tissues of the skin, eyes, muscles, heart, lungs, brain, and other organs;
- Manufacture important enzymes, hormones, antibodies, and other components; and
- Perform very specialized functions in regulating body processes.

Protein also serves as a potential source of energy if the diet does not furnish sufficient kilocalories from carbohydrate or fat. As with energy needs, protein needs for growth per unit of body weight are initially high and then decrease with age as growth rate decreases.

DRI for Protein

The DRIs for protein were devised based on the intake of protein from breast milk for the exclusively breastfed infant 0–6 months old.¹⁶ Infant formula provides higher amounts of protein than breast milk, but the protein is not used as efficiently. The contribution of complementary foods to total protein intake in the second 6 months of infancy was considered in establishing the RDA for this age.

Sources

Breast milk and infant formulas provide sufficient protein to meet a young infant’s needs if consumed in amounts necessary to meet energy needs. In later infancy, sources of protein in addition to breast milk and infant formula include meat, poultry, fish, egg yolks, cheese, yogurt, legumes, and cereals and other grain products. When an infant starts receiving a substantial portion of energy from foods other than breast milk or infant formula, these complementary foods need to provide adequate protein. See pages 109–111 for information

regarding the introduction protein-rich complementary foods into an infant's diet.

Proteins in animal foods contain sufficient amounts of all the essential amino acids needed to meet protein requirements. In comparison, plant foods contain low levels of one or more of the essential amino acids. However, when plant foods low in one essential amino acid are eaten on the same day with an animal food or other plant foods that are high in that amino acid (e.g., legumes such as pureed kidney beans [low in methionine, high in lysine] and grain products such as mashed rice [high in methionine, low in lysine]), sufficient amounts of all the essential amino acids are made available to the body.¹⁷ The protein eaten from the two foods would be equivalent to the high-quality protein found in animal products. See page 137 regarding protein concerns in vegetarian diets.

Protein Deficiency

In developing countries, infants who are deprived of adequate types and amounts of food for long periods of time may develop kwashiorkor, resulting principally from a protein deficiency; marasmus, resulting from a deficiency of kilocalories; or marasmus-kwashiorkor, resulting from a deficiency of kilocalories and protein. In the United States, very few infants suffer from true protein deficiency and cases of kwashiorkor are rare.

Lipids

AI for Infants

0–6 months	31 g/day of fat
7–12 months	30 g/day of fat

Lipids are a group of substances including fats, oils, and fat-like substances, such as cholesterol. Fatty acids are the major constituent of many lipids. Fatty acids that must be provided in the diet to maintain health are called essential fatty acids. Linoleic acid (abbreviated 18:2n-6 or LA) and α -linolenic acid (18:3n-3 or ALA) are both essential fatty acids. Small amounts of linoleic and α -linolenic acid must be provided in the diet. Two other fatty acids, arachidonic acid (20:4n-6

or ARA) and docosahexaenoic acid (22:6n-3 or DHA), also known as long-chain polyunsaturated fatty acids (LCPUFA), are derived from linoleic acid and α -linolenic acid respectively. They are considered essential fatty acids only when linoleic acid and α -linolenic acid are lacking in the diet.

AI for n-6 Polyunsaturated Fatty Acids

(Linoleic acid [LA], Arachidonic acid [ARA])

0–6 months	4.4 g/day of n-6 polyunsaturated fatty acids
7–12 months	4.6 g/day of n-6 polyunsaturated fatty acids

AI for n-3 Polyunsaturated Fatty Acids

(α -Linolenic acid [ALA], Docosahexaenoic acid [DHA])

0–12 months	0.50 g/day of n-3 polyunsaturated fatty acids
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Functions

*Infants require lipids in their diets because they:*¹⁸

- Supply a major source of energy – fat supplies approximately 50 percent of the energy consumed in breast milk and infant formula;
- Promote the accumulation of stored fat in the body which serves as insulation to reduce body heat loss, and as padding to protect body organs;
- Allow for the absorption of the fat-soluble vitamins A, D, E, and K; and
- Provide essential fatty acids that are required for normal brain development, healthy skin and hair, normal eye development, and resistance to infection and disease.

Sources

Breast milk and infant formula are important sources of lipids, including essential fatty acids, during infancy. The lipid content of breast milk varies, but after about the first 2 weeks postpartum, breast milk provides approximately 50 percent of its calories from lipids.¹⁹ Infant formulas also provide approximately 50 percent of their calories as fat. Breast milk provides approximately 5.6 g/liter of linoleic acid,¹⁶ while infant formulas currently provide 3.3–8.6 g/liter. In addition, breast milk provides approximately 0.63 g/liter of n-3 polyunsaturated fatty acids¹⁶ (including α -linolenic acid and docosahexaenoic acid) while infant formulas provide 0 to 0.67 g/

liter. Manufacturers of infant formulas add blends of vegetable oils, which are high in linoleic acid, to improve essential fatty acid content. Food sources of lipids in the older infant's diet, other than breast milk and infant formula, include meats, cheese and other dairy products, egg yolks, and any fats or oils added to home-prepared foods.

Cholesterol and Fatty Acids in Infant Diets

In agreement with the National Cholesterol Education Program,²⁰ the American Academy of Pediatrics (AAP) states that “no restriction of fat and cholesterol is recommended for infants <2 years when rapid growth and development require high energy intakes.”²¹ The fast growth of infants requires an energy-dense diet with a higher percentage of kilocalories from fat than is needed by older children.

Cholesterol performs a variety of functions in the body but is not an essential nutrient because it is manufactured by the liver. Cholesterol is not added to infant formulas whereas breast milk contains a significant amount of cholesterol. In recent years, there has been interest in whether the cholesterol content of breast milk has a beneficial or adverse effect on later development of atherosclerosis. A comprehensive analysis of 37 studies confirmed total cholesterol was higher in breastfed than formula-fed infants, no different in children or adolescents who had been breast versus formula-fed, and lower in adults who were breast versus formula-fed, reinforcing the possible protective effect of cholesterol exposure in infancy.²² It has been suggested that breast milk's high level of cholesterol stimulates the development of enzymes necessary to prepare the infant's body to process cholesterol more efficiently in later life,²³ but carefully designed, well-controlled studies need to be conducted to confirm this possibility.¹⁹

Trans fats, which are believed to be similar to saturated fats in their atherosclerotic affect, are found in fat that has been modified to a more solid form, such as polyunsaturated oils used to make spreadable margarine. They are

present in most American diets, thus may be present in breast milk but serve no physiologic purpose. Trans fats are not routinely used in the preparation of infant formulas.²⁴ Further research is needed to determine the long-term effects of the consumption of trans fats by infants.²⁵

In the last several years, interest has increased concerning the content of LCPUFA in breast milk versus infant formula. Of primary interest are ARA and DHA, which are major fatty acids important for brain and retina development. Breast milk naturally contains ARA and DHA with levels varying according to the mother's diet. Some infant formulas contain the precursors of DHA, ARA, linoleic acid, and α -linolenic acid. Infants can make DHA and ARA from these precursors. Formula-fed infants have been observed to have lower plasma levels of ARA and DHA than breastfed infants, therefore questions have been posed about the formula-fed infant's ability to synthesize these fatty acids.¹⁸ Research demonstrating better cognitive function and visual acuity in breastfed infants has led to some support for the addition of ARA and DHA to infant formula.^{18, 19} This issue remains controversial.

Vitamin and Mineral Supplements

Caregivers should not supplement their infants' diets with vitamins or minerals during the first year of life unless they are prescribed by a health care provider. If a supplement is prescribed, it is important that only the dosage prescribed be given to the infant and the supplement bottle be kept out of the reach of infants and children. Excessive amounts of certain vitamins and minerals, in the form of drops or pills, can be toxic or even fatal to infants.

Vitamin D

AI for Infants	0–12 months	5 μ g (200 IU)/day
UL for Infants	0–12 months	25 μ g (1,000 IU)/day

Functions

Vitamin D, a fat-soluble vitamin, is essential for:

- Proper formation of bones and

- Utilization of calcium and phosphorus in the body.

Sources

Vitamin D is manufactured in the skin by the action of ultraviolet light (from the sun) on chemicals naturally present in the skin. The requirement for dietary vitamin D depends on the amount of exposure an infant gets to sunlight. In the United States, fortified milk products, including milk-based infant formulas, are the major dietary source of vitamin D. Fish, liver, and egg yolk are also sources of this vitamin.

Breast milk contains a small amount of vitamin D. AAP states:

Infants who are breastfed but do not receive supplemental vitamin D or adequate sunlight exposure are at increased risk of developing vitamin D deficiency or rickets. Human milk typically contains a vitamin D concentration of 25 IU/L or less. Thus the recommended adequate intake of vitamin D cannot be met with human milk as the sole source of vitamin D for the breastfeeding infant.²⁶

There is evidence that limited sunlight exposure prevents rickets in many breastfed infants. However, experts recommend limiting sunlight exposure among young infants because of recent concerns raised about the increased risk of skin cancer which may result from early exposure to sunlight. As a result of these factors, the AAP recommends that all healthy infants have a minimum intake of 200 IU of Vitamin D per day during the first 2 months of life to prevent rickets and vitamin D deficiency.²⁶ A supplement of 200 IU per day is recommended for the following:²⁶

- All breastfed infants unless they are weaned to at least 500 mL per day of vitamin D-fortified infant formula and
- All nonbreastfed infants who are consuming less than 500 mL per day of vitamin D-fortified infant formula.

Vitamin D Deficiency

An infant not receiving sufficient vitamin D through supplementation, diet, or sun exposure can develop a deficiency. Vitamin D deficiency leads to inadequate intestinal absorption of calcium and phosphorus resulting in improper bone formation and tooth mineralization. Rickets is a disease that can result from vitamin D deficiency and is characterized by swollen joints, poor growth, and bowing of the legs or knocked knees.²⁸

Rickets was common in the early 1900s; in recent years it was thought that rickets had all but been eliminated.²⁹ However, a significant number of cases were reported in the 1990s, most often among African-American infants.³⁰ These infants were breastfed, did not receive supplemental vitamin D, and had limited exposure to sunlight.^{31,32} This recent resurgence of rickets as well as concerns regarding early sun exposure resulted in the recent recommendations on supplemental vitamin D.

Vitamin A

AI for Infants

0–6 months 400 µg Retinol Active Equivalent/day of vitamin A

7–12 months 500 µg Retinol Active Equivalent/day of vitamin A

UL for Infants

0–12 months 600 µg/day of preformed vitamin A

Vitamin A, a fat-soluble vitamin, refers to a group of compounds including preformed types of the vitamin found in animal products and carotenes, precursors of vitamin A, found in plants.

Functions

Vitamin A is essential for:

- Formation and maintenance of healthy skin, hair, and mucous membranes;
- Proper vision;
- Growth and development; and
- Healthy immune and reproductive systems.

Sources

Breast milk and infant formula are major food sources of vitamin A. Additional sources of vitamin A or carotenes for infants consuming complementary foods include: egg yolks, yellow and dark green leafy vegetables and fruits (e.g., spinach, greens, sweet potatoes, apricots, cantaloupe, peaches), and liver. Some infants may have allergic reactions to certain fruits or vegetables. See pages 104–105 for precautions that caregivers should follow when introducing new foods to infants.

Vitamin A Deficiency

Although rare in the United States, vitamin A deficiency is a major nutritional problem in developing countries.³³ This deficiency can result from insufficient vitamin A intake, infection, or malnutrition and can lead to damage of varying severity to the eyes, poor growth, loss of appetite, increased susceptibility to infections, and skin changes.

Vitamin E

AI for Infants

0–6 months	4 mg/day of α -tocopherol
7–12 months	5 mg/day of α -tocopherol

Functions

Vitamin E, a fat-soluble vitamin, performs the following roles:

- Protects vitamin A and essential fatty acids in the body and
- Prevents the breakdown of tissues.

Sources

Infants receive vitamin E from breast milk and infant formula. Other vitamin E sources for older infants include green leafy vegetables; vegetable oils and their products; wheat germ; whole-grain breads, cereals, and other fortified or enriched grain products; butter; liver; and egg yolks. Vitamin E can be destroyed through processing and cooking.

Vitamin K

AI for Infants

0–6 months	2.0 μ g/day of vitamin K
7–12 months	2.5 μ g/day of vitamin K

Functions

Vitamin K, a fat-soluble vitamin, is necessary for proper blood clotting.

Sources

Sources of vitamin K include infant formula, green leafy vegetables, pork, and liver. Although this vitamin is manufactured by bacteria normally found in the intestine, this process is not fully developed in the early stages of an infant's life. Since breast milk is normally low in vitamin K, exclusively breastfed infants are at risk of developing a fatal brain hemorrhage due to vitamin K deficiency. Therefore, it is recommended that all infants be given an intramuscular injection of vitamin K at birth, regardless of the mothers' plans to breast- or formula-feed.³⁴ Infants fed an adequate amount of infant formula receive sufficient vitamin K. No requirement for vitamin K supplementation of breastfed infants after hospital discharge has been established, but some experts recommend that mothers be supplemented while they are breastfeeding.¹⁹

Vitamin C

AI for Infants

0–6 months	40 mg/day vitamin C
7–12 months	50 mg/day vitamin C

Functions

The major functions of Vitamin C (ascorbic acid), a water-soluble vitamin, include the following:

- Forming collagen, a protein that gives structure to bones, cartilage, muscle, blood vessels, and other connective tissue;
- Helping to maintain capillaries, bones, and teeth;
- Healing wounds;
- Playing a role in the body's ability to resist infections; and
- Enhancing the absorption of iron.

Sources

Breast milk and infant formulas are major food sources of vitamin C. Additional vitamin C sources include vegetables (e.g., tomatoes, cabbage, potatoes), fruits (e.g., citrus fruits, papaya, cantaloupe, and strawberries), and infant and regular fruit and vegetable juices naturally high in or fortified with vitamin C. Cooking home-prepared vegetables (or fruits if they need to be cooked) for the minimum time required to process them reduces the destruction of vitamin C in the food. See pages 108–109 for precautions that caregivers should follow when introducing vegetables and fruits.

Vitamin C Deficiency

Vitamin C deficiency can eventually lead to scurvy, a serious disease with the following symptoms in infants: poor bone growth, bleeding, and anemia.³⁵ Since breast milk and infant formula are both good sources of vitamin C, infantile scurvy is rarely seen. It should be kept in mind that cow's milk, evaporated milk, and goat's milk contain very little vitamin C.

Vitamin B12

AI for Infants

0–6 months	0.4 µg/day of vitamin B12
7–12 months	0.5 µg/day of vitamin B12

Functions

Vitamin B12, a water-soluble vitamin, is necessary for:

- Healthy blood cells and
- Proper functioning of the nervous system.

Sources

An infant's vitamin B12 stores at birth generally supply his or her needs for approximately 8 months. Major food sources of vitamin B12 are breast milk and infant formulas. Infants consuming appropriate amounts of breast milk from mothers with adequate B12 stores or infant formula receive adequate amounts of this vitamin. Complementary foods such as meat, egg yolks, and dairy products provide this vitamin later in infancy as well.

Vitamin B12 Deficiency, Breastfed Infants, and Vegetarian Diets

Vitamin B12 status at birth is strongly associated with the mothers' vitamin B12 status and the number of previous pregnancies.³⁶ After birth, the exclusively breastfed infant's vitamin B12 intake depends on the mother's intake and stores. Concentrations of vitamin B12 in breast milk are adequate as long as the maternal diet is adequate. However, infants of breastfeeding mothers who follow strict vegetarian (vegan) diets or eat very few dairy products, meat, or eggs are at risk for developing vitamin B12 deficiency.^{37,38} In these infants, vitamin B12 status may be abnormal by 4 to 6 months of age.³⁹ Signs of vitamin B12 deficiency in infancy include failure to thrive, movement disorders, delayed development, and megaloblastic anemia. The Institute of Medicine's Food and Nutrition Board recommends that infants of vegan mothers be supplemented from birth with vitamin B12 at the AI for age (0–6 months, 0.4 µg/day; 7–12 months, 0.5 µg/day).³⁹ Vitamin B12 is also a concern for an infant on a strict vegetarian or vegan diet and supplementation is indicated.⁴⁰ Advise caregivers of infants on a strict vegetarian or vegan diet to consult their health care provider regarding B12 supplementation. See page 137–138 for more information regarding vitamin B12 in vegetarian and vegan diets.

Folate

AI for Infants

0–6 months	65 µg/day of dietary folate equivalents
7–12 months	80 µg/day of dietary folate equivalents

Functions

Folate, a water-soluble or B-vitamin, is required for the following:

- Cell division
- Growth and development of healthy blood cells and
- Formation of genetic material within every body cell.

At times, folate is referred to as folic acid, but there is a difference between the two. Both are forms of the same B-vitamin, but they come from different sources. Folate occurs naturally in foods while folic acid is a synthetic form of the vitamin that is added to foods and supplements.

Sources

Infants receive folate from breast milk; infant formula; green leafy vegetables; oranges; cantaloupe; whole-grain breads, cereals, and fortified or enriched grain products; legumes; lean beef; egg yolks; and liver. Folate can be lost from foods during preparation, cooking, or storage.

Vitamin B6 (Pyridoxine)

AI for Infants

0–6 months	0.1 mg/day of vitamin B6
7–12 months	0.3 mg/day of vitamin B6

Functions

Vitamin B6 (pyridoxine), a water-soluble vitamin, is necessary for:

- Helping the body use protein to build tissues and
- Aiding in the metabolism of fat.

The need for this vitamin is directly related to protein intake; as protein intake increases, the need for vitamin B6 in the diet increases.

Sources

Food sources of vitamin B6 include breast milk; infant formula; liver; meat; whole-grain breads, cereals, and other fortified or enriched grain products; legumes; and potatoes.

Thiamin (Vitamin B1)

AI for Infants

0–6 months	0.2 mg/day of thiamin
7–12 months	0.3 mg/day of thiamin

Functions

Thiamin (vitamin B1), a water-soluble vitamin, is needed by infants to:

- Help the body release energy from carbohydrates during metabolism and

- Play a vital role in the normal functioning of the nervous system.

Sources

Food sources of thiamin include breast milk; infant formula; whole-grain breads, cereals, and other fortified or enriched grain products; legumes; lean pork; and potatoes.

Thiamin Deficiency

Thiamin deficiency can occur in breastfed infants of thiamin-deficient mothers. However, there have been no recent reports in the United States or Canada of thiamin deficiency in exclusively breastfed infants regardless of their mother's thiamin status.^{39,41}

Riboflavin (Vitamin B2)

AI for Infants

0–6 months	0.3 mg/day of riboflavin
7–12 months	0.4 mg/day of riboflavin

Functions

Riboflavin (vitamin B2), a water-soluble vitamin, helps the body release energy from protein, fat, and carbohydrates during metabolism.

Sources

Food sources of riboflavin include breast milk; infant formula; organ meats; dairy products; egg yolks; green vegetables (e.g., broccoli, asparagus, turnip greens); and whole-grain breads, cereals, and fortified or enriched grain products.

Riboflavin Deficiency Associated With Macrobiotic Diets

Riboflavin deficiency has not been reported among infants in the United States, although breastfed infants whose mothers are on a macrobiotic diet that excludes dairy products, red meat, and poultry may be at risk. See page 136 for a description of the macrobiotic diet. Riboflavin deficiency can lead to growth inhibition; deficiency symptoms include skin changes and dermatitis, anemia, and lesions in the mouth.

Niacin

AI for Infants

0–6 months 2 mg/day of preformed niacin

7–12 months 4 mg/day of niacin equivalents

Functions

Niacin, a water-soluble vitamin, helps the body release energy from protein, fat, and carbohydrates during metabolism. The need for niacin is normally met in part by the body's conversion of the amino acid tryptophan in the diet to niacin.

Sources

Food sources of niacin include breast milk; infant formula; egg yolks; poultry; meat; fish; and whole-grain breads, cereals, and fortified or enriched grain products. Niacin can be formed in the body from the tryptophan in these foods: meat, poultry, cheese, yogurt, fish, and eggs.

Calcium

AI for Infants

0–6 months 210 mg/day of calcium

7–12 months 270 mg/day of calcium

Functions

Calcium, a mineral, plays an important role in the following activities:

- Bone and tooth development
- Blood clotting and
- Maintenance of healthy nerves and muscles.

Sources

An infant can obtain sufficient calcium by consuming adequate amounts of breast milk or infant formula. Older infants can obtain additional calcium from complementary foods such as yogurt, cheese, fortified or enriched grain products, some green leafy vegetables (such as collards and turnip greens), and tofu (if the food label indicates it was made with calcium sulfate).

The absorption and use of calcium in the body is affected by the presence of other nutrients,

such as vitamin D which must be available in the body for an infant to retain and use the calcium consumed. The calcium from breast milk is more completely absorbed than the calcium from cow's-milk-based or soy-based infant formulas. However, higher levels are present in these infant formulas to account for the difference in absorption.

Calcium Deficiency and Vegetarian Diets

Infants on certain strict vegetarian diets may be at risk for developing a calcium deficiency.⁴² Use of soy-based infant formulas, which are fortified with calcium, are recommended for infants whose caregivers place them on a vegan diet, low in breast milk.³⁹ Soy-based beverages (sometimes called soy drink or soy milk), available in most retail food stores, typically do not provide sufficient calcium for infants and thus are not recommended for infants. See pages 86 and 137 for more information on soy-based beverages.

Calcium Deficiency and Lead Poisoning

Calcium deficiency is related to increased blood lead levels and perhaps increased vulnerability to the adverse effects of lead in the body.⁴³ Infants at risk for lead poisoning should receive the recommended amount of breast milk or infant formula to provide adequate dietary calcium.

Iron

AI for Infants

0–6 months 0.27 mg/day of iron

RDA for Infants

7–12 months 11 mg/day of iron

UL

0–12 months 40 mg/day of iron

Functions

Iron, a mineral, is needed by infants for:

- Proper growth and formation of healthy blood cells and
- Prevention of iron-deficiency anemia.

This mineral is a vital component of hemoglobin, the part of red blood cells that carries oxygen

throughout the body; myoglobin, the part of muscle cells that stores oxygen; and many enzymes in the body.

Sources

Most full-term infants are born with adequate iron stores that are not depleted until about 4 to 6 months of age.³³ In comparison, preterm infants and twins have lower iron stores at birth and, with their rapid growth rate, may deplete their iron stores by 2 to 3 months of age.⁴⁴

Sources of iron for infants include breast milk; infant formula; meat; liver; legumes; whole-grain breads, cereals, or fortified or enriched grain products; and dark green vegetables. The ability to absorb the iron in food depends on the infant's iron status and the form of iron in the food. Absorption of iron from the diet is relatively low when body iron stores are high and absorption may increase when iron stores are low.⁴⁵

Iron in food occurs in two major forms:

- **Heme iron** – found primarily in animal tissues, including red meat, liver, poultry and fish. This form is well absorbed into the body. Commercially prepared infant food plain meats contain more heme iron than infant food combinations and dinners.
- **Nonheme iron** – found in breast milk; infant formula; iron-fortified breads, cereals, or other grain products; legumes; fruits; and vegetables. Infants receive most of the iron in their diets as nonheme iron. This form is not as well absorbed into the body as heme iron and its absorption can be affected by other foods in the same feeding or meal. Vitamin C-rich foods or meat, fish, or poultry in a meal increase the absorption of nonheme iron. Thus, it is recommended to serve a vitamin C source (such as breast milk, iron-fortified infant formula, or vitamin C-rich fruit juices or foods) at the same meal as iron-fortified grain products or legumes. Dairy products reduce the absorption of iron.

Meeting Iron Requirements of Breastfed and Formula-Fed Infants

The AAP has carefully reviewed the need for iron supplementation in infancy.⁴⁶ To ensure adequate iron intake, they recommend the following:⁴⁴

Breastfed Infants:

- Full-term, appropriate-for-gestational-age breastfed infants need a supplemental source of iron starting at 4 to 6 months of age (approximately 1 mg/kg/day) preferably from complementary foods. Iron-fortified infant cereal and/or meats are a good source of iron for initial introduction of an iron-containing food. An average of 2 servings (½ oz or 15 g of dry cereal per serving) is needed to meet the daily iron requirement.
- If a full-term, breastfed infant is unable to consume sufficient iron from dietary sources after 6 months of age, an oral iron supplemental should be used.
- For all infants younger than 12 months, only iron-fortified infant formula (10 to 12 mg/L) should be used for weaning or supplementing breast milk.

Formula-Fed Infants:

- For full-term infants, only iron-fortified infant formula should be used during the first year of life regardless of the age when infant formula is started. All soy-based formulas are iron-fortified to 12 mg/L.
- No common medical indication exists for the use of a low-iron infant formula. The AAP has recommended the discontinuation of the manufacturing of low-iron formula and that all infant formulas contain at least 4 mg/L of iron. Although some believe that iron-fortified infant formula increases gastrointestinal symptoms, no scientific evidence supports this belief. Consequently, using non-iron-fortified infant formula for healthy infants is not justified.

Other Milks

Cow's milk, goat's milk, and soy-based beverages (e.g., soy milk) contain relatively little iron or the

iron they contain is poorly absorbed by infants. These milks can promote the development of iron-deficiency anemia by causing microscopic gastrointestinal bleeding and nutritionally significant blood loss in infants.⁴⁷ Studies show that blood loss induced by the consumption of cow's milk decreases in the older infant and disappears by 12 months of age.^{48,49} For this and other reasons, cow's milk, goat's milk, or soy-based beverages are not recommended for infants less than 12 months old.⁴⁴ See pages 85–86 for additional information regarding other milks.

Iron Deficiency

The WIC Program screens for iron deficiency (deficiency in iron stores) using hematological tests, such as the hemoglobin and hematocrit tests. Hemoglobin is the iron-containing, oxygen-carrying protein in the blood. Hematocrit refers to the packed cell volume (volume of red blood cells and other particulate elements in the blood), that is, the percentage the red cell volume is of a total unit volume of blood. The symptoms of iron deficiency include anemia, malabsorption of food, irritability, anorexia, pallor, and lethargy. Studies have also shown that iron deficiency in infants and older children may be associated with irreversible behavioral abnormalities and abnormal functioning of the brain.⁵⁰ Elevated blood lead levels have been associated with iron deficiency; however, the relationship is unclear.⁵¹ Current recommendations from the CDC are for infants at high risk for iron-deficiency anemia to be screened between 9 and 12 months of age regardless of blood lead levels.^{51, 52} If an infant has a low hematocrit or hemoglobin level based on blood testing, it is appropriate to assess the infant's diet and refer him or her to a health care provider for further assessment and treatment.

Zinc

AI for Infants	0–6 months	2 mg/day of zinc
UL for Infants	0–6 months	4 mg/day of zinc
UL for Infants	7–12 months	5 mg/day of zinc
RDA for Infants	7–12 months	3 mg/day of zinc

Functions

Zinc, a mineral that is a component of many enzymes in the body, is involved in most metabolic processes.

Zinc plays a role in the following bodily functions:

- Formation of protein in the body and thus assists in wound healing
- Blood formation
- General growth and maintenance of all tissues
- Taste perception and
- A healthy immune system.

Sources

Infants obtain zinc from breast milk; infant formula; meat; poultry; liver; egg yolks; cheese; yogurt; legumes; and whole-grain breads, cereals, and other fortified or enriched grain products. Meat, liver, and egg yolks are good sources of available zinc, whereas whole-grain products contain the element in a less available form. Breast milk is considered to be a good source of zinc for the first 6 months, but is inadequate for the older infant.³³ In addition to breast milk or infant formula, complementary food sources of zinc, such as meats or fortified infant cereal, help meet an infant's zinc needs after 6 months of age.

Zinc in Vegetarian Diets

Some vegetarian diets may be deficient in zinc. Some researchers have recommended zinc supplementation for infants on vegan diets during weaning;^{53,54} however, the AAP does not currently recommend supplementation because zinc deficiency among vegetarians is rare.⁵⁵ Advise caregivers of infants on vegan/vegetarian diets to consult their health care provider regarding supplementation. See page 138 for more information regarding zinc in vegetarian diets.

Zinc and Lead Poisoning

High levels of dietary zinc may inhibit absorption of lead; however, zinc supplementation is not recommended for infants with elevated blood lead levels.⁵¹

Fluoride

AI for Infants

0–6 months 0.01 mg/day of fluoride

7–12 months 0.5 mg/day of fluoride

UL for Infants

0–6 months 0.7 mg/day of fluoride

7–12 months 0.9 mg/day of fluoride

Functions

Fluoride is not considered an essential nutrient, but is a beneficial mineral. If consumed at appropriate levels, fluoride decreases the susceptibility of the teeth to dental caries (tooth decay). When allowed to come in contact with the teeth and to some extent when consumed before teeth erupt, this mineral is incorporated into the mineral portion of the teeth. Once fluoride is an integral part of the tooth structure, teeth are stronger and more resistant to decay.

Sources

Fluoride is present in small but varying concentrations in water supplies and in plant and animal foods. The major dietary sources for infants are fluoridated water, infant formulas made with fluoridated water, and some marine fish.²⁸ Since continued exposure to appropriate levels of fluoride throughout one's lifetime is effective in reducing the prevalence of dental caries, many communities add fluoride to the water supply if it is naturally low in that mineral. Most public water supplies are fluoridated to provide 0.7 ppm to 1.2 ppm of fluoride.

If the fluoride content of the home drinking water is unknown, the water should be tested. Some health departments will test water for fluoride at no cost, if the request is signed by a dental or medical health care provider. Private laboratories can also test for fluoride. Fluoride may not be specifically added to bottled waters, but the mineral may be inadvertently present. The majority of bottled waters do not contain adequate fluoride to meet daily needs. Manufacturers of bottled water are not required to include fluoride content on the label and few do. Thus, caregivers using bottled water (other than distilled water) to mix infant formula,

prepare food, and drink should contact the manufacturer to determine its fluoride content or have it tested. Without this information it is impossible for the health care provider to adequately assess the amount of fluoride the infant is ingesting. Bottled waters manufactured and marketed specifically for infants may contain fluoride and must be labeled as such. In some cases, fluoride in these products may exceed the safe amount for an infant to ingest if used to prepare infant formula. Caregivers should be advised to discuss use of these products with a health care provider. Certain types of home water treatment systems, such as reverse osmosis and distillation units, may remove fluoride from the water.⁵⁶ Carbon and charcoal water filtration systems, the most common types used in homes, and water softeners do not significantly change the fluoride content of water. Commercially prepared infant food is generally prepared with nonfluoridated water.

Fluoride Supplementation for Infants

Recommended fluoride supplementation depends on the total amount of fluoride available to the infant from all sources, including infant formula, water, and commercially and home-prepared infant foods.

The AAP, the American Academy of Pediatric Dentistry (AAPD), and the CDC recommend no fluoride supplementation for infants less than 6 months old.^{56,57,58} For infants older than 6 months, whose community drinking water contains <0.3 ppm fluoride, supplementation of 0.25 mg sodium fluoride/day is recommended.

Excessive Fluoride

Fluoride supplementation should not be given to infants who are consuming an adequate amount of fluoride from either naturally occurring or community-supplemented water supplies. Some infants and children may be drinking water that contains naturally occurring fluoride that exceeds the recommended levels for optimal dental health. To determine whether drinking water may contain excessive levels of fluoride, testing should be done as mentioned above. If a fluoride

Considerations for Breastfed Infants.

Breast milk contains little fluoride even in areas with fluoridated water.⁵⁹ Since fluoride intake during the first 6 months does not affect the development of caries, no supplementation is indicated.²⁸ It should also be noted that fluoride supplementation may not be appropriate for older breastfed infants who are consuming either fluoridated drinking water, infant formula mixed with fluoridated water, or complementary foods (beverages or solids) prepared with fluoridated water.⁵⁷ Given the above controversies and concerns, caregivers of exclusively or partially breastfed infants should consult their infants' health care provider for advice on fluoride.

Considerations for Formula-Fed Infants.

The amount of fluoride in concentrated or powdered infant formula depends on the amount of fluoride in the infant formula and in the water used for mixing. Ready-to-feed infant formulas are manufactured with nonfluoridated water. Infants receiving ready-to-feed infant formula as well as concentrated or powdered infant formula in areas where the water is not fluoridated may receive little or no fluoride. Infants fed infant formula made with fluoridated water may receive up to 1.0 mg/day of fluoride.²⁸ Given the variability of exposure to fluoride from infant formula and water used for mixing, caregivers of formula-fed infants should consult their infants' health care provider for advice on fluoride.

Considerations for Infants on Complementary Foods.

Once a breastfed or formula-fed infant begins drinking fluoridated water or eating foods prepared with fluoridated water on a regular basis, the fluoride in the infant's diet will increase. Infants consuming primarily commercially prepared infant foods or infant formula, foods or beverages prepared with water low in fluoride should be referred to a health care provider for advice on fluoride.

supplement is prescribed, it is important for the caregiver to give only the amount prescribed. These concerns are important because fluoride (from natural sources or supplements), when consumed in excess over time, may cause staining or “mottling” of the teeth, termed dental fluorosis. Fluorosis affects approximately 22 percent of children, almost all to a mild to moderate degree.⁵⁶ An alternative water source is recommended when the home water supply contains 2.0 ppm or more of fluoride. The unintentional ingestion of toothpaste can cause an increase in daily fluoride intake. For this reason, it is not recommended that fluoridated toothpaste be used until after 2 years of age.

Sodium**Functions**

Sodium, a mineral, is required to:

- Maintain the water balance in the body
- Regulate blood volume and
- Ensure the proper functioning of cell membranes and other body tissues.

Sources

Healthy, full-term infants consuming primarily breast milk or infant formula of standard dilution receive a relatively small amount of sodium but an amount adequate for growth. Estimated minimum requirements for infants are 100 to 200 mg/day.⁶⁰ The sodium level in cow's milk is greater than that in breast milk and most infant formulas; however, cow's milk is not recommended for infants. Salt is not added to commercially prepared infant foods; however, salt is added to “junior” or “toddler” foods designed for children from 1 to 4 years old to improve their taste. These foods are not recommended for infants. The amount of sodium consumed by an infant on home-prepared complementary foods reflects the cooking methods used in the home and the eating habits and cultural food patterns of the infant's family.

Water

Functions

Water is required by infants for the following activities:

- Body temperature regulation
- Transport route (fluid medium) for nutrients and metabolic waste products
- Cell metabolism and
- Normal kidney function.

Water and Renal Solute Load of Foods

The role that water plays in the excretion of waste products by an infant's kidneys is particularly important. The kidney needs water to easily excrete waste products, called solutes, via the urine. Solute is "end products" formed after food has been fully digested and metabolized. Examples of solutes include compounds containing nitrogen from the breakdown of protein and the minerals sodium, potassium, and chloride that are consumed in excess of body needs. The term used to express the relative amount of solutes from a food or a mixture of foods presented to the kidney for excretion is "renal solute load."

The higher the renal solute load of a food, the more water is required to properly excrete the byproducts that result from digestion and metabolism of the food. The immature kidneys in very young infants have difficulty handling the byproducts of foods with a high renal solute load.⁶¹ These foods include cow's milk and high protein foods. Breast milk has a lower renal solute load compared to infant formulas and diluted evaporated whole-milk formulas; cow's and goat's milk have a much higher renal solute load than infant formulas.⁶² Due to their very high renal solute load, cow's milk, highly concentrated infant formula, undiluted evaporated milk, or boiled undiluted cow's milk should not be fed to infants. When milk is boiled, some of the water in it evaporates leading to an excessive concentration of protein and minerals.

Sources of Water

Infants' water needs are met from consuming breast milk, infant formula, and complementary foods. Water is also formed in the body in chemical reactions occurring to metabolize protein, fats, and carbohydrates. Under normal circumstances, the water requirements of healthy infants who are fed adequate amounts of breast milk or properly reconstituted infant formula are met by the breast milk or infant formula alone. Supplemental water is not necessary, even in hot, dry climates,⁶³ and may have severe consequences if given in excess. See page 39 for more information regarding excess water in the diet.

An infant's health care provider may recommend feeding a small amount of sterile water (~4 to 8 oz per day) in a cup when complementary foods are introduced at the appropriate time. Sterile water is water that is brought to a very bubbly boil, boiled for 1 to 2 minutes, and then allowed to cool. Instruct the caregiver to consult their health care provider concerning their infant's water needs when introduced to complementary foods.

Insufficient Water Intake

Infants may receive an insufficient amount of water under any of the following circumstances:⁶⁴

Dietary Intake-Related Circumstances

- **Infant is fed infant formula that is too concentrated** – When too little water is added to liquid concentrate or powdered infant formula, the renal solute load of the infant formula will be high. Instruct the caregiver on proper infant formula preparation to avoid this problem.
- **Infant consumes much less infant formula or breast milk than usual, such as when ill** – Infants who are ill and are not feeding normally should be referred to a health care provider.
- **Infant consumes protein-rich or salty foods with a high renal solute load** – These foods include protein-rich foods such as home-prepared meats, commercially prepared infant meats and meat dinners, egg yolks,

and foods with added salt. Water (about 4 to 8 ounces per day) may be recommended for the infant when these foods are introduced at the developmentally appropriate time (usually after 6 months of age). See pages 109–111 for more information regarding introducing protein-rich complementary foods.

- **Infant is fed whole-fat, low-fat, or skim cow's milk** – These milks are not recommended because they have a high renal solute load and are dangerous for infant consumption.

Medical Condition-Related Circumstances (Water Requirements/Needs Are Increased)

- **Infant is vomiting or has diarrhea** – Refer infants with vomiting or diarrhea to a health care provider. Caregivers who attempt to self-treat diarrhea by, for example, feeding their infants large amounts of water or other liquids (e.g., fruit juices; soda; diluted fruit punches, drinks, or aides; tea; broth; or gelatin water), may actually worsen the condition. Home-prepared beverages can cause fluid from the body to be drawn into the intestinal tract and thus encourage greater fluid loss from the body. Caregivers should use an oral electrolyte solution (e.g. Pedialyte, Equalyte) to treat vomiting or diarrhea only when prescribed by a health care provider. See page 30 for information regarding excessive water intake.
- **Infant has a fever** – Fever may increase an infant's water requirements. Refer infants whose caregivers report that they have a fever to a health care provider.
- **Infant has a medical condition that increases water requirements (e.g., diabetes insipidus)** – Infants with medical conditions, such as diabetes insipidus, should be under a health care provider's care.

Excessive Water in the Diet and Water Intoxication

Water intoxication can occur in either breastfed or formula-fed infants who are fed excessive amounts of water. This condition can develop in infants who consume infant formula over-diluted with water, those who are force-fed water, or

those who are fed bottled water in place of breast milk or infant formula.^{65, 66, 67} This condition, while preventable, can be life-threatening to an infant. Symptoms of the condition include irritability, sleepiness, hypothermia, edema, and seizures. Also, infants fed excessive water will not receive adequate kilocalories to meet their needs for growth and development.

Dehydration

Since dehydration (excessive loss of water from the body) can lead to death in infants, caregivers need to be aware of the signs of dehydration, which include the following:

- A reduced amount of urine, which is also dark yellow in color;
- Dry membranes in the mouth;
- No tears when crying;
- Sunken eyes; and
- Restlessness, irritability, or lethargy.

Refer the infant to a health care provider for immediate medical attention if the caregiver notes that the infant has any symptoms of dehydration.

Safety of the Water Supply

Formula-fed infants on concentrated or powdered infant formula consume a significant amount of water from the amount used in infant formula preparation. So, it is important that the water consumed be safe and free of potentially harmful contaminants. Water from public or municipal water systems is regularly tested for contaminants regulated by Federal and State standards, such as pathogens, radioactive elements, and certain toxic chemicals. Since 1999, public water suppliers have been required by the United States Environmental Protection Agency (EPA) to provide residents with a consumer confidence report on their water each year by July 1. They are also required to provide notification of any contamination when it is discovered.

*Consumer Confidence Reports for public water systems must include:*⁶⁸

- The lake, river, aquifer, or other source of the drinking water;

- Information on the susceptibility of the source to contamination, the level of any contaminant found in the drinking water, the likely source of the contaminant, the EPA health-based standard (maximum allowed) for the contaminant, health effects of the contaminant, and the actions to restore safe water;
- The system's compliance with other drinking water-related rules;
- Educational information on avoidance of *Cryptosporidium* for vulnerable populations and on nitrate, arsenic, and lead where these exceed 50 percent of the EPA standard; and,
- Information on how to get more complete information from the water supplier and the EPA's Safe Drinking Water Hotline, 1-800-426-4791.

Large water system suppliers often mail this report, while smaller system suppliers may publish it in a local newspaper. The largest systems are required to post their reports on the web and the EPA is working to have all reports posted on the Web. Reports from public water systems nationwide are available on the Web at <http://cfpub.epa.gov/compliance/resources/reports/accomplishment/sdwa/>.

Anyone with an infant or child and all pregnant women should be aware that contaminants can enter a home's or apartment's water supply from a

variety of sources; e.g., via lead pipes, lead solder, or lead service lines; bacteria inside the home's or building's plumbing system, or community water system; or a contaminated ground water supply draining into a household well. If they suspect any of these sources could be contaminating their drinking water, they should strongly consider having their tap water tested. If contaminants are found, appropriate actions can be taken to reduce the risk to infants and children. Refer to pages 35–39 for more information regarding the safety of well water, lead, copper, and nitrate contamination, the use of bottled water, and home water treatment units.

For more information on health issues specific to drinking water contaminants (e.g., lead, nitrate, bacteria, pesticides) contact the EPA Safe Drinking Water Hotline at 1-800-426-4791. The hotline operates from 9:00 a.m. to 5:00 p.m. Eastern Standard Time (EST).

What to do if the parent/caregiver runs out of infant formula

Since the WIC and CSF Programs' infant formula allowance is intended to be supplemental and not meet the nutritional needs of all infants, caregivers will need to obtain additional infant formula beyond that provided by WIC or CSFP. If the amount of infant formula provided by the WIC or CSF Program is insufficient to meet an infant's needs, then:

- Offer powdered infant formula instead of concentrated or ready-to-feed infant formula, since powdered infant formula has a higher yield.
- Refer the parent/caregiver to sources of financial or food assistance in the community that they may be eligible for.

References:

1. Klawitter BM. Nutrition Assessment of Infants and Children. In: Nevin-Folino N, editor. *Pediatric Manual of Clinical Dietetics*, 2nd ed. Chicago, IL: American Dietetic Association, 2003:145-161.
2. Olsen IE, Mascarenhas MR, Stallings VA. Clinical Assessment of Nutritional Status. In: Walker WA, Watkins JB, Duggan C, editors. *Nutrition in Pediatrics*. 3rd ed. Hamilton, Ontario: BC Decker, Inc., 2003.
3. Story M, Holt K, Sofka D. *Bright Futures in Practice: Nutrition - Pocket Guide* Arlington, VA: National Center for Education in Maternal and Child Health, 2002.
4. Lo CW, O'Bryan A. Laboratory Assessment of Nutritional Status. In: Walker WA, Watkins JB, Duggan C, editors. *Nutrition in Pediatrics*. 3rd ed. Hamilton, Ontario: BC Decker, Inc., 2003.
5. Institute of Medicine, Food and Nutrition Board. *Dietary Reference Intakes. Applications in Dietary Assessment*. Washington, D.C.: National Academy Press, 2000.
6. FAO/WHO/UNU Expert Consultation. *Energy and Protein Requirements*. Geneva, Switzerland: World Health Organization, 1985.
7. Butte NF. Meeting Energy Needs. In: Tsang RC, Zlotkin SH, Nichols BL, Hansen JW, editors. *Nutrition During Infancy: Principles and Practice*. 2nd ed. Cincinnati, OH: Digital Educational Publishing, Inc., 1997:57-82.
8. Kleinman RE, editor. *Pediatric Nutrition Handbook*. 5th ed. Elk Grove Village, IL: American Academy of Pediatrics, 2004:407-423.
9. Lucas BL, Feucht SA. Introduction to Using Growth Charts for Medical Nutritional Evaluations. In: Nevin-Folino N, editor. *Pediatric Manual of Clinical Dietetics*. 2nd ed. Chicago, IL: American Dietetic Association, 2003:758-762.
10. National Center for Chronic Disease Prevention and Health Promotion. *Use and Interpretation of the CDC Growth Charts - An Instructional Guide*. Atlanta: Centers for Disease Control and Prevention; 2001 (accessed August 22, 2007). Available from : http://www.cdc.gov/nccdphp/dnpa/growthcharts/guide_intro.htm
11. Butte NF, Hopkinson JM, Wong WW, Smith EO, Ellis KJ. Body composition during the first 2 years of life: an updated reference. *Pediatric Research* 2000; 47(5):578-585.
12. Breastfeeding In: Kleinman RE, editor. *Pediatric Nutrition Handbook*. 5th ed. Elk Grove Village, IL: American Academy of Pediatrics, 2004:55-85.
13. Lifschitz CH. Carbohydrate absorption from Fruit Juices in Infants. *Pediatrics* 2000; 105(1):e04.
14. Committee on Nutrition, American Academy of Pediatrics. The use and misuse of fruit juice in pediatrics. *Pediatrics* 2001; 107(5):1210-1213.
15. Agostoni C, Riva E, Giovannini M. Dietary fiber in weaning foods of young children. *Pediatrics* 1995; 96(5):1002-1005.
16. Institute of Medicine, Food and Nutrition Board. *Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids*. Prepublication edition. Washington, D.C.: National Academies Press, 2005.
17. Young VR, Pellett PL. Plant proteins in relation to human protein and amino acid nutrition. *American Journal of Clinical Nutrition* 1994; 59(5):1203S-1212S.

18. Fats and Fatty Acids. In: Kleinman RE, ed. *Pediatric Nutrition Handbook*. 5th ed. Elk Grove Village, IL: American Academy of Pediatrics, 2004:261-284.
19. Lawrence RA, Lawrence RM. *Breastfeeding: A Guide for the Medical Profession*. 6th ed. Philadelphia, PA: Mosby, Inc., 2005.
20. National Cholesterol Education Program. Report of the Expert Panel on Blood Cholesterol Levels in Children and Adolescents. Bethesda, MD: U.S. Department of Health and Human Services, National Institutes of Health, National Heart, Lung and Blood Institute, 1991.
21. Committee on Nutrition, American Academy of Pediatrics. Cholesterol in children. *Pediatrics* 1998; 101(1):141-147.
22. Owen CG, Whincup PH, Odoki K, Gilg JA, Cook DG. Infant feeding and blood cholesterol: a study in adolescents and a systematic review. *Pediatrics* 2002; 110:597-608.
23. Wong J, Hachey D, Insull W, et al. Effect of dietary cholesterol synthesis in breast-fed and formula-fed infants. *Journal of Lipid Research* 1993; 34:1403.
24. Life Sciences Research Office, Food and Drug Administration. Assessment of nutrient requirements for infant formulas. *Journal of Nutrition* 1998; 128:11S.
25. Larque E, Zamora S, Gil A. Dietary trans fatty acids in early life: a review. *Early Human Development* 2001;65:S31-S41.
26. Section on Breastfeeding and Committee on Nutrition, American Academy of Pediatrics. Prevention of rickets and vitamin D deficiency: new guidelines for vitamin D intake. *Pediatrics* 2003; 111(4):908-910.
27. Committee on Environmental Health, American Academy of Pediatrics. Ultraviolet light: a hazard to children. *Pediatrics* 1999; 104(2):328-333.
28. Institute of Medicine, Food and Nutrition Board. *Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride*. Washington, D.C.: National Academy Press, 1997.
29. Welch TR, Bergstrom WH, Tsang RC. Vitamin D-deficient rickets: the reemergence of a once-conquered disease. *Journal of Pediatrics* 2000; 137(2):143-145.
30. Vitamin D Expert Panel Meeting Final Report. Scanlon KS, editor. Atlanta: Centers for Disease Control, 2001 (accessed August 22, 2007). Available at http://www.cdc.gov/nccdphp/dnpa/nutrition/pdf/Vitamin_D_Expert_Panel_Meeting.pdf
31. Pugliese MT, Blumberg DL, Hludzinski J, Kay S. Nutritional rickets in suburbia. *Journal of the American College of Nutrition* 1998; 17(6):637-641.
32. Kreiter SR, Schwartz RP, Kirkman HN, Charlton PA, Calikoglu AS, Davenport ML. Nutritional rickets in African American breast-fed infants. *Journal of Pediatrics* 2000; 137(2):153-157.
33. Institute of Medicine, Food and Nutrition Board. *Dietary Reference Intakes for Vitamin A, Vitamin K, Arsenic, Boron, Chromium, Copper, Iodine, Iron, Manganese, Molybdenum, Nickel, Silicon, Vanadium, and Zinc*. Washington, D.C.: National Academy Press, 2001.
34. Committee on Fetus and Newborn, American Academy of Pediatrics. Controversies concerning vitamin K and the newborn. *Pediatrics* 2003; 112(1):191-192.
35. Jacob R. Vitamin C. In: Shils M, Olson J, Shike M, Ross A, editors. *Modern Nutrition in Health and Disease*. 9th ed. Baltimore: Williams & Wilkins, 1999:467-483.

36. Monsen AB, Ueland PM, Vollset SE, Guttormsen AB, Markestad T, Solheim E, et al. Determinants of coalmine status in newborns. *Pediatrics* 2001; 108(3):624-630.
37. Specker B, Black A, Allen L, Morrow F. Vitamin B12: low milk concentrations are related to low serum concentrations in vegetarian women and to methylmalonic aciduria in their infants. *American Journal of Clinical Nutrition* 1990; 52(6):1073-1076.
38. Emery ES, Homans AC, Colletti RB. Vitamin B12 deficiency: a cause of abnormal movements in infants. *Pediatrics* 1997; 99(2):255-256.
39. Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin, and Choline. Washington, D.C.: National Academy Press, 1998.
40. Mangels R, Messina V. Considerations in planning vegan diets: infants. *Journal of the American Dietetic Association* 2001; 101(6):670-677.
41. Hass RH. Thiamin and the brain. *Annual Reviews of Nutrition* 1988; 8:483-515.
42. Dagnelie P, F V, van Staveren W, van den Berg H, Dingjan P, Hautvast J. High Prevalence of rickets in infants on macrobiotic diets. *American Journal of Clinical Nutrition* 1990; 51:202-208.
43. Mahaffey K, Gartside P, Glueck, CJ. Blood lead levels and dietary calcium intake in 1 to 11 year old children: The Second National Health and Nutrition Examination Survey, 1976 to 1980. *Pediatrics* 1986; 78:257-262.
44. Iron Deficiency. In: Kleinman RE, editor. *Pediatric Nutrition Handbook*. 5th ed. Elk Grove Village, IL: American Academy of Pediatrics, 2004:299-312.
45. Bothwell T, Caharlton R, Cook J, Finch C. *Iron Metabolism in Man*. Oxford, UK: Blackwell Scientific, 1979.
46. Committee on Nutrition, American Academy of Pediatrics. Iron fortification of infant formulas. *Pediatrics* 1999; 104(1):119-123.
47. Ziegler EE, Fomon SJ, Nelson SE, Rebouche C, Edwards B, Rogers R, et al. Cow milk feeding in infancy: further observations on blood loss from the gastrointestinal tract. *Journal of Pediatrics* 1990; 116(1):11-18.
48. Jiang T, Jeter JM, Nelson SE, Ziegler EE. Intestinal blood loss during cow milk feeding in older infants. *Archives of Pediatrics and Adolescent Medicine* 2000; 154:673-678.
49. Ziegler EE, Jiang T, Romero E, Vinco A, Frantz JA, Nelson SE. Cow's milk and intestinal blood loss in late infancy. *Journal of Pediatrics* 1999; 135(6):720-726.
50. Nokes C, van den Bosch C, Bundy DA. The Effects of Iron Deficiency and Anemia on Mental and Motor Performance, Education Achievement, and Behavior in Children: A Report of the International Nutritional Anemia Consultative Group. International Nutritional Anemia Consultative Group, 1998.
51. U.S. Department of Health and Human Services. *Managing Elevated Blood Lead Levels Among Children: Recommendations from the Advisory Committee on Childhood Lead Poisoning Prevention*. Atlanta: Centers for Disease Control and Prevention, 2002.
52. U.S. Department of Health and Human Services. *Recommendations to Prevent and Control Iron Deficiency in the United States*. *Morbidity and Mortality Weekly Report* 1998; 48:No. RR-3.
53. Allen LH. Zinc and micronutrient supplements for children. *American Journal of Clinical Nutrition* 1998; 68(suppl):495S-498S.

54. Krebs NF. Zinc supplementation during lactation. *American Journal of Clinical Nutrition* 1998; 68(suppl):509S-512S.
55. Nutritional Aspects of Vegetarian Diets. In: Kleinman RE, editor. *Pediatric Nutrition Handbook*. 5th ed. Elk Grove Village, IL: American Academy of Pediatrics, 2004:191-203.
56. Nutrition and Oral Health. In: Kleinman RE, editor. *Pediatric Nutrition Handbook*, 5th ed. Elk Grove Village, IL: American Academy of Pediatrics, 2004:789-800.
57. American Academy of Pediatric Dentistry. Clinical guideline on fluoride therapy. *Pediatric Dentistry* 2003; 25(7):67-68.
58. U.S. Department of Health and Human Services. Recommendations for using fluoride to prevent and control dental caries in the United States. *Morbidity and Mortality Weekly Report* 2001; 50(RR-14).
59. Hale TW. *Medications and Mothers' Milk*. 11th ed. Amarillo, TX: Pharmasoft Publishing L.P., 2004.
60. National Research Council, Food and Nutrition Board. *Recommended Dietary Allowances*. 10th ed. Washington, DC: National Academy Press, 1989.
61. Fomon SJ, Ziegler EE. Renal solute load and potential renal solute load in infancy. *Journal of Pediatrics* 1999; 134(1):11-14.
62. Ziegler EE. Milk and formulas for older infants. *Journal of Pediatrics* 1990; 117:576-579.
63. Complementary Feeding. In: Kleinman RE, editor. *Pediatric Nutrition Handbook*. 5th ed. Elk Grove Village, IL: American Academy of Pediatrics, 2004:103-115.
64. Fomon SJ. Potential renal solute load: considerations relating to complementary feedings of breastfed infants. *Pediatrics* 2000; 106(5):1284.
65. Dietz WH, Stern L. *American Academy of Pediatrics Guide to Your Child's Nutrition: Making peace at the Table and Building Healthy Eating Habits for Life*. New York: Villard Books; 1999.
66. Keating J, Schears G, Dodge P. Oral water intoxication in infants, an American epidemic. *American Journal of Diseases of Childhood* 1991; 145:985-990.
67. Bruce RC, Kliegman RM. Hyponatremic seizures secondary to oral water intoxication in infancy: association with commercial bottled drinking water. *Pediatrics* 1997; 100(6):e4.
68. U.S. Environmental Protection Agency. *Consumer Confidence Reports: Final Rule*. 2001. (accessed August 27, 2007) Available at: <http://www.epa.gov/safewater/ccr/regulations.html>

Additional Information on Safety of the Water Supply

Well Water

About 14 to 15 million United States households get their drinking water from a private household well. Caregivers whose drinking water source is a private household or community well should be strongly urged to have their water tested for bacteria, nitrates, and other contaminants. Private wells are not regulated by the same Federal drinking water standards as a public water system. As a result, the burden is on the user to determine if the water is safe to drink. The Centers for Disease Control and Prevention (CDC) recommend that private wells be tested annually for germs and every 2 to 3 years for harmful chemicals.¹ Wells should also be tested if there is a problem with other wells in the area where there has been flooding, land disturbance, or nearby waste disposal or if any part of the well system is repaired or replaced.

Potential sources of contaminants of well water include the following:

- Naturally occurring chemicals like arsenic, lead, and cadmium found in rocks and soils;
- Human and animal waste coming from polluted storm water runoff, agricultural runoff, or flooded sewers;
- Nearby gas stations or factories;
- Improperly functioning septic systems;
- Any past and present activities in the area near the well, such as the application of lawn care or agricultural chemicals or improper disposal of household chemicals (e.g., used motor oil, paints and thinners, cleaning fluids).

Well water containing greater than 2.0 ppm (parts per million) levels of fluoride may cause dental fluorosis (staining or mottling of the teeth) if infants or children drink it during tooth formation for an extended time. Thus, well water should be tested for fluoride. When water contains 2.0 ppm or more of fluoride, advice should be obtained from a medical or dental health care provider to determine if the

exclusive use of bottled water or the blending of home and bottled water is recommended.²

For information on testing well water and a list of State-certified laboratories in the area, caregivers can contact the local health or environmental department or the State drinking water office (usually located in the State health department or environmental agency). For advice and information on possible contaminants in well water, contact the local health department, the State drinking water office, the nearest public water utility, the Environmental Protection Agency's (EPA) Web site at <http://www.epa.gov>, or the EPA Safe Drinking Water Hotline at 1-800-426-4791 between 9 a.m. and 5 p.m. Eastern Standard Time (EST).

Lead

Lead levels are typically low in ground and surface water. Lead can enter drinking water from plumbing materials that carry water to and within homes and residential buildings. Until the Federal Government banned the manufacture of lead plumbing materials in 1986, pipes and solder containing lead were often used in water systems and homes.

Lead is a poison that can accumulate in the body and cause brain, nerve, and kidney damage; anemia; and even death. Lead is especially dangerous, even with short-term exposure, to infants, children, and pregnant women. While lead exposure through various sources (e.g., paint chips, lead dust, toys, and pottery) can occur, lead can be present in drinking water at sufficient levels to warrant concern.

Lead levels in drinking water are likely to be highest if:

- A home or water system has lead pipes
- A home has brass fixtures or
- A home has copper pipes with lead solder where:
 - The home is relatively new (i.e., built shortly before the 1986 ban on lead in pipes – it takes time for mineral deposits to build up and cover up the lead inside pipes)

- The home has soft water or
- Water sits in the pipes for several hours.

Since one cannot see, taste, or smell lead dissolved in water, household drinking water must be tested to determine its lead content. The local water utility or local department of environment or health can provide information and assistance regarding testing and how to locate a laboratory qualified to test for lead. Testing is especially important because flushing (described below) may not be effective in reducing lead levels in high-rise buildings with lead-soldered central piping or in homes receiving water through lead service lines (the local water utility company can be contacted for information on the pipes carrying water into a home).

Unless a caregiver is certain that there is no lead contamination in his or her water, precautions can be taken against the possible leaching of lead from metal water pipes in the home.

Caregivers can take these steps when using tap water to prepare powdered or concentrated infant formula or complementary food for their infants:

- Anytime a faucet has not been used for 6 or more hours, allow the cold tap water to run for 2 to 3 minutes to allow the water to get as cold as it will get before collecting it for infant formula or food preparation. This flushing is recommended for any faucet used to collect water for the infant. Flushing may help because the longer the water is exposed to lead pipes or lead solder, the more lead it may contain. As noted, flushing might not work in high-rise buildings or when lead service lines carry water into a home. Water for infant formula preparation should be collected in the evening after the water has been running for cooking or cleaning and stored in a clean lead-free container for use later or the next day. See page 120 for more information regarding lead and containers.
- Always draw water for infant formula preparation, drinking, and cooking from the cold water tap. Avoid feeding water from the

hot water tap to infants or young children. Hot water is more likely to dissolve lead from plumbing materials and thus contain more lead. Infants have contracted lead poisoning from drinking infant formula made using hot tap water that was then boiled (this concentrates the lead).

- If water is to be boiled, do so by bringing the water to a rolling boil and boiling for 1–2 minutes. Avoid prolonged boiling or reboiling greater than 5 minutes; these practices will cause further water evaporation and concentration of any lead present. See page 91 for instructions on boiling water for infant formula preparation.
- Have their water tested for lead because lead can come from pipes inside or outside a home or apartment or from a well.
- If water treatment devices installed at the tap are used, be aware that their effectiveness in reducing lead in water varies. It may be affected by the location of the device in relation to the lead source and by compliance with the manufacturer's use and maintenance instructions. Some types of units, such as reverse osmosis and distillation, may be effective. Carbon, sand, and cartridge filters do not remove lead.

If caregivers are concerned about the lead level in water or if lead contamination is found through testing, encourage them to discuss this issue with their health care provider.

Copper

High levels of copper can dissolve from some pipes in areas with corrosive water. Copper, which is beneficial at lower levels, is a health risk at levels above 1.3 milligrams per liter in water. Acute exposure to copper results in gastrointestinal symptoms such as nausea, vomiting, stomach cramps, and diarrhea. Chronic exposure can cause liver or kidney damage. Infants are more sensitive to the effects of copper than are older children or adults. When water is tested, it can be tested for copper. If high levels of copper are found, encourage the caregiver to contact a health care provider for advice.

Nitrate

Drinking water from private household or community water system wells may become contaminated from nitrate derived from agricultural and home lawn and garden uses of nitrate fertilizers, septic tank wastes, and sewage sludge. Nitrate in drinking water above the national standard (10 milligrams nitrate per liter) poses an immediate threat to infants. In infants younger than 6 months of age, exposure to high levels of nitrate from well water may result in methemoglobinemia, also known as “blue baby syndrome,” in which the blood’s ability to carry oxygen is reduced.³ Blueness may appear around the mouth, hands, and feet but does not necessarily mean that the infant is having breathing problems. This condition could result in a severe oxygen deficiency and could lead to death. Vomiting and diarrhea may also occur. Pregnant women are also susceptible and nitrate can pass through breast milk to breastfeeding infants.

It is recommended that caregivers with private household wells have their water tested for nitrate, especially if agricultural activities including home gardening occur in the area or if animal and human wastes are suspected of entering the well. Users of water from community wells who suspect that their water is contaminated can contact their State public water supply agency regarding contaminant levels in the water.

If the nitrate level in well water is confirmed to be above 10 mg/L, it is recommended that caregivers:

- Consult their health care providers about this problem
- Feed their infants only water from an alternate source that has less than 10 mg/L of nitrate and
- Avoid feeding their infants the nitrate-rich water plain or in infant formula, especially if boiled (boiling concentrates the nitrate). Ready-to-feed infant formula can be used as an alternative to concentrated or powdered infant formula that requires dilution with water.

Bacterial and Viral Contaminants

Bacteria and viruses can also contaminate private wells and cause disease. Three organisms of particular concern for infants are *Cryptosporidium*, *Escherichia coli* O157:H7, and rotavirus.

Cryptosporidium:⁴ Cryptosporidiosis is caused by infection with the parasite *Cryptosporidium*, which can live in the intestines of humans or animals and is passed in feces. It has become one of the most common waterborne diseases in humans in the United States. Symptoms include watery diarrhea, dehydration, weight loss, stomach cramps, and slight fever. Rapid dehydration can be life-threatening for infants with cryptosporidiosis. Boiling water for at least 1 minute (3 minutes at high altitude) will kill or inactivate the parasite; reverse osmosis filters or filters with an absolute pore size of < 1 micron will also remove the parasite. If cryptosporidiosis is suspected, contact a health care provider right away.

***Escherichia coli* O157:H7:**⁵ This strain of the *E. coli* bacteria lives in the intestines of healthy cattle. Infection may occur from eating meat, especially ground beef that has not been fully cooked, drinking unpasteurized milk or juice, or drinking sewage-contaminated water. While most types of *E. coli* are harmless, this strain produces a toxin that can cause severe bloody diarrhea and abdominal cramps. In infants and children under 5, a serious illness called hemolytic uremic syndrome (HUS) may result, leading to kidney failure. HUS occurs in 2 percent to 7 percent of infections with *Escherichia coli* O157:H7 and is the principal cause of acute kidney failure in children. Boiling contaminated water for 1 minute (3 minutes at high altitude) will kill or inactivate the bacteria; filtering is not an appropriate way to remove the bacteria. If infection with *E. coli* is suspected, contact a health care provider right away.

Rotavirus:⁶ Rotavirus is the most common cause of severe diarrhea among infants and children, resulting in about 55,000 hospitalizations per

year in the United States. It is found in water sources that have been contaminated with human feces, usually as a result of sewage overflows or sewage systems not working properly. It usually occurs in the winter with symptoms of vomiting and watery diarrhea and can lead to dehydration. Boiling water for 1 minute (3 minutes at high altitude) will kill or inactivate rotaviruses; filtration will not remove the virus. If infection with rotavirus is suspected, contact a health care provider right away.

Use of Bottled Water

Bottled water may be an alternative to tap water used in preparing infant formula and complementary foods for the following circumstances:

- The local water supply does not meet health-based drinking water standards
- Naturally occurring fluoride exceeds the recommended levels for safe drinking water or
- Corrosion of household plumbing causes lead and/or copper to enter the drinking water.

Bottled water is regulated by the Food and Drug Administration (FDA) as a food. *Bottlers are required to:*⁷

- Process, bottle, hold, and transport bottled water under sanitary conditions;
- Meet standards of identity established in 1995 that define types of waters (artesian, mineral, purified (distilled), sparkling, and spring water); and
- Meet standards of quality in terms of maximum allowable amounts of chemical, physical, microbial, and radiological contaminants.

FDA is responsible for inspecting and monitoring bottled waters and processing plants. Only optional microbial agents or fluoride may be

added to bottled water. Bottled waters contain varying levels of fluoride and may have fluoride added, which will affect the amount of fluoride an infant consumes. Thus, caregivers who wish to feed their infants a specific brand of bottled spring or mineral water should consider contacting the manufacturer of the water product for information on the quality of their water.

If bottled water is to be used, distilled bottled water may be the best choice as it may contain fewer contaminants than bottled spring or mineral water. To help decide whether to use bottled water, caregivers can contact a health care provider and the local or State health department for information on local water quality problems and recommendations.

Home Water Treatment Units

Home water treatment units can potentially remedy a water contamination problem; however, it is important to keep in mind that no single household treatment unit will remove all potential drinking water contaminants. Treatment is very specific to the substances of concern. Before selecting a unit, the water should be tested to confirm the nature and extent of contamination. After identifying the substances to be removed, a unit can be selected. Home water treatment units do not eliminate the need for boiling water used to prepare infant formula for young infants. See page 91 for information regarding infant formula preparation.

A reliable source of information on home water treatment units is:

NSF International
3475 Plymouth Road
P.O. Box 130140
Ann Arbor, MI 48113-0140
(877) 867-3435
Web site: <http://www.nsf.org>

References:

1. Centers for Disease Control and Prevention. Drinking water: well water testing frequently asked questions. 2003. (accessed August 22, 2007) Available at: <http://www.cdc.gov/ncidod/dpd/healthywater/factsheets/pdf/wellwater.pdf>
2. American Dental Association. Fluoridation Facts. 2005 (accessed August 22, 2007) Available at: <http://www.ada.org/public/topics/fluoride/facts/index.asp>
3. Centers for Disease Control and Prevention. Nitrate and drinking water from private wells. 2001. (accessed August 22, 2007) Available at: <http://www.cdc.gov/ncidod/dpd/healthywater/factsheets/nitrate.htm>
4. Centers for Disease Control and Prevention. Cryptosporidium and drinking water from private wells. 2002 (accessed August 22, 2007) Available at: <http://www.cdc.gov/ncidod/dpd/healthywater/factsheets/crypto.htm>
5. Centers for Disease Control and Prevention. Escherichia coli O157:H7 and drinking water from private wells. (accessed August 22, 2007) Available at: <http://www.cdc.gov/ncidod/dpd/healthywater/factsheets/ecoli.htm>
6. Centers for Disease Control and Prevention. Rotavirus and drinking water from private wells. 2003 (accessed August 22, 2007) Available at: <http://www.cdc.gov/ncidod/dpd/healthywater/factsheets/rotavirus.htm>
7. Posnick LM, Kim H. Bottled water regulation and the FDA. 2002 (accessed August 22, 2007) Available at: <http://www.cfsan.fda.gov/~dms/botwatr.html>



CHAPTER 2: DEVELOPMENT OF INFANT FEEDING SKILLS

An infant's developmental readiness determines the type and texture of foods to feed and which feeding styles to use. Each infant develops at his or her own rate. Although age and size often correspond with developmental readiness, these should not be used as the only factors considered when deciding what and how to feed infants. The rate at which an infant progresses to each new food texture and feeding style is determined by the infant's own skills and attitudes. Some infants are cautious, others venturesome. Infants always do better if they are allowed to develop at their own rate. It is important to be aware of the stages of mouth, hand, and body skill development in infants so that you can provide appropriate nutrition counseling on food types, texture, and feeding methods to caregivers. This chapter provides an overview of the development of feeding skills, the rate of acquisition of skills, and the feeding relationship. Counseling points related to the information presented in this chapter are found in Chapter 8, pages 158–159.

Infant Development and Feeding Skills

Newborn infants are only able to suck and swallow liquids because of their limited level of development, but these skills are integral to their survival. Their ability to feed well at birth can be attributed to a combination of reflexive responses that enables them to locate the source of nourishment, suck, and swallow the liquid.¹

Reflexive responses important for successful feeding during early infancy are described as follows:¹

- **Rooting reflex** – When an infant's oral area (corners of the mouth, upper and lower lip, cheek, and chin) is touched by an object, he reacts. The infant turns in the direction of the object and opens his or her mouth. This reflex allows the infant to locate the source of food (i.e. seek out and grasp a nipple). This reflex is seen from birth to about 4 months.
- **Suck/Swallow reflex** – When an infant's lips and mouth area are touched, the mouth opens and suckling or sucking movements begin. As liquid moves into the mouth, the tongue immediately moves it to the back of the mouth for swallowing. This reflex facilitates feeding from the breast or bottle but not from a spoon or cup. This reflex is seen from birth to about 4 months.
- **Tongue thrust reflex** – When the lips are touched, the infant's tongue extends out of the mouth. This reflex allows for feeding from the breast or bottle but not from a spoon or cup. This reflex is seen from birth to about 4 to 6 months.
- **Gag reflex** – The infant gags when any object, such as a spoon or a piece of solid food, is placed way back in the mouth; the object is then propelled forward on the tongue. This reflex helps to protect an infant from swallowing inappropriate food or objects that could cause choking. This reflex is one reason for delaying the introduction of complementary foods until 4 to 6 months of age. This reflex diminishes by 4 months, but is retained to some extent in adults.

Note that infants with developmental disabilities may retain these reflexes longer than normally expected or the reflexes may be stronger or weaker than normal.

As infants mature, they gain the skills necessary to progress from eating strained complementary foods from a spoon to feeding themselves finger foods and eventually begin to feed themselves with a spoon (see Chapter 5 for more information regarding complementary foods). This acquisition of skills follows a sequential pattern that is similar in most infants. However, each infant is unique. As shown in Figure 1, page 42, it is normal for infants to develop the skills and abilities needed for feeding progression at their own rates. Caregivers must carefully observe and

Figure 1: Sequence of Development and Feeding Skills in Healthy, Full-Term Infants

Infant's Approximate Age	Mouth Patterns	Hand and Body Skills	Feeding Skills or Abilities	Hunger and Satiety (Fullness) Cues
Birth through 5 months	<ul style="list-style-type: none"> • Suck/swallow reflex • Tongue thrust reflex • Rooting reflex • Gag reflex 	<ul style="list-style-type: none"> • Poor control of head, neck, trunk • Needs head support • Brings hands to mouth around 3 months 	<ul style="list-style-type: none"> • Swallows liquids but pushes most solid objects from the mouth • Coordinates suck-swallow-breathe while breast or bottle feeding • Moves tongue forward and back to suck 	<p>Hunger cues:</p> <ul style="list-style-type: none"> • Wakes and tosses • Sucks on fist • Cries or fusses • Opens mouth while feeding to indicate wanting more <p>Satiety cues:</p> <ul style="list-style-type: none"> • Seals lips together • Turns head away • Decreases or stops sucking • Spits out the nipple or falls asleep when full
4 months through 6 months	<ul style="list-style-type: none"> • Up-and-down munching movement • Transfers food from front to back of tongue to swallow • Draws in upper or lower lip as spoon is removed from mouth • Tongue thrust and rooting reflexes begin to disappear • Gag reflex diminishes • Opens mouth when sees spoon approaching 	<ul style="list-style-type: none"> • Sits with support • Good head control • Uses whole hand to grasp objects (palmer grasp) • Recognizes spoon and holds mouth open as spoon approaches 	<ul style="list-style-type: none"> • Takes in a spoonful of pureed or strained food and swallows without choking • Drinks small amounts from cup when held by another person, with spilling 	<p>Hunger cues:</p> <ul style="list-style-type: none"> • Cries or fusses • Smiles, gazes at caregiver, or coos during feeding to indicate wanting more • Moves head toward spoon or tries to swipe food towards mouth <p>Satiety cues:</p> <ul style="list-style-type: none"> • Decreases rate of sucking or stops sucking when full • Spits out the nipple • Turns head away • May be distracted or pay attention to surroundings more
5 months through 9 months	<ul style="list-style-type: none"> • Begins to control the position of food in the mouth • Up-and-down munching movement • Positions food between jaws for chewing 	<ul style="list-style-type: none"> • Begins to sit alone unsupported • Follows food with eyes • Transfers food from one hand to the other • Tries to grasp foods such as toast, crackers, and teething biscuits with all fingers and pull them into the palm. 	<ul style="list-style-type: none"> • Begins to eat mashed foods • Eats from a spoon easily • Drinks from a cup with some spilling • Begins to feed self with hands 	<p>Hunger cues:</p> <ul style="list-style-type: none"> • Reaches for spoon or food • Points to food <p>Satiety cues:</p> <ul style="list-style-type: none"> • Eating slows down • Clenches mouth shut or pushes food away

Infant's Approximate Age	Mouth Patterns	Hand and Body Skills	Feeding Skills or Abilities	Hunger and Satiety (Fullness) Cues
<p>8 months through 11 months</p>	<ul style="list-style-type: none"> Moves food from side to side in mouth Begins to use jaw and tongue to mash food Begins to curve lips around rim of cup Begins to chew in rotary pattern (diagonal movement of the jaw as food is moved to the side or center of the mouth) 	<ul style="list-style-type: none"> Sits alone easily Transfers objects from hand to mouth Begins to use thumb and index finger to pick up objects (pincer grasp) Feeds self finger foods Plays with spoon at mealtimes, but does not spoon- feed yet 	<ul style="list-style-type: none"> Begins to eat ground or finely chopped food and small pieces of soft food Begins to experiment with spoon but prefers to feed self with hands Drinks from a cup with less spilling 	<p>Hunger cues:</p> <ul style="list-style-type: none"> Reaches for food Points to food Gets excited when food is presented <p>Satiety cues:</p> <ul style="list-style-type: none"> Eating slows down Pushes food away
<p>10 months through 12 months</p>	<ul style="list-style-type: none"> Rotary chewing (diagonal movement of the jaw as food is moved to the side or center of the mouth) 	<ul style="list-style-type: none"> Feeds self easily with fingers Begins to put spoon in mouth Dips spoon in food rather than scooping Demands to spoon-feed self Begins to hold cup with two hands Drinks from a straw Good eye-hand-mouth coordination 	<ul style="list-style-type: none"> Begins to eat chopped food and small pieces of soft, cooked table food Begins spoon-feeding self with help Bites through a variety of textures 	<p>Hunger cues:</p> <ul style="list-style-type: none"> Expresses desire for specific food with words or sounds <p>Satiety cues:</p> <ul style="list-style-type: none"> Shakes head to say “no more

***Developmental stages may vary with individual infants. Developed with the use of references 1, 5, 7, 8 and 9.**

acknowledge when major reflexive responses needed during early infancy have diminished and the infant has developed the mouth patterns, hand and body skills, and feeding skills required to consume more than infant formula or breast milk.

Hand and body skill development is an important factor in establishing when to introduce complementary foods as well as determining the infant's ability to eat foods of different textures as he or she grows older. Most infants have good head control and can sit with support between 4 and 6 months. When these skills are developed in conjunction with mouth pattern development, such as the ability to transfer food from the front to the back of the tongue to swallow (See Figure 1, page 42), the introduction of complementary foods with a spoon is appropriate. An infant's ability to control the neck and head as well as balance the trunk are required for the infant to sit without support and use hand and arm movements in the self-feeding process. Two significant developmental skills acquired during the self-feeding process are the palmer grasp and the pincer grasp. At about 6 months, infants develop what is known as a palmer grasp – the ability to push something into the palm using the fingers. Between 6 and 8 months, they develop the ability to hold something between their thumb and forefinger – this is called a pincer grasp. When these skills have developed, infants can begin to feed themselves with their hands and try finger foods.

Figure 1-Sequence of Infant Development and Feeding Skills in Normal, Healthy Full-Term Infants, page 42, summarizes the development of an infant's mouth, hand, and body skills and how these skills correspond with an infant's ability to consume different complementary foods. Recognizing these skills is important for assessing when certain types and textures of food should be introduced at certain stages of an infant's development. *Refer infants who appear to have feeding problems to a health care provider for assessment.*

When Do Infants Develop Different Feeding Skills?

A parent/caregiver may expect their infant to acquire certain feeding skills at specific ages associated with “normal development.” However, infants develop the skill to feed themselves at varying rates.² Parents/caregivers need to be aware of their infants' developmental capabilities and nutritional needs when deciding the type, amount, and texture of food to feed their child as well as the method of feeding (e.g., use a spoon for feeding; allow self-feeding with fingers). A survey of caregivers of more than 3,000 infants and toddlers indicated the following skills and age ranges:³

- **Grasps food with hands** – 68 percent of 4 to 6 month old infants and 96 percent of 7 to 8 month old infants demonstrated this skill.
- **Removes food from spoon with lips without spilling much** – 77 percent of 7 to 8 month old infants, 88 percent of 9 to 11 month old infants, and 90 percent of 12 to 14 month old infants demonstrated this skill.
- **Self-feeds with spoon without spilling much** – 5 percent of 7 to 8 month old infants, 11 percent of 9 to 11 month old infants, 29 percent of 12 to 14 month old infants, and 64 percent of 15 to 18 month old infants demonstrated this skill.
- **Drinks from sippy cup without help** – 42 percent of 7 to 8 month old infants, 70 percent of 9 to 11 month old infants, 91 percent of 12 to 14 month old infants, and 96 percent of 15 to 18 month old infants demonstrated this skill.
- **Drinks from a regular cup without help** – 10 percent of 9 to 11 month old infants, 14 percent of 12 to 14 month old infants, and 34 percent of 15 to 18 month old infants demonstrated this skill.

See Figure 1, page 42, for the sequence of development of feeding skills for a healthy, full-term infant.

The Feeding Relationship

The interactions and communication between a caregiver and infant during feeding influence the infant's ability to progress in feeding skills and consume a nutritionally adequate diet. These interactions comprise “the feeding relationship,” defined as “the complex of interactions that take place between the parent and infant as they engage in food selection, ingestion, and regulation behaviors.”⁴ This relationship is nurtured when the caregiver correctly interprets the infant's feeding cues and abilities, is attentive to the infant's needs, and responds appropriately to satisfy those needs.⁵ When the feeding relationship is positive (the caregiver is sensitive and responsive to an infant's feeding cues) and the infant is fed a nutritionally balanced diet, the infant's health and nutritional status is promoted. See page 47, Figure 2: Desired Outcomes for the Infant and the Role of the Family in the Feeding Relationship.

A dysfunctional feeding relationship can result in poor dietary intake and impaired growth.⁵ Such a negative relationship is characterized by a caregiver consistently misinterpreting, ignoring, or overruling the infant's feeding cues, e.g., when a caregiver regularly forces an infant to consume additional food after he or she has become full and satisfied. Infants whose feeding cues are not eliciting the expected response from their caregiver tend to become dissatisfied, confused about their sensations of hunger and satiety (fullness), and may become unusually passive.

Conversely, infants whose intake is strictly regulated by their caregivers may develop unhealthy food preferences. Evidence indicates infants will self-regulate their energy intake when how much they consume is within their control,⁶ but when infants are not allowed some measure of self-control in the feeding process, they may develop preferences for high-fat, high-calorie foods and may not learn to pay attention to their own internal cues of hunger and satiety.⁷ This lack of attention to hunger and satiety cues has been linked to childhood obesity.

Instruct caregivers to observe the hunger and satiety cues listed on page 46.^{7,8}

To develop positive feeding relationships between caregivers and their infants, encourage caregivers to:⁵

- Be sensitive to their infants' hunger, satiety, and food preferences and act promptly and appropriately to meet their feeding needs. Also, it is best to avoid putting the infant on a rigid feeding schedule. An older infant can be offered food at around the time when he or she usually eats but, in general, the caregiver should watch for the infant to indicate hunger. Feeding at specific intervals of time may be necessary if an infant has certain medical conditions or is a sleepy infant who needs to be awakened to feed.
- Remember their infants' developmental capabilities and nutritional needs when deciding the type, amount, and texture of food and the method of feeding (e.g., use a spoon for feeding; allow self-feeding with fingers). See Figure 1, page 46, for more information regarding the development of feeding skills for healthy, full-term infants.
- Offer food in a positive and accepting fashion without forcing or enticing the infant to eat. Avoid withholding food. Infants are biologically capable of regulating their own food intake to meet their needs for growth. Their diets may vary in the amount and types of foods eaten each day.

In addition, caregivers can help their infants have positive feeding experiences and learn new eating skills by making the feeding environment relaxed and calm in these ways:

- Designate a comfortable place in the home for feeding and act calm and relaxed during feeding.
- Have patience and take time to communicate with and learn about their infant during feeding.
- Show their infant lots of love, attention, and cuddling in addition to feeding. Reassure them that doing so will decrease fussiness and will not “spoil” the infant.

Table 2: Infant Hunger and Satiety Cues

Infant's Approximate Age	Hunger Cues	Satiety (Fullness) Cues
Birth through 5 months	<ul style="list-style-type: none"> • Wakes and tosses • Sucks on fist • Cries or fusses • Opens mouth while feeding to indicate wanting more 	<ul style="list-style-type: none"> • Seals lips together • Turns head away • Decreases or stops sucking • Spits out the nipple or falls asleep when full
4 months through 6 months	<ul style="list-style-type: none"> • Cries or fusses • Smiles, gazes at caregiver, or coos during feeding to indicate wanting more • Moves head toward spoon or tries to swipe food towards mouth 	<ul style="list-style-type: none"> • Decreases rate of sucking or stops sucking when full • Spits out the nipple • Turns head away • May be distracted or pays attention to surroundings more
5 months through 9 months	<ul style="list-style-type: none"> • Reaches for spoon or food • Points to food 	<ul style="list-style-type: none"> • Eating slows down • Pushes food away
8 months through 11 months	<ul style="list-style-type: none"> • Reaches for food • Points to food • Gets excited when food is presented 	<ul style="list-style-type: none"> • Eating slows down • Clenches mouth shut or pushes food away
10 months through 12 months	<ul style="list-style-type: none"> • Expresses desire for specific food with words or sounds 	<ul style="list-style-type: none"> • Expresses desire for specific food with words or sounds • Shakes head to say “no more”

In some instances, social and financial problems within a household may cause anxiety with detrimental effects on the interaction and feeding relationship between caregiver and infant. This can lead to failure to thrive in an infant. If you perceive that a caregiver is not recognizing an infant’s feeding cues, responds to them inappropriately, or cannot feed the infant properly, the infant and caregiver should be referred to:

- A health care provider for advice
- Resources offering help with parenting skills
- A specialist or other services for psychosocial evaluation or

- The Early Periodic Screening, Diagnosis, and Treatment Program (EPSDT) for additional assessment, counseling, and follow-up services.

See page 47, Figure 2: Desired Outcomes for the Infant and the Role of the Family in the Feeding Relationship, and Satter’s work (1986 and 1987),^{4,5} for more information regarding the feeding relationship. See *Bright Futures in Practice: Nutrition* (2002)⁹ for more information concerning feeding cues.

Figure 2: Desired Outcomes for the Infant and the Role of the Family in the Feeding Relationship

Infant

Educational/Attitudinal	Behavioral	Health
<ul style="list-style-type: none"> • Has a sense of trust • Bonds with parents • Enjoys eating 	<ul style="list-style-type: none"> • Breastfeeds successfully • Bottle feeds successfully if not breastfeeding • Consumes complementary foods to support appropriate growth and development 	<ul style="list-style-type: none"> • Develops normal rooting, sucking, and swallowing reflexes • Develops fine and gross motor skills • Grows and develops at an appropriate rate • Maintains good health

Family

Educational/Attitudinal	Behavioral	Health
<ul style="list-style-type: none"> • Bonds with the infant • Enjoys feeding the infant • Understands the infant's nutrition needs • Acquires a sense of competence in meeting the infant's needs • Understands the importance of a healthy lifestyle, including healthy eating behaviors and regular physical activity, to promote short-term and long-term health 	<ul style="list-style-type: none"> • Meets the infant's nutrition needs • Responds to infant's hunger and satiety cues • Holds the infant when breastfeeding or bottle feeding and maintains eye contact • Talks to the infant during feeding • Provides a pleasant eating environment • Uses nutrition programs and food resources if needed • Seeks help when problems occur 	<ul style="list-style-type: none"> • Maintains good health

Story M, Holt K, Sofka D, eds. 2000. **Bright Futures in Practice: Nutrition.** Arlington, VA: National Center for Education in Maternal and Child Health.

References:

1. Morris SE, Klein MD. Pre-Feeding Skills. 2nd ed. USA: Therapy Skill Builders, 2000.
2. Carruth BR, Skinner JD. Feeding behaviors and other motor development in healthy children (2-24 months). *Journal of the American College of Nutrition* 2002; 21(2):88-96.
3. Carruth BR, Ziegler P, Gordon A, Hendricks K. Developmental Milestones and Self-Feeding Behaviors in Infants and Toddlers. *Journal of the American Dietetic Association* 2004; 104(1):S51-S56.
4. Satter E. The feeding relationship. *Journal of the American Dietetic Association* 1986; 86:352-356.
5. Satter E. How to Get Your Kid to Eat...But Not Too Much. Boulder, CO: Bull Publishing Company, 1987.
6. Birch LL, Fisher JO. Appetite and eating behavior in children. *Pediatric Clinics of North America* 1995; 42(4):931-953.
7. Butte NF, Cobb K, Graney L, Heird WC, Rickard KA. The Start Healthy Feeding Guidelines for Infants and Toddlers. *Journal of the American Dietetic Association* 2004;104:442-454.
8. Blum-Kemelor DM. Feeding Infants: A Guide for Use in the Child Nutrition Programs Alexandria, VA: U.S. Department of Agriculture, Food and Nutrition Service; 2001.
9. Story M, Holt K, Sofka D. Bright Futures in Practice: Nutrition. 2nd ed. Arlington, VA: National Center for Education in Maternal and Child Health. 2002.



CHAPTER 3: BREASTFEEDING

Breast milk is the optimal food for infants. A mother's breast milk has the perfect combination of nutrients needed for her infant's growth and development. The American Academy of Pediatrics (AAP), American College of Obstetricians and Gynecologists, American Academy of Family Physicians, American Dietetic Association, and World Health Organization are some of the major health organizations that recommend exclusive breastfeeding for the first 6 months of life.^{1, 2, 3, 4, 5} Breastfeeding rates are rising in the United States; in 2004, 70.3 percent of new mothers reported initiating breastfeeding their infants and 36.2 percent reported breastfeeding at 6 months.⁶ Healthy People 2010 established a goal for 75 percent of mothers to initiate breastfeeding, 50 percent to breastfeed at 6 months, and 25 percent to breastfeed at 12 months.⁷

Breastfeeding helps to establish a secure and loving relationship between the mother and her infant and offers many other positive benefits. For these reasons, breastfeeding should be actively promoted and supported as the most desirable method of infant feeding.

This chapter provides information on the benefits of breastfeeding; factors affecting the decision to initiate or continue breastfeeding; methods to support breastfeeding mothers; the basics of breastfeeding; practical breastfeeding techniques and tips; planning for time away from the infant; common concerns; and use of cigarettes, alcohol, other drugs, and certain beverages while breastfeeding. Counseling points related to the information presented in this chapter are found in Chapter 8, pages 159–164.

Benefits of Breastfeeding

For the infant, breast milk or breastfeeding:

- Provides the right balance of nutrients to support the infant's growth and development. These nutrients are provided in a form that is easy to digest and absorb. Breast milk composition changes over time to meet the infant's changing nutritional needs. Breast milk is designed to perfectly meet the needs of the human infant;
- Is sanitary and at the right temperature all the time;
- Provides skin-to-skin contact that is important for making the infant feel secure and loved;
- Contains “bioactive factors” that protect against infections.⁸ These factors include secretory IgA, lactoferrin, lysozyme, cytokines, growth factors, enzymes, and nucleotides. Antibodies from the mother help provide immunity which is important because the part of the infant's immune system that secretes antibodies does not mature for several months after birth;
- Appears to reduce the risk of developing gastrointestinal diseases, respiratory diseases, and otitis media (ear infections);^{9,10}
- May be associated with higher cognitive development scores;^{11,12}
- May protect an infant against food allergies;¹³
- May have a protective effect against obesity in children;¹⁴ and
- Is always available when the mother and infant are together.

For the mother, breastfeeding:

- Allows for quicker recovery from childbirth by helping the uterus to return to its pre-pregnant size sooner;
- Suppresses ovulation for many women.¹⁵ However, to assure that pregnancy is prevented in the postpartum period, alternate forms of birth control should be used;
- May be protective against breast cancer and ovarian cancer;¹⁵
- May have an effect on weight loss after childbirth in some women;
- Is less expensive, more convenient, and requires no time for preparation (e.g., no sterilization and preparation of bottles is required); and

- Stimulates the release of the hormone prolactin that brings a sense of relaxation and well-being to the mother.

The AAP recommends that breastfeeding be continued for the first year and as long as it is mutually desired by both the mother and child.¹ Breastfeeding provides significant benefits even if a mother breastfeeds for a limited time. Women should be encouraged to breastfeed even for a short period; however, exclusive and extended breastfeeding confers the greatest benefits.

Factors Affecting the Decision To Initiate or Continue Breastfeeding

Several factors have been identified as having a significant impact on a mother's decision to initiate or continue breastfeeding. These include the attitudes of healthcare providers; the mother's support network that may include fathers/partners, family members, and/or friends; hospital practices such as providing infant formula to newborns; a mother's personal experience; and workplace environment.

Mothers typically know that breastfeeding is the best way to feed their infants. However, mothers may not know about the personal health benefits associated with breastfeeding. Some mothers are challenged with combining breastfeeding and other competing demands and may focus on the barriers to breastfeeding rather than the benefits. Exploring both the benefits and barriers is an effective way to counsel a new mother. Research has shown that the common barriers to breastfeeding are embarrassment, lack of social support, lack of time, and competing demands on the mother.¹⁶

Embarrassment is the primary barrier for women of all backgrounds and in all regions of the country. Strategies to address embarrassment include teaching mothers how to breastfeed discretely, providing the opportunity to discuss mothers' concerns, and reassuring mothers they are doing something good for their infant.

Lack of social support has a major influence on the decision to breastfeed and on the duration of breastfeeding. Family and friends are often not aware of the importance of breastfeeding and how to be involved in the care and nurturing of a breastfed infant. Mothers should be encouraged to talk with their family and friends about breastfeeding and to invite them to attend prenatal classes to learn more about breastfeeding.

Time and competing demands are a reality of life and new mothers can benefit from information on how breastfeeding can be successfully combined with other commitments in their busy lives.

Methods To Support Breastfeeding Mothers in Your Program

Breastfeeding mothers benefit from education, support, and encouragement. Appropriate, accurate instruction and support can help women breastfeed successfully. Some methods to support breastfeeding mothers in your clinic or program site include the following:

- Make a place or room available for mothers to breastfeed their infants when visiting a clinic or program site.
- Offer all breastfeeding mothers a list of professional and peer resources (e.g., WIC clinic breastfeeding coordinator, WIC peer counselors, public health nurses, breastfeeding mothers group, etc.) to contact for ongoing encouragement, information, breast pumps, and assistance.
- Display culturally appropriate posters and materials on breastfeeding in the clinic or program site (do not display infant formula and materials with infant formula brand names and logos).
- Demonstrate positive attitudes towards breastfeeding and deliver positive and supportive messages about breastfeeding.

- Provide education about the benefits of breastfeeding to individuals and groups. Use printed materials and audiovisuals on breastfeeding that portray breastfeeding as the preferred infant feeding choice and are appropriate to participants' cultural and ethnic background, language, and reading level.
- Encourage the mother's family and friends to participate in breastfeeding education and support sessions.
- Coordinate breastfeeding support with other health care programs in your community.
- If your program is in a hospital clinic, encourage hospital practices that are supportive of breastfeeding.
- Make available peer counselors and/or staff who can provide regular and ongoing counseling and support services to breastfeeding women.

Refer breastfeeding mothers who request infant formula to a nutritionist, peer counselor, or WIC breastfeeding expert for nutrition assessment and counseling. **Determine why the mother is requesting infant formula and help her address barriers or concerns** (e.g., if a breastfeeding mother does not wish to totally wean her infant off the breast, counseling can be provided on the approximate amount and form of infant formula needed).

The National WIC Association has published guidelines for promoting breastfeeding in the WIC Program in the position paper, "Breastfeeding Promotion and Support in the WIC Program."¹⁷ These recommendations provide assistance to local and State WIC agencies in initiating and enhancing breastfeeding promotion and support programs. Suggestions for implementation accompanied by supporting rationale are provided regarding training, clinic environment, coordinated efforts, program evaluation, breastfeeding education and support, and the food packages for breastfed infants and breastfeeding women.¹⁷ These guidelines are a perfect starting point for establishing or

improving breastfeeding promotion and support in any local or State WIC agency.

The Basics of Breastfeeding

Making a Good Milk Supply

For most new breastfeeding mothers, making enough milk is their most important concern. Concern over milk supply is a key reason women wean their infants from the breast in the first 6 months of life.

Role of the Breasts

During pregnancy, the breasts undergo physiological and anatomical changes that enable them to produce milk for an infant. The breast has many parts, each with very specific functions that help the mother produce milk for her infant. Milk production occurs within the alveoli, which are grape-like clusters of cells located deep within the breast. Once the milk is produced, it is squeezed out through the alveoli into the milk ducts, which resemble highways, to transport the milk through the breast. See Figure 3: How the Breast Makes Milk on page 54. The milk is released through openings in the nipple that many mothers cannot see until lactation begins.

The size of a woman's breasts does not affect her ability to breastfeed; women with small breasts produce the same quantity and quality of milk as those with larger breasts. However, a woman's breasts should increase in size from pre-pregnancy to after delivery; typically the breasts double or triple in weight by the time a woman is near term. If a woman expresses concern that there is no change in the size of her breasts during pregnancy, refer her to her health care provider.

Role of the Brain

When the infant suckles, important nerve endings inside the breast send a message to the brain. The brain then signals the pituitary gland to release two important hormones; Prolactin causes the alveoli to begin making milk, and oxytocin causes the muscles around those cells to contract and squeeze

Figure 3: How the Breast Makes Milk

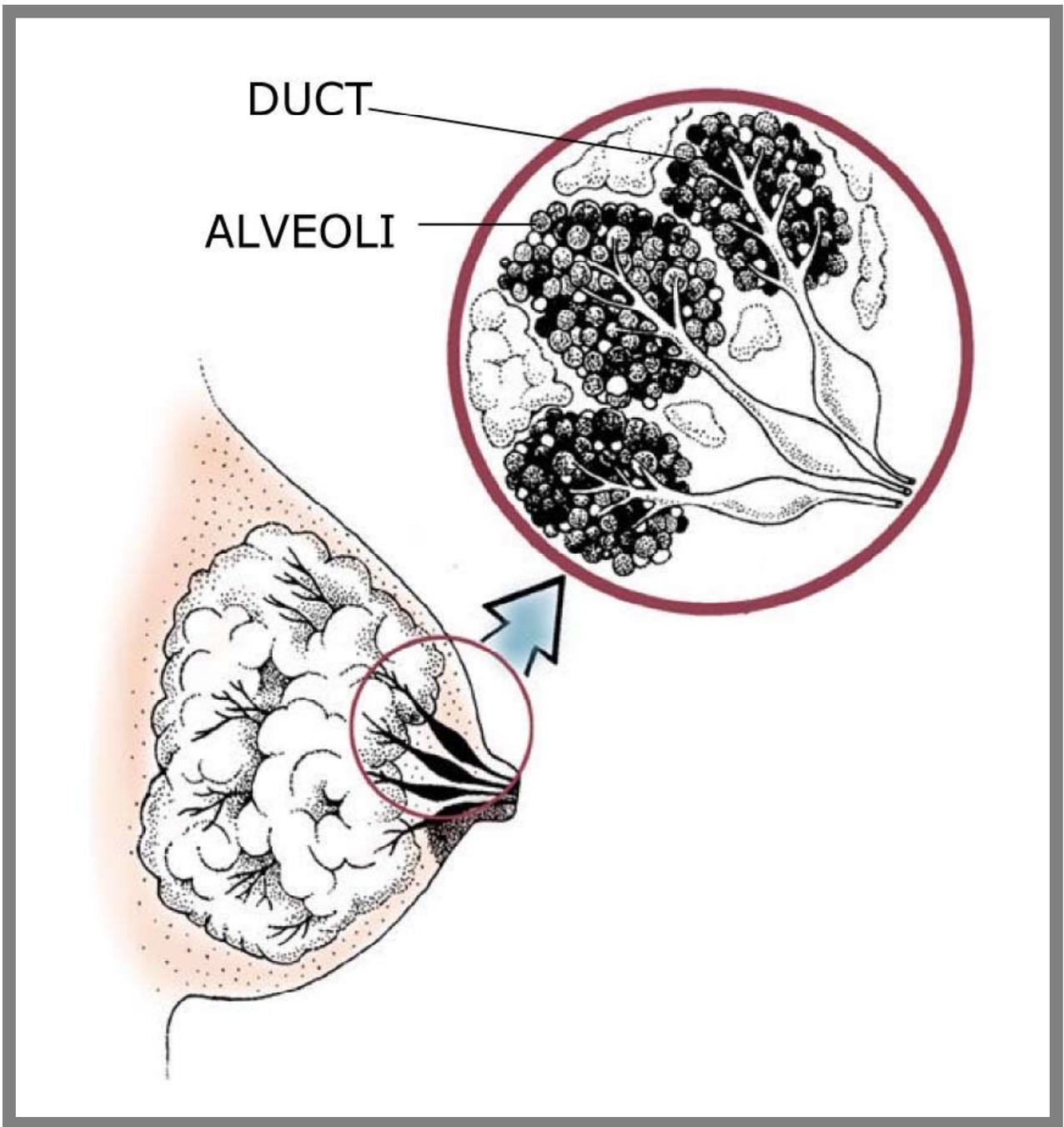


Figure courtesy of Amy Spangler, R.N., M.N., I.B.C.L.C., *Amy Spangler's Breastfeeding, A Parent's Guide*, 7th ed., 2000.

the milk out through the ducts. When milk is released it is called a “Milk Ejection Reflex,” also known as a “let down.” Being relaxed helps oxytocin release milk, so the more relaxed and comfortable mom is, the more milk her infant will receive. See Figure 4: How Mothers Make Milk: Role of the Brain on page 56.

Signs of the milk ejection reflex include the following:

- Tingling, fullness, dull ache, or tightening in the breasts (although some mothers do not feel any of these sensations);
- Milk dripping or spurting from the breast not being suckled during breastfeeding; and
- Uterine cramping after the infant is put to the breast during the first few days postpartum.

In the early postpartum period, the milk ejection reflex is primarily triggered by the infant’s suckling on the breast. After breastfeeding is well established, milk ejection reflex can occur due to a variety of other stimuli that the mother associates with the breastfeeding process; e.g., when a mother hears her infant cry, sees or thinks of her infant, or at the usual time of day her infant is breastfed even if the infant is not around. The milk ejection reflex is sensitive to a woman’s psychological state and other factors. For example, the milk ejection reflex may be inhibited if a woman is experiencing stress, fatigue, embarrassment, or pain.

*Methods to encourage the milk ejection reflex include:*¹⁸

- Relaxation exercises
- Warm compresses before breastfeeding (e.g., a warm washcloth on the breast)
- Breast massage
- Manual expression of a little milk
- Breastfeeding in a calm, undistracted setting or
- Breastfeeding while lying down.

If a woman expresses concern that her milk is not letting down, a person knowledgeable about breastfeeding management (e.g., WIC breastfeeding expert or WIC peer counselor) can

provide assessment, counseling, and follow-up services.

Role of the Infant

The infant also plays an important role in milk production through suckling at the breast and removing milk. When the infant is latched on correctly so that he or she has a mouth full of breast, the special nerve endings that signal the brain to release milk-producing hormones are stimulated. The infant also helps by removing milk. The more milk the infant removes, the more milk the mother will make. Length of time at the breast is not an indicator that the infant is removing milk. Some infants are efficient at removing milk quickly, while others take longer, or are latched on incorrectly so that they are removing very little milk. If the infant cannot go to the breast right away, the milk needs to be removed with a breast pump or through hand expression so the mother can establish a good milk supply. Frequent breastfeeding or milk removal (8 to 12 times every 24 hours) helps mothers make a good milk supply.

Characteristics of Breast Milk

Breast milk is unique in its physical structure and types and concentrations of protein, fat, carbohydrate, vitamins and minerals, enzymes, hormones, growth factors, host resistance factors, inducers and modulators of the immune system, and anti-inflammatory agents. Because it is the sole source of nutrition required for the first 6 months of an infant’s life, its nutrient content has been used by the Institute of Medicine’s Food and Nutrition Board to establish adequate intakes (AIs).¹⁹ Breast milk composition changes during a feeding, through the day, and over time to meet each infant’s nutritional needs.

Infant’s First Milk

The first milk that is produced by the breast for an infant right after birth is thick, yellow-colored fluid called colostrum. The yellow color results from colostrum’s high concentration of carotene (vitamin A precursor). Although colostrum is produced in limited quantity, it is rich in nutrients and substances the infant needs in the

Figure 4: How Mothers Make Milk: Role of the Brain

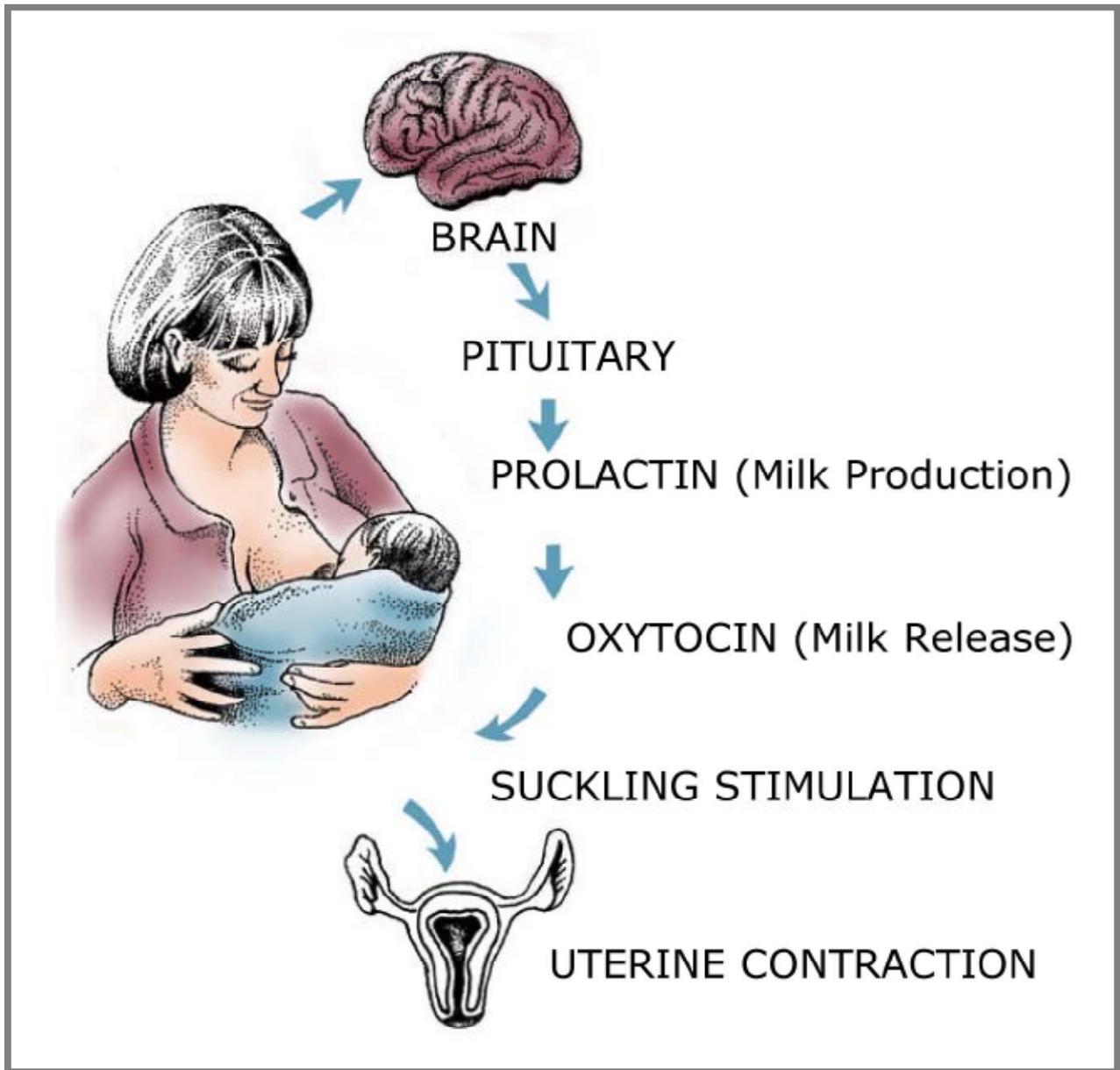


Figure courtesy of Amy Spangler, RN, MN, IBCLC, Amy Spangler's Breastfeeding, A Parent's Guide, 7th ed., 2000.

initial days following birth. It offers the following advantages for mother and infant:^{18, 20, 21}

- Nutrition high in protein and low in fat that is easily digested by the newborn infant;
- Antibodies, primarily secretory immunoglobulin A (sIgA), which protect the infant's immune system by identifying and destroying foreign objects such as bacteria and viruses; and
- Postpartum uterine contractions stimulated in

the mother; the mother will have less blood loss because the infant's sucking causes the uterus to contract.

Mothers should not express any colostrum from their breasts before their infant's birth because the pumping of the breasts may stimulate uterine contractions, risking premature delivery. All the available colostrum should be saved for the infant.²⁰

Over the first 2–3 weeks after birth, the colostrum is gradually replaced by mature breast milk. The intermediate or transitional milk is produced from about day 2–5 postpartum to 2 weeks postpartum. During the transition to mature milk, concentrations of fat, lactose, water-soluble vitamins, and total calories increase in the milk, while those of protein, immunoglobulins, fat-soluble vitamins, and minerals decrease.

Mature Milk

Mature breast milk looks thinner than colostrum. It is produced about 10 to 15 days after birth. Foremilk, the first milk available at the beginning of a feeding, is watery or pale in appearance. Hind milk, the richer milk available toward the latter part of a feeding, is more opaque and creamy white in color. This thicker part of the milk is high in fat and helps the infant feel full and sleepy. Some mothers may need reassurance that although their milk looks thinner than the richer-looking colostrum, mature milk is still full of nutrients for the infant.

Practical Breastfeeding Techniques and Tips

This section reviews basic information and techniques that can help mothers have a successful breastfeeding experience. Once a mother knows what to expect and how to handle common concerns in advance, she can better prevent and cope with most breastfeeding problems that might occur.

Comfort During Breastfeeding

Breastfeeding is easier and more enjoyable when the mother and infant are able to breastfeed in a relaxed setting. Encourage mothers to find a comfortable place for breastfeeding. Special equipment is not necessary, but pillows and a footstool may help the mother get into a comfortable position and bring her infant closer to her breasts. In the early weeks postpartum, a mother may be more comfortable during breastfeeding if she has privacy and can relax with her infant. During this period, encourage mothers to take time to interact and learn about their infants.

Feeding Positions

The way a mother holds her infant and the position of the infant on the breast can influence successful breastfeeding. Incorrect positioning can make it difficult for an infant to suckle properly on the breast, result in inadequate milk consumption by the infant, and lead to sore nipples. To help a mother learn feeding positions, try demonstrating them using a doll.

There are three commonly used positions that allow an infant and mother to breastfeed comfortably. In these positions, the infant's ear, shoulder, and hip should be in a straight line to enhance swallowing. When instructing a mother on these positions, it may be helpful to tell her that one guideline is to position her infant "chest to chest, chin to breast."

Lying down or side-lying

In this position, the mother lies on her side with pillows under her head and behind her back. The infant lies on his or her side facing the mother with his or her chest to the mother's chest and with the infant's mouth level with the nipple. Small pillows can be placed either under the infant's head to bring the infant's mouth to nipple level or under the mother's arm that is holding the infant. It is possible for a mother to breastfeed her infant from either breast in a reclining position without turning over. However, mothers may wish to roll to the other side and reposition the infant during the feeding. This position is typically recommended for a mother who has had a cesarean birth because it allows her to breastfeed without putting pressure on her incision.

Across the lap or cradle hold

In this position, the mother sits upright in a chair or couch with her back supported while holding her infant securely. The mother supports the infant's head with her arm and places the infant on his or her side with the infant's chest facing the mother's chest. It is easier for the mother to support

her infant up to the level of her nipples if she places one or more pillows on her lap under the infant. Alternately, she could cross her legs and bring the infant up to nipple level with her raised leg. To prevent straining her back, the mother should avoid leaning down to the infant and instead bring the infant to her. This position may be useful for the infant who has difficulty latching on because the mother can easily guide the infant's mouth to the breast.

Football hold or clutch hold

In this position, the infant's torso is held on the side of the mother's body and supported by a pillow. The mother's forearm supports the infant's back and head. The infant's head is facing the mother's nipple and is supported by the mother's hand, which can raise the infant's head to the breast. It is best for the mother to avoid leaning down toward the infant (this could strain her back) or pushing his or her head into her breast.

Attachment (“Latch-On”)

Before positioning the infant to start breastfeeding, it is advisable for mothers to wash their hands. It is recommended that mothers support the breast while breastfeeding by using the C-hold or Palmar grasp. This hand position involves placing only the thumb on the top of the breast well behind the areola, with the other four fingers on the bottom of the breast to lift and support it. With the breast well supported, the nipple and breast can be easily directed into the infant's mouth. It is especially helpful for the mother to support the breast in this manner while breastfeeding the young infant.

A mother can initiate breastfeeding by aiming the infant's mouth so his or her chin is touching the mother's breast and the nose is aimed toward the top of the mother's nipple. Then by stroking the lower lip of the infant with the nipple of the breast she is holding, the infant will respond by opening his or her mouth, ready to accept the nipple. When the mouth is wide open and

the infant's tongue is down on the floor of the mouth, the mother should move the infant quickly onto the breast. It is important to make sure that the infant has both the nipple and a large part of the areola in his or her mouth with his or her lips sealed around the areola. When the infant suckles in this position, the infant's gums press against the base of the areola causing the milk to eject into the mouth.

When attached properly, the infant's nose should be touching the skin of the breast (the infant's nose is designed to permit breathing during breastfeeding). The infant's lips should be flanged out (curved outward) and relaxed with neither the upper or lower lip curled inward.

If the infant is not attached correctly the first time, a mother may need to repeat the attachment procedure until her infant is latched on properly. Reassure her that sometimes she may have to try several times to get a good latch-on. If a mother experiences any pain or tenderness during latch-on in the early weeks of breastfeeding, it should subside after the first 30 seconds to 1 minute if the infant is properly attached to the breast.

An infant will not receive enough milk if suckling occurs while only the nipple is in his or her mouth. This is because an infant's mouth needs to rhythmically compress the milk-containing lactiferous sinuses, located under the mother's areola, in order to both draw the milk out and to provide the stimulation needed to bring on the milk ejection reflex. An infant's attempts at trying to breastfeed when attached only to the nipple may result in inadequate milk production and nipple soreness.

Coming Off the Breast

Some infants will automatically come off the breast when they are finished breastfeeding. At the end of a feed, the infant will slow or stop suckling and his or her fists will relax. Some infants fall asleep. A mother can either wait until the infant stops suckling and comes off the breast, or she may break the suction between the mouth

and breast by slipping a finger down into the corner of the infant's mouth alongside the gums until the release can be felt or heard. If a mother just pulls her infant off without breaking the suction first, she could hurt her nipple.

Characteristics of Feedings

Feeding Cues

Breastfed infants should be fed when they show signs of hunger. Crying is considered to be a late sign of hunger; mothers should be encouraged to begin feeding when the infant shows any of the following signs:

- Rooting reflex (see page 44 for the definition)
- Hand-to-mouth activity (e.g., sucking on hands)
- Small fussing sounds
- Pre-cry facial grimaces (i.e., the infant looks like he or she is about to cry) and
- Smacking lips.

Healthy, full-term infants express signs of hunger and satiety, learn trust, and feel secure when their mothers respond to these cues. Thus, putting healthy, exclusively breastfed infants on a strict feeding schedule is generally not recommended. Encourage mothers to watch their infants for signs indicating hunger and to put them to the breast when they see those signs. Remind mothers that it is normal for infants to have fussy times and cry when they are not hungry. They may cry because they need a diaper change, want to be held, or want to suck. (See page 59 for more information regarding non-nutritive sucking.)

Frequency and Duration

Frequent breastfeeding helps to maintain and increase a mother's breast milk supply. Exclusively breastfed newborn infants usually breastfeed 8 to 12 times in 24 hours (or about every 1½ to 3 hours).^{22,23} A newborn infant should not go longer than 2 to 3 hours during the day or 4 hours at night without breastfeeding. If a newborn sleeps longer than 4 hours at night, she or he should be awakened to breastfeed. As an infant grows older, the amount of time between feedings will increase. Each infant establishes his

own feeding pattern. Some infants breastfeed for shorter periods at more frequent intervals, while others feed longer and less often. After a usual pattern of breastfeeding is established, an infant may suddenly demand to be fed more frequently, e.g., during appetite spurts (resulting from growth spurts) or when teething. Also, the longer an infant sleeps at night, the more frequently the infant may demand to be fed during the day.

Daily breastfeeding patterns will vary from infant to infant, and an individual infant's breastfeeding pattern may change from day to day as he grows.²⁰ Infants should be fed on demand, i.e., fed when they indicate hunger. Mothers should learn and follow their infants' feeding cues (e.g., comes off the breast spontaneously, falls asleep) in determining the length of each feeding. An infant's feeding period should not be restricted by time. Infants should be allowed to breastfeed for as long as they indicate the desire.

The time period between hospital discharge and the first well infant visit is critical for successfully establishing breastfeeding. If a newborn infant is breastfeeding fewer than 10 times per day and is not gaining weight properly, encourage the mother to breastfeed more frequently and offer both breasts at each feeding.²² The infant should be referred to a health care provider for assessment.

Waking Sleepy or Placid Infants To Feed

An exception to using the demand feeding approach is for a young breastfed infant who is lethargic, sleepy, or placid. Some infants are sleepy and may not be interested in feeding every 2 to 3 hours. Infants who display these characteristics are primarily newborns recently discharged from the hospital. Nondemanding breastfed infants, who fail to "act hungry," may not gain weight adequately because they are not fed often enough. Mothers of sleepy or placid infants who are not displaying feeding cues or waking to feed should be advised not to wait more than 3 hours between feedings until the infant's first well infant check-up (within 2 weeks of birth). During this visit, the infant's health care

provider should recommend whether to continue the practice based on the infant's weight gain. If an infant is not interested in feeding, refer the mother to a health care provider for further assessment of the infant immediately.

To wake a sleepy infant, a mother can try these methods:

- Stroking the infant's cheek with the nipple
- Holding the infant in an upright position (sitting or standing) while supporting the chin with one hand, several times
- Rubbing or stroking the infant's hands and feet
- Unwrapping or loosening blankets
- Giving the infant a gentle massage
- Undressing or changing the infant's clothing or diaper or
- Playing with and talking to the infant.

Normal Fullness of Breasts

It is normal for a mother of a newborn infant to experience her breasts becoming larger, heavier, and tender a few days after birth. This normal postpartum fullness is caused by an increased volume of milk and blood flow to the breasts as well as temporary swelling of the breast tissue. Breastfeeding 8 to 12 times every 24 hours (about every 1½ to 3 hours) during the first few weeks after birth removes the colostrum and incoming milk so that painful engorgement will not develop. Engorgement hampers the infant's ability to latch on and breastfeed and may lead to poor weight gain in the infant. Normal fullness usually decreases within the first 2 or 3 weeks after birth if the infant breastfeeds frequently and unrestrictedly after birth.²⁰

When the infant stops suckling, the mother should gently remove the infant from the breast, burp the infant, and switch the infant to the other breast. Breastfed infants ingest less air during feeding than bottle-fed infants. However, it is generally recommended that breastfed infants be burped at least once between feedings on each breast and after a feeding is over. The infant may breastfeed on the second side as long as she or he is sucking effectively. Over the first 4 months, the

average exclusively breastfed infant feeds between 10 and 20 minutes per breast for a total period of 20 to 40 minutes. Some infants are very efficient and will spend less time at the breast while others are slower and tend to spend more time at the breast. Limiting breastfeeding to specific times is not recommended.

Milk production by both breasts is stimulated by offering both breasts at every feeding. It may be beneficial to alternate which breast is offered first, if the infant does not equally stimulate both breasts. The breast is never truly "empty" because the secretory cells in the alveoli continue to produce milk. Frequent feedings at each breast will stimulate greater milk production. As the demand increases, so will the milk production.

The sucking patterns and needs of breastfeeding infants vary. While some infants' sucking needs are met primarily during feedings, other infants may need additional sucking at the breast soon after feeding even though they are not hungry. They may have the desire to suck for various reasons, such as when they are lonely, frightened, or in pain. This is referred to as non-nutritive sucking.

Bowel Movements of Breastfed Infants

The bowel movements of breastfed infants are different in color, consistency, and frequency from those of formula-fed infants. In the first few days after birth, all infants eliminate the meconium; this is the first stool the infant passes and is sticky and a very dark color (greenish black). After that, the stools of an exclusively breastfed infant generally look like mustard-colored cottage cheese (although stools may be a darker brown or green color) and have a mild odor. In comparison, the stools of formula-fed infants are darker, more formed, and infrequent compared to those of breastfed infants.

Indicators of Whether an Infant Is Getting Enough Milk

A breastfeeding mother may ask how to tell if her infant is obtaining sufficient breast milk. This question may occur because mothers cannot

see how much breast milk their infants are consuming. During the first few weeks after birth, they may also notice their breast size decreasing from their initially enlarged size (this slight shrinking of breast size is normal).

To reassure mothers that their milk supply is adequate and that their infants are consuming a sufficient amount of milk, specific indicators can be examined. *An exclusively breastfed infant is probably consuming a sufficient amount of breast milk if he or she:*

- Gains weight consistently. Weight gain is the most important indicator of whether an infant is receiving sufficient milk and breastfeeding effectively. Infants generally double their birth weight by 6 months of age and triple their birth weight by 12 months of age;
- Breastfeeds frequently and is satisfied after each feeding;
- Wakes to feed;
- Can be heard swallowing consistently while breastfeeding (in a quiet room); and
- Has plenty of wet and soiled diapers, with pale yellow or nearly colorless urine, while not being given any extra fluids besides breast milk. The infant should have:
 - At least 4–8 wet and 3 soiled diapers per day in the first 3–5 days of life²
 - 6 or more wet and 3–4 soiled diapers per day by 5–7 days of age² and
 - After 6 weeks, the number of bowel movements can vary from less than once a day to many per day.

Breastfeeding mothers also have their own physiological indicators as to whether their infant is consuming an adequate amount. An exclusively breastfed infant is probably consuming a sufficient amount of breast milk if his mother has:

- Full and tender breasts at feeding times, which soften after a feeding
- A tingy sensation of the milk ejection reflex during the feeding or
- Cramping in her lower abdomen; some mothers feel these uterine contractions in the early post-partum period.²²

If there is any question whether the infant is receiving adequate nourishment, it would be appropriate to assess the infant's breastfeeding history, feeding patterns, and growth (using CDC growth charts). *Refer the infant to his health care provider or a WIC breastfeeding expert for further assessment.*

Common Concerns

Flat or Inverted Nipples

Flat or inverted nipples do not protrude properly when stimulated. Inverted nipples pull inward instead of protruding out when pressure is applied to the areola. Flat nipples neither retract nor protrude, but remain flat when the areola is gently squeezed.²³ Some infants may have difficulty latching on to flat or inverted nipples. Some experts believe that a woman can correct these conditions by wearing breast shells or milk cups (see page 66 for more information regarding breast shells) in her bra towards the end of her pregnancy and, if still needed, between feedings during the postpartum period. However, the use of breast shells has not proven to be effective in the limited studies done to date.² If a woman has or thinks she has flat or inverted nipples refer her to a health care provider or a WIC breastfeeding expert for assistance.

Sore Nipples

Some women may experience nipple sensitivity or tenderness during the early postpartum period as they are learning and adapting to breastfeeding. However, this sensitivity usually diminishes after the first week or two. It does not require medical intervention nor does it cause visible damage to the breast or the nipples. A mother should not feel pain during breastfeeding. Sore nipples beyond 2 weeks postpartum or soreness accompanied by visible damage to the breast or nipples may be caused by several factors, including the following:

- **Incorrect positioning and latch-on to the breast** – If an infant is not positioned appropriately for breastfeeding or his or her mouth is not attached to the breast with a good portion of the areola in the mouth, the

nipple can become irritated. The infant's grasp on the nipple should not feel painful to the mother if the infant is properly attached to her breast. The appropriate feeding positions, are described on page 57-58, and proper attachment is described on pages 58.

- **Inappropriate breast care practices** – Mothers should be instructed to avoid harsh soaps, use a properly fitting nursing bra, and use breast pads. A more detailed description of recommended breast care practices is found on page 66-67.
- **Inappropriate frequency and duration of breastfeeding** – An infant who is allowed to become overly hungry may traumatize the nipple by suckling too vigorously. Also, if the mother's breasts are engorged from infrequent feedings, the infant may not be able to grasp the nipple and areola properly in the mouth and thus increase irritation to the nipple. See page 59 regarding appropriate breastfeeding frequency and duration.

Nipples that suddenly become sore and cracked can also be caused by an infection called thrush.²² A woman with a thrush infection on the nipples will usually complain of itching or burning nipples and the skin may become pink and flaky. Thrush may also appear as white spots on the inside of the infant's cheeks, tongue, or gums. *A health care provider should be consulted; medication or other treatment may be prescribed for both the mother and infant.*

Expressing some milk onto the nipples at the end of a feeding and letting it dry may help sore nipples to heal. If a mother complains of sore nipples, the cause of the soreness needs to be determined in order to treat the condition and prevent it from recurring. A WIC breastfeeding expert can provide assessment, counseling, and follow-up services to mothers complaining of sore nipples.

Engorgement

Engorgement refers to the firm and painful overfilling and edema of the breasts.² Normal fullness, common in the first weeks of lactation, is the result of milk production beginning along with increased blood flow to the breasts. By the second or third week postpartum, this normal fullness decreases and the breasts will feel softer, even when the milk supply is plentiful.²²

Engorgement may occur due to infrequent or ineffective removal of milk from the breast. When engorgement occurs, the breasts will feel full, hard, warm, tender, and painful. It may be difficult to attach the infant to the breast because the nipple and areola become very taut and hard to grasp. Cases of severe engorgement are associated with abrupt changes in breastfeeding frequency, such as when a mother skips several feedings in a day. *Common recommendations to relieve engorgement include the following:*

- Apply moist heat (hold a washcloth soaked in warm water to the breasts or stand under a warm or hot shower) for 10–20 minutes before a feeding to facilitate the milk ejection reflex.
- Express some milk to soften the areola and breast and allow the nipple to protrude easily.
- Massage the breasts to encourage the flow of milk and to relieve fullness.
- Apply cold compresses to the breasts after feedings to reduce swelling and pain. For years, some women have applied clean, refrigerated, or room-temperature cabbage leaves to their breasts to relieve engorgement.^{22, 23} It is not clear whether cabbage leaves contain a substance that makes this technique effective or if the cold simply provides relief, but the practice is believed to be both effective and harmless.¹⁸

The best management for engorgement is prevention by having the infant breastfeed frequently and effectively every 1 to 3 hours. A WIC breastfeeding expert can provide assessment, counseling, and follow-up services to women complaining of engorgement.

Plugged Milk Ducts

A plugged milk duct can occur when a milk duct becomes clogged with milk. A mother with a plugged milk duct will commonly complain of a localized tender area on her breast or a lump she can feel in her breast (but does not have fever or other flu-like symptoms). Plugged ducts can be caused by improper positioning of the infant on the breast, severe engorgement, consistently breastfeeding on one breast only, infrequent or skipped feedings, or pressure applied on the breast (e.g., by a tight bra or other constricting clothing, or certain sleeping positions).

To release a plugged milk duct, a mother can take these steps:

- Take a hot shower or apply warm, moist cloths to the area where the plugged duct is located and the rest of the breast.
- Massage the breast from the plugged area down to the nipple before and during breastfeeding.
- Breastfeed frequently (at least every 2 hours) and use different positions.
- Position the infant's chin toward the plugged duct and empty the affected breast first.
- Loosen tight clothing, especially the bra.
- Get plenty of rest.

Because mastitis can result if plugged milk ducts are not relieved, a mother should contact her health care provider if the plugged duct does not go away or if she starts developing symptoms of mastitis. See below for more information regarding mastitis.

Mastitis

Mastitis is an infection of the breast. It can occur if a mother does not breastfeed frequently and effectively, and thus often appears following engorgement or plugged ducts. This condition frequently occurs at times of stress or change in usual routine (e.g., guests are visiting, holiday time, returning to work). Frequent and effective breastfeeding (which empties the milk from the breasts regularly) can prevent most cases of mastitis from developing. A mother with

mastitis may have any of the following symptoms: tenderness and/or redness of the breast or flu-like symptoms such as body aches, headache, nausea, fever, chills, malaise, or fatigue. A breastfeeding mother complaining of any of these symptoms should contact or be referred to her health care provider immediately. The treatment is the same as for plugged ducts: apply heat, get plenty of rest, drink adequate fluids, and breastfeed often. Antibiotics will usually be prescribed to cure the infection. To prevent the recurrence of mastitis, it is important that a mother take the entire course of prescribed medication, even if her symptoms have disappeared before the medication is finished. It is recommended that mothers continue breastfeeding, using both breasts at each feeding, and breastfeed frequently to remedy and prevent this condition. If mastitis is not quickly or completely treated, a more serious condition such as a breast abscess may result.¹⁸

Poor Suckling

An infant who does not appear to be correctly attached to the breast, chews on the nipple, or pushes the nipple out of his or her mouth may not be suckling effectively. Poor suckling may result from improperly positioning an infant, incorrect use of the tongue while breastfeeding, nipple preference, and other problems. An infant who suckles poorly may be breastfeeding often but ineffectively and thus not necessarily receiving sufficient milk from the breasts. Ultimately, poor suckling can result in a decrease in the mother's milk supply as well as an infant who is frustrated, gaining weight inadequately, has a low urinary output, and has abnormally infrequent stools. If a mother complains that her infant has any of these symptoms, refer the infant to a health care provider or WIC breastfeeding expert. A WIC breastfeeding expert can provide assessment, counseling, and follow-up services to correct suckling problems.

Appetite/Growth Spurts

Appetite or growth spurts are short periods of time when the infant breastfeeds more frequently than normal.^{2,16} Around 8 to 12 days of age, mothers may notice the infant acts hungrier than

normal and may not seem satisfied.² During this time, the fullness of the mother's breasts may have also subsided. Consequently, a mother may feel these signs indicate that she is not producing enough milk for her infant.^{2,16} Many mothers begin to supplement their feedings with infant formula, try to feed their infant complementary foods, or even stop breastfeeding completely.^{2,16}

Although a mother may feel that she has an insufficient milk supply, what is actually happening is the infant is signaling the mother's body to produce more milk to meet his growing needs.¹⁶ Encourage the mother to keep the infant at the breast as often as the infant demands to feed during this period.^{2,16} Frequent feeding will increase her milk supply to meet her infant's increased needs and eventually he or she will resume a more normal feeding pattern.^{2,24}

Other periods when appetite spurts can occur are 6 weeks, 3 months, and 6 months.^{2,16} However, the time period an infant goes through an appetite spurt may vary. Anticipatory guidance to breastfeeding mothers regarding infant feeding patterns often eliminates supplementation and premature weaning.² If a mother expresses concern that an appetite spurt lasts longer than a few days, refer her to a WIC breastfeeding expert.

Teething and Biting

Teething and biting are not reasons to wean an infant from the breast. Infants can continue to breastfeed while growing teeth without causing pain to the mother. References such as La Leche League (2003)²⁰ and Meek (2002)²³ include useful tips on coping with teething and biting in breastfeeding infants. See page 134 for tips regarding soothing an infant who is teething.

Refusing To Breastfeed

An infant's sudden refusal to breastfeed is often referred to as a "nursing strike" and may occur at any time. Mothers may perceive this as a personal rejection, and a nursing strike may lead to early or unplanned weaning. Many mothers never figure out what caused the nursing strike but some common causes include:

- Onset of a mother's menses;
- Maternal stress;
- Change in maternal diet;
- Change in maternal soap, deodorant, or perfume;
- Infant nasal congestion;
- A mother returning to work, or a period of separation of the dyad (mother and infant); and
- Infant nasal obstruction or gastroesophageal reflux disease.

Efforts to restore or continue breastfeeding may take several days. Mothers will need reassurance to continue the breastfeeding relationship. Encourage mothers to continue putting infant to breast especially when he shows signs of hunger or when he is just awakening or sleepy; increase the amount of time holding or cuddling, including skin-to-skin contact; and minimize distractions. Mothers should be advised to maintain their milk supply by pumping or hand expression to assure continued adequate milk production. Instruct mothers to provide pumped breast milk in a cup, spoon, or dropper until breastfeeding resumes.

Slow Weight Gain

An infant's weight gain is the most reliable sign of breastfeeding success. When an infant does not gain weight adequately, appropriate action should be taken to increase the infant's weight as well as ensure that premature weaning does not occur. It is common for infants, both breastfed or formula-fed, to lose a few ounces of weight in the first 3 or 4 days of life. During this period, infants pass their first stools and eliminate extra fluids that they are born with. This weight loss should stop as the mother's milk production increases. At this time, an infant who is breastfeeding effectively should begin gaining weight and ultimately exceed his or her birth weight by 14 days after birth.²³ After infants experience the typical early weight loss and regain their birth weight, they usually gain around 6 ounces per week during the first 6 months. See pages 60-61 for signs indicating the infant is getting enough milk.

If an infant is under birth weight by 2 weeks of age or a mother is concerned about her infant's weight, advise her to consult her infant's health care provider.

Sleeping Through the Night

Although many mothers worry about getting their infant to sleep through the night, the reality is that an infant's digestive system is not designed to go an extended amount of time without food.

Mothers have different definitions of what "through the night" means. Researchers use midnight to 5 a.m. as the standard definition; however, many mothers consider it to be much longer.¹⁶

Infants need the important nutrition that night feedings can provide for growth and development. Night feedings are also important for the breastfeeding mother because they help maintain a healthy milk supply and prevent the mother's breasts from becoming overly full. Mothers may feel pressure from family members and friends who indicate that their infant slept through the night at an early age; however, it is important to remind mothers that infants have different feeding patterns and feed at different time intervals. Some infants cluster feed in the late evening and sleep longer at night. Other infants continue to feed every 2 to 3 hours through the night.¹⁶

Sleep deprivation is natural in the early weeks after childbirth. Getting to know an infant's feeding and sleeping patterns is a learning process for mothers whether they breastfeed or formula-feed. Both feeding methods may disrupt sleep but breastfeeding eliminates having to get up and prepare a bottle of infant formula. Mothers can use strategies such as keeping the infant close to the bed in a bassinet, sleeping when the infant sleeps, and accepting help from others to get adequate rest. Assure the mother that as her infant grows he/she will sleep for longer intervals.

Complementary Bottles and Pacifier Use

In order to establish a good breast milk supply, advise mothers to avoid feeding complementary bottles of infant formula and water or using

pacifiers for the first 2 to 4 weeks of an infant's life. Supplementation with fluids other than breast milk as well as pacifier use can interfere with establishing effective breastfeeding and have been associated with early weaning.^{25, 26, 27} Some of the problems that may be caused or aggravated by feeding complementary bottles or using a pacifier include:

- **Nipple preference** – Artificial nipples on bottles and pacifiers require different movements of the infant's tongue, lips, and jaw and may make it difficult for infants to easily go back to the mother's nipple and breast.
- **Engorgement** – Bottles and pacifiers decrease the amount of time the infant spends breastfeeding. Breastfeeding immediately postpartum, and frequently, helps prevent engorgement.²⁰
- **Refusal of the breast** – After being on a bottle, the infant may become frustrated and not express as much interest in suckling from the breast.
- **Early weaning** – Because the infant fills up on infant formula and suckles less on the breast, a reduction in milk production occurs.

Mothers who report any of the above problems can be referred to a WIC breastfeeding expert for assistance.

Some mothers may wish to partially breastfeed and feed some infant formula. It is possible to combine both breastfeeding and formula feeding. However, as a mother increases the amount of infant formula fed and decreases the number of feedings, her breast milk production will decrease, possibly resulting in total weaning. If a mother desires to wean her infant from the breast over the first few weeks of life, complementary bottles of infant formula can be given gradually as she weans. See pages 74-75 for guidelines on weaning.

Breastfeeding Aids and Devices

Elaborate equipment is not needed in order to breastfeed. However, there are some aids that can assist in avoiding breastfeeding problems. Items that can help mothers include:

Nursing Bra

Nursing bras are specially designed to allow a mother to open a flap of the bra over each breast separately so that she can easily feed her infant with one breast at a time. When choosing a nursing bra, the mother should shop for one a week or two before delivery when her breasts will be close to the size they will be during breastfeeding (after delivery, she can select additional bras to fit her size). The bra should be comfortable and nonconstraining, made with cotton cups (permitting adequate air circulation), and made with nonelastic adjustable straps for sufficient support.

Ideally, the bra should allow room inside for nursing pads and, if used, breast shells. Generally, underwire bras are not recommended during the lactation period. Wearing a bra is not necessary when a mother is sleeping; however, if a mother chooses to wear a bra while sleeping, it should be loose fitting and as nonbinding as possible.

Nursing Pad

Nursing pads are placed in a bra to soak up leaking milk. Washable or disposable nursing pads without plastic or waterproof liners are recommended because they allow air circulation. It is best to change nursing pads frequently to assure that moisture is not sitting on the nipples. Alternatives to commercial nursing pads include cotton handkerchiefs or squares cut from terry cloth, cotton diapers, or cotton T-shirts. Using toilet paper or facial tissue is not recommended because they dampen easily, fall apart, and hold liquid against the nipple.

Breast Shell (Milk Cup)

A breast shell (milk cup) is a two-piece hard plastic device that contains two parts: an inner center ring and an attached overlying dome.

These may be used to correct inverted or flat nipples (nipples that do not protrude properly; see page 61 for more information regarding inverted nipples). The shells may be used during the end of pregnancy or for 30 minutes prior to each feeding. Milk that collects in the shell should not be fed to the infant and should be discarded. Mothers should follow advice from a WIC breastfeeding expert on the proper use of breast shells. If a woman has inverted or flat nipples, refer her to the *WIC breastfeeding expert for assistance*.

Nipple Shield

A nipple shield is an artificial rubber latex or silicone nipple that rests on a mother's nipple while she is breastfeeding. Although previously not recommended because they were believed to interfere with milk supply, newer silicone nipple shields may be used in certain situations. *With the guidance of the WIC breastfeeding expert, using nipple shields for a period of a few days to a few weeks may be appropriate to.*²

- Help an infant latch on to a flat or inverted nipple
- Help an infant latch onto an engorged breast
- Protect sore nipples
- Reduce an excessively rapid milk flow and
- Help an infant learn to latch on during the process of relactation (see page 75 for information regarding relactation).

Nipple shields have been used by some women who believe they relieve sore nipples; however, they do not prevent sore nipples, nor correct their underlying cause. *If a mother is using the nipple shields and having trouble weaning her infant off them, refer her to a WIC breastfeeding expert, healthcare provider, or lactation management expert for assistance.*

Breast Care

Mothers can take simple steps when caring for their breasts to minimize the development of some common breastfeeding-related breast and nipple problems.

Recommended breast care practices:

- **Keep nipples dry between feedings** – Nipples should be air dried after each feeding and breast pads should be replaced frequently (when moist) to reduce the likelihood of bacterial or fungal growth. Expressing some milk onto the nipples at the end of a feeding and letting it dry may help sore nipples to heal.
- **Do not dry the nipples with a hair dryer or heat lamp after breastfeeding** – Drying the nipples with a hair dryer or heat lamp removes the internal moisture in the skin, which may cause drying and cracking of the nipples.
- **Avoid using harsh soaps and detergents on nipples and areolae** – Soap, shampoo, detergents, or alcohol used on the nipples and areolae remove natural lubricants and dry them out. Soap or shampoo that drips onto the nipples or areolae during a bath or shower can be rinsed off with clean water. Excessive washing or rubbing may remove the protective outer layer of cells on the nipples and areolae, contributing to soreness.
- **Avoid “toughening” the nipples by rubbing them with a towel/cloth or otherwise “preparing the nipples” for breastfeeding before delivery** – This practice can remove natural lubricants and some of the outer cell layer from the breast and increase irritation to the nipple.
- **Do not use creams, ointments, or oils on the nipples or areolae on a routine basis to heal sore nipples, abrasions, or cracks** – The Montgomery’s glands in the areola secrete oils that naturally cleanse, lubricate, and protect the nipple and the areola during breastfeeding. This process eliminates the need for routine application of creams, ointments, or oils. However, there are circumstances when pure lanolin cream is recommended to occasionally soothe sore nipples. Creams and ointments do not prevent nipple soreness and should not be used as a substitute for determining and correcting the cause of a mother’s sore nipples.

Expressing Breast Milk

A woman may need or want to express some of her breast milk under these circumstances:

- Her breasts are engorged
- Mother and infant are separated (e.g., if milk is needed while the infant is with a babysitter or in day care) or
- Mother or infant is sick or hospitalized.

All breastfeeding mothers can benefit from knowing how to express their breast milk. Breast milk can either be expressed manually or by breast pump (hand or electric). A variety of resources include instructions on hand expression of breast milk (see La Leche League (2004)²² or Meek (2002)²³ for examples).

The basic steps for manual milk expression:²

- Wash hands thoroughly with soap and warm water.
- Gently massage the breast from the outside quadrants toward the areola; avoid applying deep pressure or friction.
- A washcloth with warm water may be placed on the breast about 5 minutes before milk expression.
- Place the hand with the fingers below and the thumb above about 1¼ inch away from the nipple base so they form a “C.” Press toward the chest wall and then compress the thumb and fingers together, rolling them toward the nipple. Move the hand around the areola to reach all of the areas that cover the pooled milk in the lactiferous sinuses. Use the free hand to massage the breast from the outer quadrants toward the nipple. Do not squeeze the nipple.
- The manual method can take 20 to 30 minutes for adequate draining of both breasts.

Refer mother to a WIC breastfeeding expert for more information concerning manual breast milk expression.

General guidelines for breast pump milk expression:²

- Wash hands before beginning to express milk.
- Ten minutes of pumping each breast should

be sufficient for maintenance of adequate milk production, preferably from both breasts simultaneously.

- Develop relaxation techniques, such as sitting in a comfortable environment. Think about the infant or look at a photograph of the infant. Gently massage the breast before and during the milk expression.

Mother should refer to the manufacturer's instructions for the specific pump. If instructions are not available, refer her to a WIC breastfeeding expert.

Breast milk should always be collected in a very clean container (rigid plastic or glass containers are generally recommended). See pages 68–69 for guidelines on safe storage and preparation of expressed breast milk for feeding.

Since breast milk is not homogenized, the fat in it will separate and come to the top. Also, if breast milk sits for a while, there may be small lumps of cream that do not dissolve. These characteristics are all normal.

Storing Expressed Breast Milk

Expressed breast milk is a perishable food which must be stored properly for safe consumption.

The following guidelines are recommended to prevent contamination of breast milk:

- Store expressed breast milk in clean glass bottles, rigid plastic bottles, or disposable plastic nursing bags tightly capped after filling (sterilized bottles and parts should be used for infants less than 3 months old) (see page 91 regarding sterilization of bottles). Do not use ordinary plastic bags or infant formula bottle bags since they may crack and leak.²³
- Breast milk can be frozen immediately after collection in portions generally needed for a single feeding (e.g., 2 to 3 ounce portions for most infants less than 3 months old; 3 to 4 ounce portions for infants 3 to 5 months old; 4 ounce or larger portions for infants 6 months and older). Also, some 1 ounce portions can be frozen for times when the infant wants some extra milk. When filling a

bottle, leave room (about 1 inch) at the top for expansion. Never add fresh breast milk to already frozen breast milk.

- Store bottles of breast milk in a properly functioning refrigerator at 39 degrees Fahrenheit (F) or below after collection.² Breast milk is remarkably resistant to bacterial growth but, to be safe, use refrigerated breast milk within 48 hours from the time it is collected.^{2, 24} Since refrigerators may be opened regularly, it is advisable to store the milk in the back section of the refrigerator, which tends to be colder than the front or door.
- Breast milk that will not be fed within 48 hours of collection should be frozen.²⁴ Frozen breast milk should be stored in the rear of a properly functioning refrigerator freezer, where the temperature is at 0 degrees F, and can be stored for as long as 3 to 6 months.²⁴ If the freezer is not working or if there is a power failure, frozen milk may thaw out and become rancid and spoil sooner. Label the container of milk for storage with the collection date. Use the oldest milk first.
- Once frozen breast milk is thawed, it should be refrigerated at 39 degrees F or below, used within 24 hours, and should not be refrozen.² If the milk has an offensive odor when thawed, it may have spoiled and should be discarded. Also, do not add warm milk to cold or frozen milk. While breast milk is very resistant to bacterial growth when fresh, it is much less resistant after it has been frozen. Each time a liquid is added to frozen milk, a thin layer of milk thaws which is a potential area for bacterial growth. While the risk is small, the best practice is not to open stored milk until feeding time.
- If traveling with bottles of expressed breast milk, store them in a cooler with ice or an ice pack.
- Clean used bottles and their parts with soap and hot water. If the infant is less than 3 months old, sterilize those items in boiling water, as shown in Figure 6a-c, pages 93–95, or wash in a dishwasher before reusing.

Warming Expressed Breast Milk

The following guidelines are recommended to thaw and warm breast milk:

- Milk should be thawed quickly. To thaw and warm a container of frozen expressed breast milk:
 - Hold the bottle under running lukewarm water.²
 - Shake the bottle gently to mix (breast milk separates into a fatty layer and a watery layer when it is stored).
 - Avoid too much heat or shaking because heat will damage the protective substances in the milk and very vigorous shaking will cause the milk fat to separate out.
- Test the temperature before feeding to make sure that it is not too hot or cold (test by squirting a couple of drops onto the back of your hand). Use the milk immediately after warming to avoid breakdown of the milk fat, the development of rancidity, and bacterial growth.
- Thaw and/or warm only as much breast milk as you think will be needed for a feeding. Thawed breast milk must be used within 24 hours or discarded.² Do not refreeze breast milk that has been thawed.
- Never use a microwave oven to thaw or warm breast milk.² Liquid in a bottle may become very hot when heated in a microwave oven and remain hot after removal from the oven even though the bottle feels cool. Infants have been seriously burned while being fed liquids warmed in microwave ovens. Covered bottles can explode when heated in a microwave oven. Also, many of the immunities in breast milk can be destroyed if the milk is heated in a microwave oven.

Planning for Time Away From the Infant

Many mothers need or want to return to work or school outside their home shortly after their infant's birth. Mothers who are temporarily separated from their infants can successfully continue to breastfeed them. The following tips may improve a mother's ability to continue breastfeeding whether she chooses to work, go

to school, or leave her infant temporarily in someone else's care:

If possible, delay the return to work or school until the infant is at least 4 to 6 weeks old. The period from birth to 4 to 6 weeks is critical for establishing a mother's milk supply. If a mother returns to work or school before that time and is away from her infant for long periods, she may have difficulty maintaining her milk supply.

Learn how to express breast milk. A mother who is comfortable expressing breast milk manually (by hand) or mechanically (using a breast pump) can collect her milk while away from her infant. Mothers who begin expressing, collecting, and freezing small amounts of milk each day are able to build up a stored supply of milk. Thus, some recommend pumping twice a day, in addition to breastfeeding the infant, beginning several weeks before they return to work or school. This allows the milk supply to increase gradually over the weeks. See page 67 on milk expression.

Inquire about breastfeeding support at the workplace/school. Some workplaces or schools may feature supportive policies (e.g., allowing breaks or flexible work hours for pumping or breastfeeding) and facilities for breastfeeding mothers (e.g., special rooms or areas for breastfeeding with privacy, an electric breast pump for employees' use, and a refrigerator to store expressed milk).

Make child care arrangements for the infant. The arrangements families make for their children can vary including care by relatives, center-based care, family child care provided in the caregiver's home, and care provided in the child's home by babysitters. Encourage mothers to choose an arrangement that is supportive of breastfeeding and, in the case of a child care center, allows her to breastfeed if she visits. The temporary caregiver needs to be instructed on:

- How to use frozen breast milk (see pages 68–69 for instructions on how to handle frozen breast milk) and

- How much expressed breast milk (or infant formula) the infant usually consumes and how often he or she usually eats (this will depend on the infant's stage of development and other factors); The temporary caregiver should still be encouraged to follow the infant's hunger and satiety cues in deciding when and how much to feed.

Make arrangements for safely storing expressed breast milk while away from home.

It helps if a refrigerator is available for storage at the worksite or school. If not, some mothers store their milk in coolers packed with ice or ice packs. See pages 68 for information regarding storage of expressed milk. Encourage the mother to label the container of milk for storage with the collection date. The oldest milk should always be used first.

Prepare the infant for being fed by someone other than the mother. An infant who will be fed by someone else needs to be introduced to a bottle before his or her mother starts going to work or school – some recommend 2 weeks before she returns and preferably no sooner than when the infant is 3 to 4 weeks old. By that age, the mother's milk supply should be established and there will be less chance of causing nipple preference in the infant. An older infant may take breast milk from a cup.

Maintain a good milk supply.

The easiest time to express milk to build up a supply is in the morning. Most mothers have more milk in the morning and find that it is easiest to express then. One technique that works well for many mothers is as follows:

- Breastfeed the infant from one breast after waking up in the morning.
- Put the infant down, pump the milk from the other breast, and store it.
- As soon as the pumping is finished, let the infant breastfeed on the side that was just pumped.

Infants will usually consume the remaining milk that the pump did not extract. The extra suckling will also increase the mother's milk supply.

- Breastfeed the infant when home; express milk during the day if possible. In order to maintain her milk supply and avoid engorgement and breast infections, a mother should breastfeed her infant before leaving for work or school, after coming home for the day, and in the evening, and, if possible, express her milk during the day. Mothers often express their milk during breaks and/or lunch hour. Some mothers go to their infants or have their infants brought to them for breastfeeding at lunch time. Alternately, when milk expression is not possible, infant formula can be provided while the mother is away. Some infants may wait until their mothers arrive home to do most of their feeding; this is not a problem as long as the infant is consuming an adequate amount to maintain proper growth.

- Breastfeed regularly on weekends and evenings. Breastfeeding mothers decrease their chances of experiencing discomfort, engorgement, and a lower milk supply if they breastfeed frequently at times when they may not be expressing their milk (i.e. evenings and weekends). As the week progresses, some mothers may find that there seems to be less milk to express. A mother can maintain and increase her milk supply if she breastfeeds (or pumps) often (6 or more times a day during the week and more on weekends), gets adequate rest, and consumes a nutritionally adequate diet.

Although additional planning and scheduling is required when breastfeeding while working or attending school, continuing to breastfeed, to whatever degree, benefits both the mother and her infant.

Use of Cigarettes, Alcohol, Other Drugs, and Certain Beverages During Breastfeeding

This section provides guidelines and background information on the use of cigarettes, alcohol, other drugs, caffeine-containing products, and herbal teas during breastfeeding.

Cigarettes

A mother who smokes cigarettes can still provide her infant the benefits of breastfeeding. However, breastfeeding mothers should be actively discouraged from smoking. Smoking is associated with a poor milk supply and has harmful effects on the mother and her infant.¹⁸

Effects of Cigarette Smoking on Breastfeeding Infants

Nicotine and other compounds such as cyanide and carbon dioxide from cigarettes can enter an infant's system through breast milk.² Nicotine, the addictive substance inhaled when smoking cigarettes, does not disrupt lactation but may interfere with the milk ejection reflex and milk production. The nicotine content of the milk is correlated with the number of cigarettes smoked per day and how recently the mother smoked before a feeding. Maternal smoking has been associated with:¹⁸

- Decreased infant growth
- Increased number of infant respiratory illnesses and
- Increased rates of infantile colic.

Sudden Infant Death Syndrome is more common in infants of smokers.¹⁸

The Environmental Protection Agency²⁸ has concluded that second-hand smoke (cigarette smoke exhaled by smokers and given off by the burning ends of cigarettes) is a human lung carcinogen and that exposure to such smoke has these harmful effects on infants and children:

- Increases the risk of lower respiratory tract infections such as bronchitis and pneumonia

- Increases the prevalence of fluid in the middle ear, a sign of chronic middle ear disease
- Irritates the upper respiratory tract and is associated with a small but significant reduction in lung function
- Increases the frequency of episodes and severity of symptoms in asthmatic children and
- Is a risk factor for new cases of asthma in children who have not previously displayed symptoms.

Effects of Cigarette Smoking on the Mother

The U.S. Surgeon General has concluded that cigarette smoking increases a woman's risk of developing cardiovascular diseases (including atherosclerosis, stroke, and coronary heart disease), respiratory diseases (including chronic obstructive pulmonary disease and asthma), infertility, cataracts, hip fractures and low bone density postmenopausal, peptic ulcer, cancers (of the lung, larynx, oral cavity, esophagus, stomach, pancreas, urinary bladder, cervix, and kidney), and risk of dying prematurely in general, and is a major threat to the outcome of pregnancy and the well-being of the newborn infant.²⁹

Smoking Cessation

Refer breastfeeding mothers who smoke, and are having difficulty quitting, to smoking cessation programs in your area. Refer to the U.S. Department of Agriculture, Food and Nutrition Information Center resource list entitled "Alcohol and Substance Abuse During Pregnancy and Breastfeeding, September 2003" available at http://www.nal.usda.gov/fnic/pubs/bibs/topics/pregnancy/substance_abuse_resourcelist.pdf for guidance and publications appropriate to counsel pregnant or breastfeeding mothers about smoking cessation.

If a breastfeeding mother is unable to totally quit smoking, recommend that she do the following:²³

- Cut down on the number of cigarettes smoked
- Refrain from smoking while breastfeeding her infant

- Avoid smoking in her infant's presence (nicotine, via cigarette smoke, can also enter an infant's system from the air) and
- Refrain from smoking until right after a feeding so that nicotine levels will have time to decrease before the next feeding.

Nicotine patches or gums are often promoted for use to help smoking cessation; however, mothers should consult their health care provider before using these products.

Given the effects of second-hand smoke on children, advise mothers to also ask other smokers they know to avoid smoking around the infant or other children.

Alcohol

Contrary to popular belief, consumption of alcoholic beverages has not been shown to have any beneficial effects on breastfeeding (i.e., drinking beer does not increase your milk supply). Alcohol consumed by a mother can enter her infant's body through breast milk; levels have been shown to peak in breast milk³⁰ to 90 minutes after alcohol consumption by the mother. It is recommended that mothers avoid habitual use of alcohol while breastfeeding.

Effects of Alcohol on Mother and Infant

Excessive alcohol intake is associated with failure to initiate the milk ejection reflex, high alcohol levels in milk,³⁰ lower volumes of breast milk ingested by the infant,³¹ and disturbances in the infant's sleep-wake pattern.³² The amount of alcohol that may impair the milk ejection reflex is more than about two alcoholic drinks (0.5 grams of alcohol per kilogram body weight) per day for the average woman.³⁰ Two drinks are equivalent to about 3 ounces of liquor, two 12 ounce cans of beer, or 8 ounces of table wine. Also, a mother who drinks excessively may not be able to think and act normally and could accidentally take actions that endanger her infant.

Recommendations on Alcohol

The Dietary Guidelines for Americans, 2005 recommends that alcoholic beverages should

not be consumed by breastfeeding women.³³ If a breastfeeding mother will not or is unable to stop drinking alcohol, recommend that she limit her intake as much as possible. Breastfeeding mothers who consume alcohol should wait at least 2 hours before breastfeeding their infant.¹⁸ Refer breastfeeding mothers who drink excessively to alcohol assessment, treatment, and counseling services in your community. Refer to the U.S. Department of Agriculture, Food and Nutrition Information Center resource list entitled "Alcohol and Substance Abuse During Pregnancy and Breastfeeding, September 2003" available at http://www.nal.usda.gov/fnic/pubs/bibs/topics/pregnancy/substance_abuse_resourcelist.pdf for guidance and publications appropriate to counsel pregnant or breastfeeding mothers about alcohol abuse.

Caffeine-Containing Products

Moderate caffeine intake in the form of coffee, tea, or caffeinated sodas is acceptable while breastfeeding. The amount of caffeine in breast milk is usually less than 1 percent of the amount ingested by the mother.² Caffeine is not detected in infants' urine whose mothers consume up to 3 cups of coffee a day.

Recommendations on Caffeine-Containing Products

The AAP Committee on Drugs states that no effect of caffeine has been observed in breastfeeding infants of mothers with moderate intake of caffeinated beverages (2–3 cups per day).³⁴ However, excessive intake (>5 caffeinated beverages per day) may result in a more fussy and irritable infant. If an infant exhibits these symptoms, decreasing caffeine intake is recommended for the mother.

Caffeine-containing medications (e.g., certain varieties of stimulants, pain relievers, cold remedies, and weight-control aids) should also be avoided. Breastfeeding mothers on these medications should consult their health care providers.

Herbal Teas

Use of herbs and herbal teas continues to increase; however, little research on the safety and efficacy of herbal therapies exists and herbal preparations remain unregulated by the Food and Drug Administration. Herbs contain compounds that may have pharmaceutical effects similar to drugs and, like drugs, may pass into breast milk. Concern has been expressed regarding the effects of some herbal teas consumed by breastfeeding mothers on their infants. Many herbal teas are benign and serve as flavorful alternatives to caffeinated beverages; these include chicory, orange spice, peppermint, raspberry, red bush, and rose hip teas.¹⁸ However, components in some herbal teas made with buckhorn bark, senna, star anise, comfrey, chamomile, and a tea called “Mother’s Milk Tea” (available in specialty food stores) may have undesirable effects on a breastfed infant when the tea is consumed by the mother.¹⁸ Lawrence¹⁸ and Hale³⁴ provide information on the effects of different herbs used in herbal teas on the body. *Generally, herbal preparations should be avoided while breastfeeding; use of any herbal teas should be discussed with the mother’s health care provider.*

Other Drugs

Most nonprescription, prescription, and recreational or illicit drugs (e.g., marijuana, heroin, cocaine) used by a breastfeeding mother are absorbed and excreted into her breast milk. However, not all drugs are excreted into breast milk at concentrations that are harmful to the infant.

Nonprescription and Prescription Drugs

Some drugs that may not harm the breastfed infant may have a detrimental effect on the mother’s ability to produce or secrete milk. The AAP Committee on Drugs publishes guidance regarding the transfer of drugs and medications, radiopharmaceuticals (radioactive drugs), and food and environmental agents into breast milk and reported effects on lactation or on the infant when a mother ingests or is exposed to these

substances.³⁴ Extensive and detailed information on medications and mothers milk is also available in Hale (2004).³⁵ Breastfeeding is contraindicated when drugs, medications, or other substances taken by the mother and transmitted to the infant in the breast milk may harm the infant.

Recreational or Illicit Drugs

Use of illicit drugs is contraindicated because of the potential effects on the infant as well as hazards to the mother. Thus, the use of illicit drugs by breastfeeding mothers should be actively discouraged and affected mothers, regardless of their mode of feeding, should be assisted to enter a rehabilitative program that makes provision for infants.

Remind all breastfeeding mothers to inform their health care providers that they are breastfeeding and consult with their providers before taking any type of drug or vitamin/mineral supplements. Any decisions regarding drug use during lactation should be made between the mother and her health care provider.

Contraindications to Breastfeeding

In general, there are very few true contraindications to breastfeeding. Most women who desire to breastfeed can do so without problems. Breastfeeding may not be possible if a mother is an alcoholic or an intravenous drug user, has a serious infectious or other illness, or has an illness in which the medication or treatment prescribed is contraindicated during breastfeeding (e.g., when chemotherapeutic or radioactive drugs are prescribed during an illness).

Infectious Diseases

Acute infectious illnesses, such as colds or gastrointestinal and urinary tract infections, are not contraindications to breastfeeding. More significant infectious diseases must be evaluated for their risk to transmit the infection to the infant. Research has conclusively demonstrated that the human immunodeficiency virus (HIV) can be transmitted by breast feeding and/or breast

milk.³⁶ In the United States, the AAP and the Centers for Disease Control and Prevention (CDC) recommend that HIV-positive mothers should not breastfeed their infants.^{37, 38} Because of the lack of unsafe water supplies or nutritious alternatives in developing countries, breastfeeding is recommended for infants of HIV mothers in some other parts of the world. Breastfeeding is also contraindicated for infants of mothers with human T-cell leukemia virus type 1 or type 2 (HTLV-1, HTLV-2) in the United States.³⁷ Other infectious diseases for which breastfeeding may need to be temporarily discontinued while therapy is initiated or the risk of transmission is passed include hepatitis, cytomegalovirus (CMV), herpes simplex virus, varicella-zoster virus, tuberculosis, and Lyme disease.³⁹ *In all cases of nonroutine infectious illness, the mother's health care provider should be consulted for appropriate therapy and guidance on continuation of breastfeeding.*

Metabolic Disorders

If an infant has a metabolic disease that requires a specialized infant formula, breastfeeding may be contraindicated (e.g., in the case of infants with galactosemia, a rare medical condition). Infants with the metabolic disorder phenylketonuria (PKU) can breastfeed on a limited basis as long as their diet is supplemented with a special low-phenylalanine infant formula and they are carefully monitored by their health care provider.³⁹

Breast Surgery or Piercing

Medically indicated or cosmetic breast surgery and nipple piercing have become more common in recent years, but generally do not interfere with breastfeeding.²³ Women with a history of breast cancer may successfully breastfeed. Previous radiation or lumpectomy does not preclude breastfeeding; those who have had a single mastectomy can breastfeed from the remaining breast. Mothers who have undergone breast enlargement with silicone or saline implants can also safely breastfeed their infants. Breast reduction surgery is more likely to interfere with successful breastfeeding since milk ducts and nerves may have been cut. Pierced nipples do not

interfere with breastfeeding but rings or studs should be removed to prevent the infant from choking. If a pierced nipple was infected at any time, scar tissue may have developed that could make breastfeeding more difficult.

If a woman questions whether breastfeeding is recommended during certain illnesses or medical or drug treatments, refer her to a qualified health care provider for advice.

Weaning the Breastfed Infant

The AAP recommends that breastfeeding be continued through the infant's first year and for as long after as is mutually desired by the mother and child.¹ Research demonstrates that the benefits of breastfeeding are dose-responsive; the longer a mother breastfeeds, the more benefit her infant will receive. Healthy People 2010 goals call for an increase in breastfeeding rates at 1 year to 25 percent of all infants.⁷ The decision of when to begin weaning an infant from the breast is up to each mother and infant. However, the weaning process begins in part when complementary foods are introduced and the infant begins breastfeeding less frequently.

Approach to Gradual Weaning

Mothers who wish to wean their exclusively breastfed infants onto infant formula tend to experience less discomfort if the weaning process is gradual (e.g., over several weeks or longer). Gradual weaning also allows infants time to adjust to both the taste of infant formula and to drinking from a bottle or cup. Mothers can formally start weaning from the breast by replacing a feeding of breast milk with a feeding of infant formula (or whole cow's milk if the infant is over 12 months old). The first feeding to replace could be the one the infant is least interested in or when the breasts do not feel full. Gradually, over several days or even weeks, additional feedings can be eliminated. When down to one feeding per day, the infant can be breastfed every other day. Some mothers and infants may still want to breastfeed once in a while just for comfort or to relax.

Weaning to a Bottle or a Cup

Mothers who wish to discontinue breastfeeding can wean their infants, over 6 months old, to infant formula in a bottle and/or cup, depending on the infant's developmental ability. Some older infants may need to be weaned to a bottle because they are not developmentally ready to drink significant quantities of liquid from a cup. It is advisable to wean infants entirely off the bottle and onto a cup by about 12 months old. Weaning to infant formula may be easier if powdered infant formula is used – this type of infant formula allows the caregiver to prepare a limited number of bottles, if necessary, without wasting infant formula.

Relactation

A mother who has mostly or totally weaned and then decides she wants to resume breastfeeding for reasons such as her infant is intolerant to infant formula, can consult with a person trained in lactation management for assistance. Relactation is rebuilding a birth mother's milk supply after it has been reduced or dried up. Refer the mother to a WIC breastfeeding expert or lactation expert for assistance with relactation.

References:

1. Work Group on Breastfeeding, American Academy of Pediatrics. Breastfeeding and the use of human milk. *Pediatrics* 1997;100(6):1035-1039.
2. Breastfeeding Handbook for Physicians, American Academy of Pediatrics and American College of Obstetricians and Gynecologists. 2006
3. American Academy of Family Physicians, Breastfeeding Position Paper, 2001.
4. Position of the American Dietetic Association. Breaking the barriers to breastfeeding. *Journal of the American Dietetic Association* 2001;101(10):1213-1220.
5. WHO Expert Consultation. The optimal duration of exclusive breastfeeding. 2001 (accessed September 5, 2007). Available at: http://www.who.int/child-adolescent-health/New_Publications/NUTRITION/WHO_CAH_01_24.pdf.
6. National Immunization Survey; Breastfeeding Data, Centers for Disease Control and Prevention, U.S. Department of Health and Human Services. 2004 (accessed September 5, 2007) Available at: http://www.cdc.gov/breastfeeding/data/NIS_data/data_2004.htm.
7. U.S. Department of Health and Human Services. Healthy People 2010. 2000 (accessed September 5, 2007). Available at: <http://www.healthypeople.gov>.
8. Hamosh M. Bioactive factors in human milk. *Pediatric Clinics of North America* 2001;48(1):69-86.
9. Heinig MJ. Host defense benefits of breastfeeding for the infant: effect of breastfeeding duration and exclusivity. *Pediatric Clinics of North America* 2001;48(1):105-123.
10. Wright AL, Bauer M, Naylor A, Sutcliff E, Clark L. Increasing breastfeeding rates to reduce infant illness at the community level. *Pediatrics* 1998;101(5):837-844.
11. Anderson JW, Johnstone BM, Remley DT. Breast-feeding and cognitive development: a meta-analysis. *American Journal of Clinical Nutrition* 1999;70:525-535.
12. Jain A, Concato J, Leventhal JM. How good is the evidence linking breastfeeding and intelligence? *Pediatrics* 2002;109(6):1044-1053.
13. Zeiger RS. Food allergen avoidance in the prevention of food allergy in infants and children. *Pediatrics* 2003;111(6):1662-1671.
14. Arenz S, Ruckerl R, Koletzko B, von Kries R. Breast-feeding and childhood obesity - a systematic review. *International Journal of Obesity* 2004;28:1247-1256.
15. Labbok MH. Effects of breastfeeding on the mother. *Pediatric Clinics of North America* 2001;48(1):143-158.
16. USDA Food and Nutrition Service, Best Start Social Marketing. *Loving Support Through Peer Counseling Curriculum*. 2005.
17. National WIC Association. *Breastfeeding Promotion and Support in the WIC Program*. Washington, DC: NWA; 2004. Position Paper 04-001.
18. Lawrence RA, Lawrence RM. Breastfeeding: A Guide for the Medical Profession. 6th ed. Philadelphia, PA: Mosby, Inc., 2005.

19. Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes. Applications in Dietary Assessment. Washington, D.C.: National Academy Press; 2000
20. Mohrbacher N, Stock J. La Leche League International. The Breastfeeding Answer Book. 3rd Rev. ed. Franklin Park, Illinois: La Leche League International; 2003.
21. Picciano MF. Nutrient composition of human milk. *Pediatric Clinics of North America* 2001;48(1):53-67.
22. La Leche League International. The womanly Art of Breastfeeding. 7th ed. Schaumburg, IL: La Leche League International; 2004.
23. Meek JY. American Academy of Pediatrics - New Mother's Guide to Breastfeeding New York, NY: Bantam Books; 2002.
24. Breastfeeding. In: Kleinman RE, editor. Pediatric Nutrition Handbook. 5th ed. Elk Grove Village, IL: American Academy of Pediatrics, 2004:55-85.
25. Dewey KG, Nommsen-Rivers LA, Heinig MJ, Cohen RJ. Risk factors for suboptimal infant breastfeeding behavior, delayed onset of lactation, and excess neonatal weight loss. *Pediatrics* 2003;112(3):607-619.
26. Howard CR, Howard FM, Lamphear B, deBlieck EA, Eberly S, Lawrence RA. The effects of early pacifier use on breastfeeding duration. *Pediatrics* 1999;103(3):e33.
27. Wright AL, Rice S, Wells S. Changing hospital practices to increase the duration of breastfeeding. *Pediatrics* 1996;97(5):669-675.
28. U.S. Environmental Protection Agency. Respiratory Health Effects of Passive Smoking: Lung Cancer and Other Disorders. Report EPA/600/6-90/006F. Washington, D.C.: U.S. Environmental Protection Agency; 1992.
29. U.S. Department of Health and Human Services. The Health Consequences of Smoking: A Report of the Surgeon General. Atlanta: Centers for Disease Control and Prevention; 2004.
30. Cobo E. Effect of different doses of ethanol on the milk-ejecting reflex in lactating women. *American Journal of Obstetrics and Gynecology* 1973;115:817-821.
31. Mennella J, Beauchamp G. The transfer of alcohol to human milk. *New England Journal of Medicine* 1991; 325:981.
32. Mennella J, Gerrish C. Effects of exposure to alcohol in the mother's milk on infant sleep. *Pediatrics* 1998;101(5):e2.
33. U.S. Department of Health and Human Services and U.S. Department of Agriculture. Dietary Guidelines for Americans, 2005. 2005 (accessed September 5, 2007) Available at: <http://www.health.gov/dietaryguidelines/default.htm>.
34. Committee on Drugs, American Academy of Pediatrics. The transfer of drugs and other chemicals into human milk. *Pediatrics* 2001;108(3):776-789.
35. Hale TW. Medications and Mothers' Milk. 11th ed. Amarillo, TX: Pharmasoft Publishing; 2004.
36. Read JS; Committee on Pediatric AIDS, American Academy of Pediatrics. Human milk, breastfeeding, and transmission of human immunodeficiency virus type 1 in the United States. *Pediatrics* 2003;112(5):1196-1205.

37. Committee on Pediatric AIDS, American Academy of Pediatrics. Human milk, breastfeeding, and transmission of human immunodeficiency virus in the United States. *Pediatrics* 1995; 96(5):977-979.
38. Centers for Disease Control and Prevention. Current trends recommendations for assisting in the prevention of perinatal transmission of human T-lymphotropic virus type III/lymphadenopathy-associated virus and acquired immunodeficiency syndrome. *Morbidity and Mortality Weekly Report* 1985;34(48):721-6,731-2.
39. Lawrence RM, Lawrence RA. Given the benefits of breastfeeding, what contraindications exist? *Pediatric Clinics of North America* 2001;48(1):235-251.



CHAPTER 4: INFANT FORMULA FEEDING

This chapter reviews commonly used types of infant formula; recommended amounts to feed formula-fed infants in the first year; tips on bottle feeding; guidelines on the selection, preparation, and storage of infant formula; traveling with infant formula; warming bottles; and infant formula use when there is limited access to common kitchen appliances. Additional information is provided regarding milks and other food products inappropriate for infants. Counseling points related to the information presented in this chapter are found in Chapter 8, pages 161–167.

This chapter does not address the infant formula needs and feeding protocols for premature and low-birth-weight infants or infants with medical conditions requiring exempt infant formulas (see page 83 for more information regarding exempt infant formulas). Since nutritional management of these infants may be complicated by treatment for existing medical conditions, consult with and follow the recommendations of the infant's health care provider when counseling caregivers.

Types of Infant Formulas

Breast milk is the optimal source of nutrition for the infant but, when breast milk is not available, iron-fortified infant formula is an appropriate alternative for the infant's first year of life. Infant formula is “a food which purports to be or is represented for special dietary use solely as a food for infants by reason of its simulation of human milk or its suitability as a complete or partial substitute for human milk.”¹ The Food, Drug, and Cosmetic Act mandates that all infant formulas marketed in the United States provide the same nutrition for healthy, full-term infants.¹ Because infant formulas are often the only source of nutrition for infants, the Food and Drug Administration (FDA) monitors infant formula manufacturers very closely to assure the product provides the appropriate nutrition for all infants.²

A variety of infant formulas are available for healthy, full-term infants who are not breastfed or partially breastfed. These include cow's milk or soy-based infant formulas (iron-fortified), hypoallergenic infant formulas, and other infant formulas designed to meet the nutritional needs of infants with a variety of dietary needs (e.g., lactose-free or Kosher).

Milk-Based Infant Formula

The most common infant formulas consumed by infants are made from modified cow's milk with added carbohydrate (usually lactose), vegetable oils, and vitamins and minerals. Casein is the predominant protein in cow's milk. Since the primary protein in breast milk is whey protein, rather than casein, some milk-based infant formulas have been altered to contain more whey. Despite that alteration, the protein in infant formula is significantly different from that in breast milk because of their different amino acid and protein composition. In milk-based infant formulas, about 9 percent of the kilocalories are provided by protein, 48–50 percent by fat, and 40–45 percent by carbohydrate. These infant formulas are lower in fat and higher in carbohydrate, protein, and minerals than breast milk.

Iron-Fortified Infant Formula

The American Academy of Pediatrics (AAP) recommends that iron-fortified cow's milk-based infant formula is the most appropriate milk feeding from birth to 12 months for infants who are not breastfed or who are partially breastfed.³

Use of an iron-fortified infant formula ensures that formula-fed infants receive an adequate amount of iron, an important nutrient during the first year. Standard iron-fortified infant formulas are fortified with approximately 10 to 12 milligrams of iron, in the form of ferrous sulfate, per quart. Research shows that providing iron-fortified infant formula and cereal for the first 12 months of life, as done in the WIC and CSF

Programs, has been successful in reducing iron deficiency.^{4, 5, 6} Iron deficiency is associated with poor cognitive performance and development in infants. See pages 24–25 for more information regarding iron deficiency.

Low-Iron Infant Formula

In 1997, the AAP Committee on Nutrition recommended that the manufacture of infant formula containing less than 4 milligrams of iron per quart be discontinued.³ Some of the most commonly used milk-based infant formulas are also available with reduced iron content. These low-iron infant formulas now contain approximately 5 milligrams of iron per quart of formula.⁷

There are no known medical conditions for which the use of iron-fortified infant formula is contraindicated. Some caregivers request low-iron infant formula for their infants because they believe that the iron in the infant formula causes gastrointestinal problems, such as colic, constipation, diarrhea, or vomiting. However, studies have demonstrated that gastrointestinal problems are no more frequent in infants consuming iron-fortified than low-iron infant formula.^{8, 9}

As noted above, for the partially or non-breastfed infant, iron-fortified infant formula is the formula of choice to assure that an infant's iron needs are met.

Soy-Based Infant Formula

Soy-based infant formulas were developed for infants who cannot tolerate infant formula made from cow's milk. These infant formulas contain soy protein isolate made from soybean solids as the protein source, vegetable oils as the fat source, added carbohydrate (usually sucrose and/or corn syrup solids), and vitamins and minerals. Soy-based infant formulas are fortified with the essential amino acid methionine, which is found in very low quantities in soybeans. In these infant formulas, 10 to 11 percent of the kilocalories are provided by protein, 45 to 49 percent by fat, and 41 to 43 percent by carbohydrate. All soy-based

infant formulas are fortified with similar amounts of iron as milk-based iron-fortified infant formulas.

The AAP has stated that soy-based infant formulas are safe and effective alternatives to cow's milk-based infant formulas, but have no advantage over them.

*Soy-based infant formulas may be indicated in the following situations:*¹⁰

- Infants with galactosemia (a rare metabolic disorder) or hereditary lactase deficiency
- Infants whose parents are seeking a vegetarian diet for their full-term infant or
- Infants with documented IgE-mediated allergy to cow's milk protein.

*The use of soy-based infant formulas has no proven benefit in the following situations:*¹⁰

- Healthy infants with acute gastroenteritis in whom lactose intolerance has not been documented
- Infants with colic
- Prevention of allergy in healthy or high-risk infants and
- Infants with documented cow's milk protein-induced enteropathy or enterocolitis.

Hypoallergenic Infant Formula

A number of infant formulas have been developed and marketed for infants with allergies or intolerances to milk or soy-based infant formulas or those with a family history of allergies. Infant formulas manufactured and labeled for infants with allergies vary in the degree to which the allergy-causing protein has been modified. They may contain partially hydrolyzed protein, extensively hydrolyzed protein, or free amino acids. Extensively hydrolyzed and free amino acid-based infant formulas have been demonstrated to be tolerated by at least 90 percent of infants with documented allergies.¹¹ Currently available partially hydrolyzed infant formulas are not hypoallergenic and should not be used to treat infants with documented allergies.¹¹

The prevalence of milk protein allergy in infancy is low, at 2 to 3 percent. However, food allergies may present in three ways:¹¹

- Immunoglobulin E (IgE)-associated reactions, such as runny nose, wheezing, eczema, vomiting, and difficulty breathing;
- Non-IgE-associated reactions including diarrhea, malabsorption, colitis, or esophagitis; and
- Extreme irritability or colic.

All suspected cases of food allergy should be referred to a qualified health care professional for further diagnosis and treatment.

The AAP recommends that the use of hypoallergenic infant formulas should be limited to infants with well-defined clinical indications.¹¹ If hypersensitivity is diagnosed, a physician may change the infant formula prescribed. The AAP states that formula-fed infants with confirmed cow's milk allergy may benefit from the use of hypoallergenic (extensively hydrolyzed or, if symptoms persist, a free amino acid-based infant formula) or soy-based infant formula.¹² Soy-based infant formula may be used for infants with IgE-associated symptoms. Improvement is usually seen in 2 to 4 weeks; however, the infant formula should be continued until at least 12 months of age. Hypoallergenic infant formulas made from extensively hydrolyzed protein or free amino acids may be used for infants with non-IgE-associated symptoms or those with a strong family history of allergy. Hypoallergenic infant formulas are significantly more expensive than either milk-based or soy-based infant formulas. In addition, their taste is altered significantly during hydrolysis of the protein and they may not be well accepted by some infants.

Lactose-Free Infant Formula

Lactose is the major carbohydrate in cow's milk-based infant formulas. Lactose intolerance may lead to excess gas, diarrhea, or fussiness. A very small number of infants produce insufficient amounts of lactase, the enzyme needed to break down lactose.¹² Congenital lactase deficiency is extremely rare. Premature infants may have lower levels of lactase than term infants, proportional to their degree of prematurity, since lactase activity develops during the last trimester of pregnancy. Lactose intolerance may develop in later childhood (>2 years of age in some susceptible populations) or adulthood, but very few term infants have true lactose intolerance. Transient lactose intolerance may occur following acute diarrhea, but enzyme activity is restored quickly and switching to lactose-free infant formulas is usually not necessary.

Several cow's milk-based infant formulas are now available for infants with documented lactose intolerance. In addition, soy-based infant formulas are lactose-free and may be used for infants with documented lactose intolerance.

Exempt Infant Formula

An exempt infant formula is one that is represented and labeled for use by infants who have inborn errors of metabolism or low birth weight, or who otherwise have unusual medical or dietary problems.¹³ There are many varieties of specially designed infant formulas developed for infants with special medical conditions. For the most up-to-date information on infant formula composition and new products, refer to pharmaceutical company product information materials or contact the manufacturer. For more information regarding exempt infant formulas access FDA's Web site at <http://www.cfsan.fda.gov/~dms/inf-exmp.html>.

WIC Formula Database on the WIC Works Resource Center Website

<http://www.nal.usda.gov/wicworks>

The Food and Nutrition Service (FNS), Department of Agriculture (USDA) developed an electronic database of infant formulas, exempt infant formulas, and medical foods that have been determined eligible for use in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC). Manufacturers benefit by having information about their WIC-eligible formulas readily available to all WIC State agencies and approximately 10,000 WIC clinic sites throughout the country. In turn, WIC agencies have access to an up-to-date formula database that will assist them in meeting the needs of participants.

Long-Chain Polyunsaturated Fatty Acids and Other Infant Formula Additives

In recent years, infant formula manufacturers have begun to examine the benefits of adding a variety of nutrients and biological factors to infant formula to mimic the composition and quality of breast milk.¹⁴ These include long-chain polyunsaturated fatty acids, nucleotides, prebiotics and probiotics.

Arachidonic Acid (ARA) and Docosahexaenoic Acid (DHA)

Long-chain polyunsaturated fatty acids include the essential fatty acids, linoleic acid (abbreviated 18:2 n-6 or LA), and α -linolenic acid (18:3 n-3 or ALA) along with their derivatives, arachidonic acid (20:4 n-6 or ARA) and docosahexaenoic acid (22:6 n-3 or DHA). Since formula-fed infants have been observed to have lower plasma levels of ARA and DHA, interest has arisen about the formula-fed infant's ability to synthesize these fatty acids.¹⁵ ARA and DHA are major fatty acids

in the brain and retina. Research demonstrating better cognitive function in breastfed infants has led some to support the addition of ARA and DHA to infant formula. This issue remains controversial; the FDA's Life Sciences Research Office Expert Panel on Assessment of Nutrient Requirements of Term Infant Formulas does not recommend either a minimum or maximum content of ARA and DHA in infant formula.¹⁶ FDA expects post-market surveillance to be conducted by infant formula manufacturers because previous studies on the effects of fatty acids in infant formulas on the growth and development of infants were based on short-term studies. Additionally, ARA and DHA were not ingredients in infant formula in the United States before early 2002. FDA treats the evaluation of the safety of ARA and DHA as new ingredients in infant formula as a judgment dependent on scientific data as well as time.¹⁷ The AAP has taken no official position on their addition.¹⁵ Most infant formula manufacturers currently offer products containing added ARA and DHA.

Nucleotides, Prebiotics, and Probiotics

Nucleotides are metabolically important compounds that are the building blocks of ribonucleic acid (RNA), deoxyribonucleic acid (DNA), and adenosine triphosphate (ATP), and are present in breast milk.¹⁸ It is thought that they may enhance immune function and development of the gastrointestinal tract and may be beneficial when added to infant formula.¹⁹ Prebiotics are nutrients that support the growth of "good" bacteria in the intestine, while probiotics are these nonpathogenic bacteria, including Bifidobacteria and Lactobacilli. Since these organisms are present in the intestines of breastfed infants and may protect from infection by other pathogenic bacteria, researchers are studying the effect of adding them to infant formula. Although infant formula manufacturers are beginning to add these compounds to infant formula, more research is needed to confirm the benefits of adding nucleotides, prebiotics, and probiotics to infant formula.²⁰

Other Milks and Other Products

This section provides information on different milk and other products that are not appropriate substitutes for infant formula for infants, less than 12 months old, in the WIC and CSF Programs.

Whole Cow's Milk

The AAP Committee on Nutrition recommends that whole cow's milk not be fed to infants during the first year of life.²¹ Breast milk or iron-fortified infant formula is recommended instead of cow's milk for a number of nutritional and medical reasons.

*Whole cow's milk is not recommended for infants for the following reasons:*²⁰

- **Inappropriate nutrient content** – Research indicates that it is difficult for infants to consume a balanced diet, with adequate nutrients, when whole cow's milk replaces breast milk or iron-fortified infant formula.²¹ Infants fed whole cow's milk have low intakes of iron, linoleic acid (an essential fatty acid), and vitamin E and excessive intakes of sodium, potassium, chloride, and protein. These nutrient intakes are not optimal and may alter an infant's nutritional status, with the most dramatic effect on iron status. Infants over 6 months old require good sources of iron in their diets; there is very little iron in whole cow's milk. The composition of whole cow's milk (i.e., high calcium, high phosphorus, and low vitamin C) may inhibit an infant's ability to absorb iron from different complementary foods, including iron-fortified infant cereals.
- **Microscopic gastrointestinal bleeding and blood loss** – Cow's milk has been shown to cause microscopic bleeding and blood loss from an infant's immature gastrointestinal tract when fed to infants in the first 6 months of life²² and to a lesser extent between 6 and 12 months.²³ These problems disappear at about 12 months.²⁴ This bleeding promotes the development of iron deficiency anemia. Studies show that iron deficiency in early childhood may lead to long-term changes in learning and behavior that might not be reversed even with iron supplementation

sufficient to correct iron-deficiency anemia²⁵

- **Stress on the kidneys** – Cow's milk is difficult for a young infant's immature kidneys to process because of its concentrated protein, sodium, potassium, and chloride and resulting high renal solute load (see page 30 for more information regarding renal solute load). The renal solute load of infants fed whole cow's milk is two to three times higher than that of formula-fed infants.²⁶ Even older infants may have a problem with the load of these nutrients on the kidneys and be at greater risk for developing dehydration.²⁷ The possibility of developing dehydration as a result of a high renal solute load is greatest during: an acute illness when intake is lower, especially if there is fever; when the diet is calorie dense, that is, high in calories but low in volume of food/fluid; and when renal concentrating ability is decreased, as in chronic renal disease and diabetes.²⁸
- **Hypersensitivity (allergic) reactions** – Cow's milk contains proteins that may cause hypersensitivity (allergic) reactions in the young infant due to his immature gastrointestinal tract.

Given these concerns about cow's milk, the recommended choices to use in meeting an infant's nutritional needs are breast milk and iron-fortified infant formulas (for those not breastfed or partially breastfed). Encourage caregivers to breastfeed or keep their infants on iron-fortified infant formula until 12 months old.

Low-Fat or Skim Cow's Milk

Pediatric nutrition authorities agree that skim milk (fresh liquid, reconstituted nonfat dry milk powder, or evaporated skimmed milk) or low-fat milk (1 or 2 percent low-fat milk) should not be fed to infants.^{20, 21, 29} These milks contain insufficient quantities of fat (including linoleic acid), iron, vitamin E, and vitamin C; and excessive protein, sodium, potassium, and chloride. The amount of protein and minerals in low-fat and skim milk is even higher than in whole cow's milk; these milks place a strain on an infant's kidneys in the same way as does whole cow's milk.

Fat, as found in sufficient amounts in breast milk and infant formula, is needed to meet an infant's energy needs for growth and for proper development of the nervous system. Increased publicity of the association between high-fat diets and heart disease has led some caregivers to believe that they should feed their infants skim or low-fat milk to prevent obesity or atherosclerosis later in life. However, feeding skim or low-fat milk to infants and children up to age 2, in an attempt to prevent heart disease from developing later in life, is not considered appropriate.³⁰ According to the AAP, consumption of skim or low-fat milk is not recommended in the first 2 years of life because of the high protein and electrolyte content and low caloric density of these milks.³⁰

Evaporated Cow's Milk

Homemade formulas made from evaporated milk are not recommended in the first 12 months of life.²⁹ Evaporated whole milk is whole cow's milk from which approximately 60 percent of the water has been removed. This milk is fortified with vitamin D but remains low in the same nutrients as whole cow's milk and low in folate if the milk is boiled. Evaporated milk can also be made from skim cow's milk. Before the development of infant formulas, evaporated whole milk was used to make a homemade infant formula which was thought to be easier for an infant's kidneys and digestive system to handle than plain whole cow's milk. However, the disadvantages of evaporated milk formulas are now considered similar to those of whole cow's milk.

Sweetened Condensed Milk

Sweetened condensed milk is not an appropriate food or beverage for infants.²⁹ This milk product has a high sugar concentration and similar disadvantages to whole cow's milk. It is made by adding sugar to whole cow's milk and then evaporating water from the milk. When undiluted, this milk contains seven times the carbohydrate content of evaporated whole milk.

Goat's Milk

Goat's milk is **not** recommended for infants.²⁹ Goat's milk contains inadequate quantities of iron, folate, vitamins C and D, thiamin, niacin, vitamin B6, and pantothenic acid to meet an infant's nutritional needs. Some brands of goat's milk are fortified with vitamin D and folate, but other brands may not be fortified. This milk also has a higher renal solute load compared to cow's milk and can place stress on an infant's kidneys. This milk has been found to cause a dangerous condition called metabolic acidosis when fed to infants in the first month of life.

Soy-Based (Soy Milks) and Rice-Based (Rice Milk) Beverages

Beverages made from soy, rice, or other grains or nuts are not equivalent to infant formulas or breast milk and are not appropriate for infant consumption.³¹ Although most are fortified with vitamins A, D, and B12, riboflavin, calcium, and zinc, these beverages lack appropriate amounts of kilocalories, protein, and fat needed by infants for adequate growth.³¹ Use of these milks can be dangerous to an infant's health. Marasmus and malnutrition have been reported in infants fed these beverages as the whole or major source of nutrition.³¹

Sweetened Beverages Fed From a Bottle

Infants should **never** be given sweetened beverages (e.g., soda, fruit drinks, powdered beverages, sweetened teas) because they are associated with a higher risk for developing early childhood caries and childhood obesity. These beverages lack appropriate amounts of kilocalories, protein, and other key nutrients and displace breast milk or infant formula in the infant's diet.^{32,33} See page 114 for more information regarding sweetened beverages.

Feeding Infant Formula in the First Year

The amount of infant formula needed by an infant over a 24-hour period will vary depending on the infant's age, size, level of activity, metabolic rate, medical conditions, and other source(s) of nutrition (breast milk and/or complementary food). Infants have the ability to regulate their food intake relative to their nutritional needs. In doing so, they express signs of hunger and satiety and expect their caregiver to respond to these cues. Thus, unless medically indicated otherwise, infants should be fed on demand, i.e., fed when they indicate their hunger, and not forced to follow a strict feeding schedule, nor to finish a bottle when no longer hungry. Infants placed on strict feeding schedules in the early months of life stand a greater chance of being either overfed or underfed.

Hunger and Satiety Cues

Infants, especially newborns, may not be consistent or follow a timed schedule as to when and how often they want to eat. A healthy infant eventually establishes an individual pattern according to his or her growth requirements. It is normal for infants to have fussy times; an infant may cry and just want to be held, to suck, or need to be changed; or may not be hungry. Thus, encourage caregivers to watch for and respond appropriately to the infant's cues of hunger and satiety or fullness. Caregivers should look for the following common signals of hunger and fullness in their infants.³⁴

Signs of Hunger

An infant who is hungry may:

- Wake and toss
- Suck on a fist
- Cry or fuss or
- Appear like he or she is going to cry.

Caregivers should respond to the early signs of hunger and not wait until the infant is upset and crying from hunger.

Signs of Fullness

Encourage the caregiver to feed the infant until he or she indicates fullness. Signs of fullness include:

- Sealing the lips together
- A decrease in sucking
- Spitting out the nipple and
- Turning away from the breast or bottle.

Some infants may eat less than the portions offered if they are not hungry. A caregiver should never force an infant to finish what is in the bottle. Infants are the best judge of how much they need. They may want to eat less if they are not feeling well and may want more if they are in a growth spurt.³⁵

If you perceive that a caregiver is frustrated or having difficulty coping with an infant's fussiness or crying, refer him or her to a health care provider for further assessment and assistance.

Feeding Frequency and Amount

Newborn formula-fed infants are generally fed infant formula as often as exclusively breastfed infants are fed for a total of 8 to 12 feedings within 24 hours. These young infants need to be fed small amounts of infant formula often throughout the day and night because their stomachs cannot hold a large quantity. If a newborn infant sleeps longer than 4 hours at a time, the infant should be awakened and offered a bottle. See page 59 for more information regarding the sleepy infant.

From birth to 6 months of age, infants grow rapidly and will gradually increase the amounts of infant formula they can consume at each feeding, the time between each feeding, and the total amount of infant formula consumed in 24 hours. Encourage parents or caregivers to prepare 2 ounces of infant formula every 2 to 3 hours at first. More should be prepared if the infant seems hungry, especially as the infant grows.³⁶

The partially breastfed infant will consume less infant formula than given in these examples,

depending on the frequency of breastfeeding. At 6 months old, infants begin to shift from dependence on breast milk or infant formula as the primary nutrient source to dependence on a mixed diet including complementary foods. Thus, the consumption of breast milk or infant formula tends to decrease as the consumption of complementary foods increases.

Sleepy or Placid Infant

An exception to using the demand feeding approach is for a young infant who is sleepy or placid. Some infants may either fall asleep after feeding on a bottle for a short time, may not be easy to wake for feeding every 2 to 3 hours, or do not show signs of hunger normally. To assure that such infants obtain sufficient nourishment, it is advisable for mothers to wait no more than 4 hours (or sooner if the infant's health care provider indicates) between feedings until the infant's first well check up (between 2 and 4 weeks old). At that time, the infant's health care provider should be consulted to determine whether to recommend continuation of that practice based on the infant's weight gain.

To wake a sleepy infant, a mother can try these methods:

- Stroking the infant's cheek with the nipple
- Holding the infant in an upright position (sitting or standing) while supporting the chin with one hand, several times
- Rubbing or stroking the infant's hands and feet
- Unwrapping or loosening blankets
- Giving the infant a gentle massage
- Undressing or changing the infant's clothing or diaper or
- Playing with and talking to the infant.

Feeding throughout the night is not usually necessary for the older infant with a normal growth rate. *Refer an infant, whose caregiver complains of the infant's sleepiness or lack of hunger signs, to a health care provider for further assessment.*

Formula Feeding Tips

Caregivers can help their formula-fed infants have a positive feeding experience by feeding in a relaxing setting. *Encourage caregivers to:*

- Find a comfortable place in the home for feeding;
- Interact with the infant in a calm and relaxed manner in preparation for and during feeding (e.g., by cuddling and talking gently to the infant); and
- Show the infant lots of love, attention, and cuddling in addition to feeding - reassure them that doing so will decrease fussiness and will not "spoil" the infant.

Guidelines on Feeding From a Bottle

To make bottle feeding safe and comfortable for infants, encourage caregivers to do the following:

- Wash their hands with soap and water before feeding.
- Hold the infant in their arms or lap during the feeding (with the infant in a semi-upright position with the head tilted slightly forward, slightly higher than the rest of the body, and supported by the person feeding the infant). The infant should be able to look at the caregiver's face. If an infant's head is tilted back or lying flat down, the liquid could enter the infant's windpipe and cause choking.
- Hold the bottle still and at an angle so that the end of the bottle near the nipple is filled with infant formula and not air. This reduces the amount of air swallowed by the infant.
- Stroke the infant's cheek gently with the nipple to stimulate the "rooting" reflex. This will cause the infant to open his or her mouth to initiate feeding.
- Ensure that the infant formula flows from the bottle properly by checking if the nipple hole is an appropriate size (if the bottle is held upside down, the falling drops should follow each other closely and not make a stream). The nipple ring on the bottle should be adjusted so that air can get into the bottle (otherwise the nipple may collapse).

- Burp the infant at any natural break in or at the end of a feeding to eliminate swallowed air from the stomach. Try to avoid stopping to burp an infant after every couple of ounces because this can be disruptive to the feeding. An infant can be burped by gently patting or rubbing the infant's back while he or she is held against the front of the caregiver's shoulder and chest or held and supported in a sitting position in the caregiver's lap. Burping at natural breaks during feeding helps to slow the feeding, thereby lessening the amount of air swallowed, and may help to reduce gastroesophageal reflux and colic in some infants (see pages 139–140 for more information regarding reflux and colic). A small amount of spitting up is common in formula-fed infants. The breaks in feeding are also good times for the caregiver to socialize with (e.g., talk gently and smile at) her infant.

Throughout infancy, it is especially important that formula-fed infants be fed in a position that both minimizes their chances of choking and allows them physical and eye contact with their caregivers. When an infant is held closely and can establish eye contact with the caregiver, bonding between the two is enhanced. Older infants may prefer to hold the bottle themselves while in the caregiver's arms or lap or while sitting in a high chair or similar chair. See Figure 5 on page 90 for more tips for feeding an infant with a bottle.

See pages 123–124 for information regarding weaning an infant from the bottle.

Propping the Bottle Is Not Recommended

It is never appropriate to prop a bottle to feed an infant by placing a bottle supported by a pillow or something similar in the infant's mouth.

Caregivers should avoid propping the bottle because:

- Liquid in the bottle can accidentally flow into the lungs and cause choking;
- Infants tend to contract ear infections because fluid enters the middle ear and cannot drain properly;

- Infants may overfeed; or
- Infants do not receive human contact, which is important to make them feel secure and loved.

It is not advisable to give infants a bottle (whether propped or not) while the infant is lying down at nap or bedtime³¹ or while the infant is lying or sitting in an infant car seat, carrier, stroller, infant swing, or walker. In addition to possibly causing choking and ear infections, these practices can lead to dental problems if there is milk, fruit juice, or a sweetened beverage in the bottle. See pages 132–133 regarding early childhood caries.

Selection, Preparation, and Storage of Infant Formula

To assure that infant formula is safe for consumption, the infant formula must be properly selected, prepared, and stored and bottles must be properly sanitized.

Selecting Cans of Infant Formula

Encourage caregivers to take these steps when selecting and using cans of infant formula:

- Check the infant formula's expiration date on the label, lid, or bottom of the can. If the expiration date has passed, then the infant formula has expired and should not be used.
- Do not select cans of infant formula that have dents, leaks, bulges, puffed ends, pinched tops or bottoms, or rust spots. These characteristics indicate that the product quality may be diminished and the product is unsafe.
- Store cans of infant formula in a cool, indoor place – not in vehicles, garages, or outdoors.

Figure 5: Tips on Feeding With a Bottle



Preparing and Storing Bottles:

- Ensure that bottles and accessories are clean and sanitary.
- Do not allow bottles of breast milk or infant formula to stand at room temperature to prevent spoilage. Refrigerate prepared bottles until ready to use.
- For those infants who prefer a warm bottle, hold the bottle under running warm (not hot) water immediately before feeding.
- Shake a bottle of breast milk before feeding because breast milk separates when it is stored.
- Never use a microwave oven to heat bottles of breast milk or infant formula. They may explode or the milk may get too hot. Since the liquid heats unevenly, it can be much hotter than it feels. Microwave heating can destroy special substances in breast milk.
- Do not put cereal or other foods in a bottle. This practice replaces breast milk or infant formula with food that may not be needed by the infant, teaches the infant to eat complementary foods (solids) incorrectly, and increases the infant's risk for choking.
- Throw out unused breast milk or infant formula left in a bottle and wash the bottle with soap and hot water immediately. Clean and sterilize bottles and accessories before reusing them.

Feeding the Infant:

- Feed the infant when he indicates hunger. Respond to the early signs of hunger. Do not wait until the infant is upset or crying.
- Gently and slowly position the infant to prepare for a feeding.
- Feed the infant in a smooth and continuous fashion. Follow the infant's lead on when to feed, how long to feed, and how much to feed. Avoid disrupting the feeding with unnecessary burping, wiping, juggling, and arranging.
- Always hold the infant during feedings. Propping the bottle is never appropriate. Propping a bottle may cause ear infections and choking. It also deprives the infant of important human contact.
- Hold the infant's head a little higher than the rest of the body to prevent milk from backing up in the ear and causing an ear infection.
- Do not offer the bottle at nap time or let an infant carry a bottle around. Allowing an infant to sleep with a bottle may lead to tooth decay.
- Wait for the infant to stop eating before burping. Burp by gently patting or rubbing the infant's back while the infant is resting on your shoulder or sitting on your lap.
- Continue to feed the infant until he or she indicates being full. Signs of fullness include sealing the lips, spitting out the nipple, and turning away from the breast or bottle.
- Never force an infant to finish what is in the bottle. Infants are the best judge of how much they need.
- An older infant may be fed a bottle while sitting in a high chair.
- Before opening a can of infant formula, wash the can lid with soap and water to remove bacteria, dust, insect parts, and other substances that could contaminate the infant formula when opened. Rinse soap off thoroughly with water so that soap does not get into the infant formula.

Sterilizing Water and Bottles

Infants 3 months of age and younger are more likely to contract illnesses from micro-organisms in bottles and nipples that are improperly cleaned, cleaned in contaminated water, or filled with contaminated water. Therefore, for infants less than 3 months old, glass or hard plastic bottles and bottle parts (nipples, caps, rings) should first be thoroughly cleaned using soap, hot water, and bottle and nipple brushes, and then either be sterilized in boiling water for 5 minutes, as indicated in Figures 6a, 6b, and 6c, pages 93–95, or washed in a properly functioning dishwasher machine. If disposable plastic bottle liners are used, the bags should be discarded after one use and the nipples, rings, and caps sterilized in boiling water or washed in a dishwasher until the infant is at least 3 months old. After 3 months, unless otherwise indicated by a health care provider, bottles should be thoroughly washed using soap and hot water and bottle and nipple brushes or cleaned in a dishwasher.

As a precaution, it is generally recommended to boil the water used for infant formula preparation during the first 3 months of life.²⁹ Caregivers should consult their health care providers regarding whether the water used for preparing infant formula or for feeding should be boiled for the infant older than 3 months. If a caregiver is in doubt about the safety of the water supply or if there are reports in the community about the water supply being contaminated, he should find an alternate source of clean water and consult his health care provider as soon as possible.

Caregivers can boil water to make infant formula by bringing the water to a rolling boil, boiling it for 1–2 minutes, and then letting it cool.^{20, 37} See pages 35–39 regarding the use of different types of water, including well water, and water safety.

The terminal sterilization of infant formula, which involves filling clean bottles with properly diluted infant formula first and then boiling all the formula-containing bottles in water, is not recommended because

boiling destroys certain nutrients (e.g., folate and other water-soluble vitamins).

Preparing Infant Formula

Powdered infant formula is prepared by mixing one unpacked level scoop of dry powder to 2 ounces of sterile water. Concentrated infant formula is prepared by adding equal parts of water to concentrated liquid. Ready-to-feed infant formula is ready for the infant to consume. These preparations will yield an infant formula that is approximately 20 calories per ounce. See Figures 6a, 6b, and 6c on pages 93–95 for a checklist of instructions for preparing ready-to-feed, liquid concentrated, or powdered iron-fortified infant formula.

General guidelines for infant formula preparation are provided; however, the caregiver should always follow the manufacturer's instructions for preparation. Although infant formula cans include written instructions for preparation, caregivers may not be able to read or understand those instructions. If they are unable to read English but can read another language, printed instructions should be provided in their own language. Infant formula preparation instructions designed in picture format can be used for low-literacy or illiterate participants.

It is very important to prepare infant formula properly. Increasing the water-to-formula ratio is never recommended because it will yield a lower-calorie formula, which will not meet the infant's calorie requirements. Decreasing the water-to-formula ratio may be recommended for infants who are failing to thrive, but it should only be done when recommended by the infant's health care provider. Infants consuming incorrectly reconstituted infant formula may develop serious health problems. Under-diluted infant formula (containing too little water) puts an excessive burden on an infant's kidneys and digestive system and may lead to dehydration. This problem becomes worse if the infant has increased fluid needs due to fever or infection. Over-diluted infant formula (containing too much water) may contribute to growth problems, nutrient

deficiencies, and water intoxication. See pages 28–29 for more information regarding water needs for infants. *If the caregiver has any questions or concerns about infant formula preparation, refer him or her to their infant's health care provider.*

Special Concerns

Infant formula is a safe and effective alternative for infant nutrition when breastfeeding is impossible or impractical. However, healthcare professionals should be aware that powdered infant formulas are not commercially sterile products. Powdered infant formulas are heat-treated during processing, but unlike liquid infant formula products they are not subjected to high temperatures for sufficient time to make the final product commercially sterile. A concern about possible *Enterobacter sakazakii* (*E. sakazakii*) infections led the Food and Drug Administration to issue an alert to healthcare professionals in April 2002. For more information see <http://www.cfsan.fda.gov/~dms/inf-ltr3.html>. *E. sakazakii* is a microorganism belonging to the family of the *Enterobacteriaceae* which may cause sepsis, meningitis, or necrotizing enterocolitis among infected infants. According to the FDA, “clusters of *E. sakazakii* infections have been reported in a variety of locations over the past several years among infants fed milk-based powdered infant formula products from various manufacturers... The literature suggests that premature infants and those with underlying medical conditions may be at highest risk for developing *E. sakazakii* infection.”³⁸

Storing Infant Formula

Prepared infant formula is a highly perishable food that must be stored properly for safe consumption.

The following guidelines are recommended to prevent spoilage of infant formula:

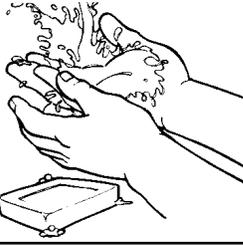
Store bottles of prepared infant formula in a properly functioning refrigerator until ready to use. Bacterial growth is reduced when infant formula is kept in a refrigerator at temperatures at 40 degrees Fahrenheit or below. (Use a special thermometer to test if the refrigerator is at the appropriate temperature.) Caregivers should always consult their health care provider and follow the manufacturer's label instructions for infant formula storage procedures. In general, it is recommended that caregivers:

- Use refrigerated bottles of concentrated or ready-to-feed infant formula within 48 hours of preparation or
- Use refrigerated bottles of powdered infant formula within 24 hours of preparation.
- Opened cans of concentrated or ready-to-feed infant formula should be covered, refrigerated, and used within 48 hours. Freezing infant formula is not recommended.
- Powdered infant formula should be tightly covered and stored in a cool, dry place and used within a month after opening.
- Discard any infant formula remaining after a feeding. The mixture of infant formula with saliva provides an ideal breeding ground for disease-causing micro-organisms.
- Infant formula that is removed from refrigeration should be used within 1 hour or discarded.³⁹
- Before reusing any bottles or their parts, they should be cleaned and sanitized as described under “Sterilizing Water and Bottles” on page 91.

Traveling With Infant Formula

When traveling, caregivers can take along a can of powdered infant formula and separate water in clean bottles (or sterilized bottles for infants under 3 months old). Then, the infant formula can be mixed up to make single bottles when needed. Alternately, single servings of ready-to-feed infant formula can be used. It is not recommended to travel with bottles of prepared infant formula held at room temperature.

Figure 6a:
**Preparation Checklist for Standard Ready-to-Feed Iron-Fortified
 Infant Formula (using glass or hard plastic bottles)**

1  Wash your hands, arms, and under your nails, very well with soap and warm water. Rinse thoroughly. Clean and sanitize your workspace.

2  Wash bottles and nipples, using bottle and nipple brushes, and caps, rings, and preparation utensils in hot soapy water before using. Rinse thoroughly.

3  Squeeze clean water through nipple holes to be sure they are open.

4  Put the bottles, nipples, caps, and rings in a pot and cover with water. Put the pot over heat, bring to a boil, and boil for 5 minutes. Remove with sanitized tongs, allow the items to cool, and air dry.

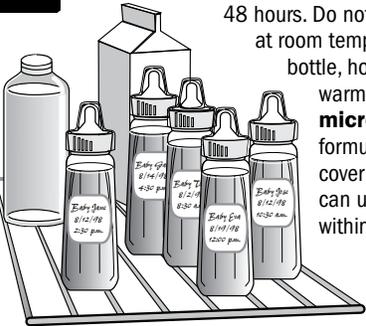
5  Wash the top of the can with soap and water and rinse well to remove dirt. Wash the can opener with soap and hot water.

6  SHAKE CAN WELL and then open the can.

7  Pour the amount of ready-to-feed formula for one feeding into a clean bottle. Do not add water or any other liquid.

8  Attach nipple and cap and SHAKE WELL. Feed prepared formula immediately.

9  If more than one bottle is prepared, put a clean nipple right side up on each bottle and cover with a nipple cap. Label each bottle with the baby's name and the date and time that it was prepared.

10  Refrigerate until feeding time. Use within 48 hours. Do not leave formula at room temperature. To warm bottle, hold under running warm water. **Do not microwave bottles.** If formula is left in the can, cover and refrigerate open can until needed. Use within 48 hours.

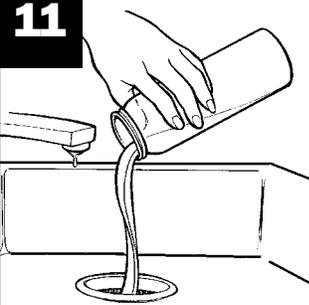
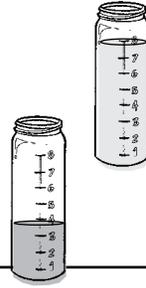
11  Throw out unused formula left in bottle after feeding or which has been unrefrigerated for 1 hour or more. Store unopened cans in a cool, dry indoor pantry shelf. Use before the expiration date.

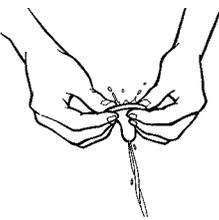
Figure 6b:
Preparation Checklist for Standard Liquid Concentrated Iron-Fortified Infant Formula
(using glass or hard plastic bottles)

1  Wash your hands, arms, and under your nails, very well with soap and warm water. Rinse thoroughly. Clean and sanitize your workspace.

7  **SHAKE CAN WELL** and then open the can.

2  Wash bottles and nipples, using bottle and nipple brushes, and caps, rings, and preparation utensils in hot soapy water before using. Rinse thoroughly.

8  Pour needed amount of formula into a clean bottle using ounce markings to measure formula and add an equal amount of cooled boiled water. Thus, if 4 oz. of formula is poured into the bottle, 4 ounces of water should also be added.

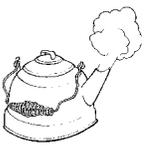
3  Squeeze clean water through nipple holes to be sure they are open.

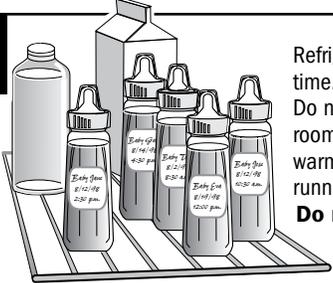
9  Attach nipple and ring to the bottle and **SHAKE WELL**. Feed prepared formula immediately. If formula is left in the can, cover and refrigerate can until needed. Use within 48 hours.

4  Put the bottles, nipples, caps, and rings in a pot and cover with water. Put the pot over heat, bring to a boil, and boil for 5 minutes. Remove with sanitized tongs, allow the items to cool, and air dry.

10  If more than one bottle is prepared, put a clean nipple right side up on each bottle and cover with a nipple cap. Label each bottle with the baby's name and the date and time that it was prepared.

5 For formula, bring water to a very bubbly boil. Keep boiling it for a minute or two, then let it cool. Use this water to mix the formula. Use water from a source approved by the local health department. If tap water is used for boiling, collect only cold tap water allowed to run for 2 minutes first.

 **BOIL**  **COOL**

 Refrigerate until feeding time. Use within 48 hours. Do not leave formula at room temperature. To warm bottle, hold under running warm water. **Do not microwave bottles.**

6  Wash the top of the can with soap and water and rinse well to remove dirt. Wash the can opener with soap and hot water.

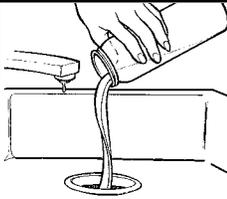
12  Throw out unused formula left in bottle after feeding or which has been unrefrigerated for 1 hour or more. Store unopened cans in a cool, dry indoor pantry shelf. Use before the expiration date.

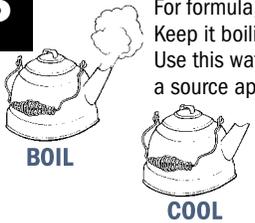
Figure 6c:
**Preparation Checklist for Standard Powdered Iron-Fortified
 Infant Formula (using glass or hard plastic bottles)**

1  Wash your hands, arms, and under your nails, very well with soap and warm water. Rinse thoroughly. Clean and sanitize your workspace.

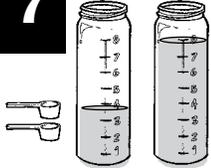
2  Wash bottles and nipples, using bottle and nipple brushes, and caps, rings, and preparation utensils in hot soapy water before using. Rinse thoroughly.

3  Squeeze clean water through nipple holes to be sure they are open.

4  Put the bottles, nipples, caps, and rings in a pot and cover with water. Put the pot over heat, bring to a boil, and boil for 5 minutes. Remove with sanitized tongs, allow the items to cool, and air dry.

5  For formula, bring water to a very bubbly boil. Keep it boiling for a minute or two, then let it cool. Use this water to mix the formula. Use water from a source approved by the local health department. If tap water is used for boiling, collect only cold tap water allowed to run for 2 minutes first.

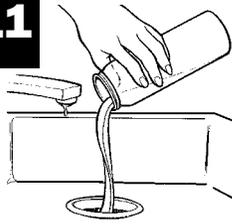
6  Remove plastic lid; wash lid with soap and clean water and dry it. Write date on outside of plastic lid. Wash the top of the can with soap and water, rinse well, and dry. Wash the can opener with soap and hot water. Open the can and remove scoop. Make sure that the scoop is totally dry before scooping out powdered formula. Only use the scoop that comes with the formula can.

7  For each 2 ounces of cooled boiled water added to a clean bottle, carefully add 1 level scoop of powdered formula. Thus, if 8 ounces of water is poured into the bottle, 4 level scoops of formula should be added.

8  Attach nipple and ring to the bottle and **SHAKE WELL**. Feed prepared formula immediately.

9  If more than one bottle is prepared, put a clean nipple right side up on each bottle and cover with a nipple cap. Label each bottle with the baby's name and the date and time that it was prepared.

10  Refrigerate until feeding time. Use within 24 hours. Do not leave formula at room temperature. To warm bottle, hold under running warm water. **Do not microwave bottles.**

11  Throw out unused formula left in bottle after feeding or which has been unrefrigerated for 1 hour or more.

12  Make sure that no water or other liquid gets into the can of powder. Cover opened can tightly and store in a cool dry place (not in the refrigerator). Use within 4 weeks after opening to assure freshness.

13  To be used again, the scoop should be washed with soap and hot water, rinsed thoroughly, and allowed to air dry. When making formula again, the scoop should be totally dry before using it to scoop powder out of the can. Store unopened cans in a cool, dry indoor pantry shelf. Use before the expiration date.

Warming Infant Formula

The following guidelines are recommended to warm refrigerated infant formula:

- For infants who prefer a warmed bottle, warm the bottle immediately before serving.
- A safe method of warming a bottle is to hold it under running warm tap water. Shake the bottle before testing the temperature. Always test the temperature before feeding to make sure that it is not too hot or cold (test by squirting a couple of drops onto the back of your hand).
- Warm only as much infant formula as you think will be needed for a feeding.
- Never use a microwave oven to warm infant formula because this practice is dangerous. Liquid in a bottle may become very hot when heated in a microwave oven and remain hot afterwards even though the bottle feels cool. Infants have been seriously burned while being fed liquids warmed in microwave ovens. Covered bottles, especially vacuum-sealed and metal-capped bottles of ready-to-feed infant formula, can explode when heated in a microwave oven.

Guidelines for Using Infant Formula When There Is Limited Access to Common Kitchen Appliances

The following guidelines regarding use of standard milk- and soy-based infant formulas are recommended for caregivers with limited access to a refrigerator or stove (or when their own appliances are not functioning properly; e.g., a caregiver's refrigerator is not working and not keeping foods at or below 40 degrees Fahrenheit).

If there is no access to a refrigerator:

- Use powdered infant formula instead of 32 ounce ready-to-feed cans or 13 ounce concentrated cans. The latter two are designed for the preparation of multiple bottles of infant formula at one time and require use of a refrigerator for storage. Alternately, ready-to-feed infant formula in 8 ounce servings can be used.

- Follow instructions for properly sanitizing bottles and water (see pages 91 and Figure 6c, page 95).
- Prepare one bottle at a time, if powdered infant formula is used; fill it with the approximate amount of infant formula that the infant can consume at one feeding. Make sure to scoop the powder out of the can using a clean, dry scoop when preparing infant formula. Make sure no liquid enters the can because it will facilitate the growth of bacteria and spoilage of the infant formula. See Figure 6c, page 95, for more detailed instructions.
- Use infant formula immediately after it is prepared or after a ready-to-feed can or nursette is opened.
- Discard any infant formula left over after a feeding or infant formula that has been sitting at room temperature for more than 1 hour.³⁹

If there is no access to a stove or dishwasher:

- Nursette bottles are the ideal packaging of infant formula to use for infants less than 3 months old when a stove or a dishwasher (for sterilizing bottles and their parts and boiling the water) is not available.

Guidelines for Using Infant Formula After a Natural Disaster or Power Outage

The Centers for Disease Control and Prevention (CDC) recommends the following after a natural disaster or power outage:⁴⁰

- Use ready-to-feed infant formula if possible.
- Use bottled water to prepare powdered or liquid concentrated infant formula.
- If bottled water is not available, use boiled water. Use treated water (treated with chlorine or iodine to disinfect it per manufacturers directions) to prepare infant formula only if bottled or boiled water is not available.

References:

1. Section 201(z), Federal Food, Drug, and Cosmetic Act, 21 USC 321
2. Code of Federal Regulations. Title 21, Parts 106 and 107. Washington, DC: US Government Printing Office.
3. Committee on Nutrition, American Academy of Pediatrics. Iron fortification of Infant Formulas. *Pediatrics* 1999;104(1):119-123. Reaffirmed 11/02.
4. Dallman P, Yip R. Changing characteristics of childhood anemia. *Journal of Pediatrics* 1989;114:161-164.
5. Moffat M, Longstaffe S, Besant J, Dureski C. Prevention of iron deficiency and psychomotor decline in high-risk infants through use of iron-fortified infant formula: a randomized clinical trial. *Journal of Pediatrics* 1994;125:527-534.
6. Pizarro F, Yip R, Dallman P, Olivares M, Hertrampf E, Walter T. Iron status with different infant feeding regimens: relevance to screening and prevention of iron deficiency. *Journal of Pediatrics* 1991;118:687-692.
7. Appendix E. In: Kleinman RE, editor. *Pediatric Nutrition Handbook*. 5th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2004:937-948.
8. Oski FA. Iron-fortified formulas and gastrointestinal symptoms in infants: a controlled study. *Pediatrics* 1980;66:168-170.
9. Nelson SE, Ziegler EE, Copeland A, Edwards B, Fomon SJ. Lack of adverse reactions to iron-fortified formula. *Pediatrics* 1988;81:360-364.
10. Committee on Nutrition, American Academy of Pediatrics. Soy protein-based formulas: Recommendations for use in infant feeding. *Pediatrics* 1998;101(1):148-153.
11. Committee on Nutrition, American Academy of Pediatrics. Hypoallergenic Infant Formulas. *Pediatrics* 2000; 106(2):346-349.
12. Ulshen MH. Carbohydrate Absorption and Malabsorption. In: Walker WA, Watkins JB, Duggan C, editors. *Nutrition in Pediatrics*. 3rd ed. Hamilton, Ontario: BC Decker; 2003:811-829.
13. Section 412(h), Federal Food, Drug, and Cosmetic Act, 21 USC 360a(h).
14. Carver JD. Advances in nutritional modifications of infant formulas. *American Journal of Clinical Nutrition* 2003; 77(suppl):550S-1554S.
15. Fats and Fatty Acids. In: Kleinman RE, editor. *Pediatric Nutrition Handbook*. 5th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2004:261-284.
16. Life Sciences Research Office, Food and Drug Administration. Assessment of Nutrient Requirements for Infant Formulas. *Journal of Nutrition* 1998;128:11S.
17. FDA/CFSAN Office of Nutritional Products, Labeling and Dietary Supplements, July 2002.
18. Grimble GK, Westwood O, M. Nucleotides as immunomodulators in clinical nutrition. *Current Opinion in Clinical Nutrition and Metabolic Care* 2001;4:57-64.
19. Yu V. Scientific rationale and benefits of nucleotide supplementation of infant formula. *Journal of Pediatric and Child Health* 2002;38:543-549.

20. Formula Feeding of Term Infants. In: Kleinman RE, editor. *Pediatric Nutrition Handbook*. 5th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2004:87-95
21. Committee on Nutrition, American Academy of Pediatrics. The use of whole cow's milk in infancy. *Pediatrics* 1992;89(6):1105-1109.
22. Ziegler EE, Fomon SJ, Nelson SE, Rebouche C, Edwards B, Rogers R, et al. Cow milk feeding in infancy: further observations on blood loss from the gastrointestinal tract. *Journal of Pediatrics* 1990;116(1):11-18.
23. Jiang T, Jeter JM, Nelson SE, Ziegler EE. Intestinal Blood Loss During Cow Milk Feeding in Older Infants. *Archives of Pediatrics and Adolescent Medicine* 2000;154:673-678.
24. Ziegler EE, Jiang T, Romero E, Vinco A, Frantz JA, Nelson SE. Cow's Milk and Intestinal Blood loss in late infancy. *Journal of Pediatrics* 1999;135(6):720-726.
25. Nokes C, van den Bosch C, Bundy DA. *The Effects of Iron Deficiency and Anemia on Mental and Motor Performance, Education Achievement, and Behavior in Children: A Report of the International Nutritional Anemia Consultative Group*. Washington, D.C.: International Nutritional Anemia Consultative Group; 1998.
26. Martinez G, Ryan AS, Malec D. Nutrient intakes of American infants and children fed cow's milk or infant formula. *American Journal of Diseases of Childhood* 1985;139:1010-1018.
27. Ziegler EE. Milk and formulas for older infants. *Journal of Pediatrics* 1990;117:576-579.
28. Fomon SJ. Potential renal solute load: considerations relating to complementary feedings of breastfed infants. *Pediatrics* 2000;106(5):1284.
29. Dietz WH, Stern L. *American Academy of Pediatrics Guide to Your Child's Nutrition: Making peace at the Table and Building Healthy Eating Habits for Life*. New York: Villard Books; 1999.
30. Hyperlipidemia. In: Kleinman RE, editor. *Pediatric Nutrition Handbook*. 5th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2004:537-550.
31. Chicago Dietetic Association; The South Suburban Dietetic Association; Dietitians of Canada. *Manual of Clinical Dietetics*. 6th ed. Chicago: American Dietetic Association; 2000.
32. Marshall TA, Levy SM, Broffitt B, Warren JJ, Eichenberger-Gilmore JM, Burns TL, et al. Dental caries and beverage consumption in young children. *Pediatrics* 2003; 112(3):e184-e191. (accessed September 5, 2007) Available at: <http://pediatrics.aappublications.org/cgi/content/full/112/3/e184>.
33. American Academy of Pediatric Dentistry. Policy on early childhood caries (ECC): classifications, consequences, and preventive strategies. 2007 (accessed September 11, 2007). Available at: http://www.aapd.org/media/Policies_Guidelines/P_ECCClassifications.pdf.
34. Blum-Kemelor DM. *Feeding Infants: A Guide for Use in the Child Nutrition Programs*. Alexandria, VA: U.S. Department of Agriculture, Food and Nutrition Service; 2001.
35. Shelov SP, Hannemann RE. *Caring for Your Baby and Young Child: Birth to Age 5*. 4th ed. USA: Bantam Books; 2004.
36. Story, M, Holt K, Sofka D, eds.. *Bright Futures in Practice: Nutrition*. Arlington, VA: National Center for Education in Maternal and Child Health; 2000.

37. Food and Drug Administration. Quick Information: Feeding Your Baby With Breast Milk or Formula. 2005 (accessed October 1, 2007). Available at: http://www.fda.gov/opacom/lowlit/feedbby_brochure.pdf.
38. FDA Talk Paper: FDA Warns About Possible Enterobacter Sakazakii Infections in Hospitalized Newborns Fed Powdered Infant Formulas. 2002 (accessed September 5, 2007). Available at: <http://www.cfsan.fda.gov/~lrd/tpinf.html>.
39. American Academy of Pediatrics; American Public Health Association; National Resource Center for Health and Safety in Child Care. Caring for Our Children: National Health and Safety Performance Standards: Guidelines for Out-of-Home Child Care Programs. 2nd ed. Elk Grove Village, IL; 2002.
40. Centers for Disease Control and Prevention. Keep Food and Water Safe after a Natural Disaster or Power Outage. 2005 (accessed September 5, 2007). Available at: <http://www.bt.cdc.gov/disasters/foodwater/>.



CHAPTER 5: COMPLEMENTARY FOODS

Complementary foods are foods other than breast milk or infant formula (liquids, semisolids, and solids) introduced to an infant to provide nutrients. Recommendations on the introduction of complementary foods provided to caregivers of infants should take into account:

- The infant’s developmental stage and nutritional status;
- Coexisting medical conditions;
- Social factors;
- Cultural, ethnic, and religious food preferences of the family;
- Financial considerations; and
- Other pertinent factors discovered through the nutrition assessment process.

This chapter reviews current knowledge regarding the introduction of complementary foods, the appropriate types of complementary foods to feed an infant, home preparation of infant food, using commercially prepared infant food, how to prevent choking, and other practical aspects of feeding complementary foods and beverages. Counseling points that relate to the information presented in this chapter are found in Chapter 8, pages 167–176.

Guidelines on Transitioning to Complementary Foods

The ideal time to introduce complementary foods in the diets of infants is difficult to pinpoint. Complementary foods introduced too early are of little benefit to the infant and may even be harmful due to the possibility of choking, developing food allergies, or causing an infant to consume less than the appropriate amount of breast milk or infant formula. Introducing complementary foods too late may cause an infant to develop nutritional deficiencies and/or miss that period of developmental readiness. Consequently, the infant may have difficulties learning to eat complementary foods when they are introduced later. When complementary foods are introduced appropriate

to the developmental stage of the infant, nutritional requirements can be met and eating and self-feeding skills can develop properly. Pediatric nutrition authorities agree that complementary foods should not be introduced to infants before they are developmentally ready for them; this readiness occurs in most infants between 4 and 6 months of age.

“There is no evidence for harm when safe nutritious complementary foods are introduced after 4 months when the infant is developmentally ready. Similarly, very few studies show significant benefit for delaying complementary foods until 6 months.”¹ The timing of introduction of complementary foods for an individual infant may differ from this recommendation. There is some disagreement among authorities on the need for additional sources of nutrients besides breast milk in the first 6 months. However, there is agreement that infants need a good dietary source of iron and zinc by about 6 months of age, which cannot be met by breast milk alone.

Developmental Readiness for Complementary Foods

Full-term, healthy infants reach developmental readiness to begin complementary foods between 4 and 6 months old. By this age, infants begin to show their desire for food by drooling, opening their mouths, and leaning forward.² Conversely, they show lack of interest or fullness by leaning back, turning away, pushing the spoon or food away, or closing their mouths.²

From 4 to 6 months of age, the following developmental changes occur that allow the infant to tolerate complementary foods:³

- The infant’s intestinal tract develops immunologically with defense mechanisms to protect the infant from foreign proteins (thus, the risk of hypersensitive (allergic) reactions to the proteins in complementary foods is reduced).

- The infant's ability to digest and absorb proteins, fats, and carbohydrates, other than those in breast milk and formula, increases rapidly.
- The infant's kidneys develop the ability to excrete the waste products from foods with a high renal solute load, such as meat.
- The infant develops the neuromuscular mechanisms needed for recognizing and accepting a spoon, masticating, swallowing nonliquid foods, and appreciating variation in the taste and color of foods.

*There are milestones an infant reaches when he/she is ready to consume complementary foods, such as being able to:*⁴

- Sit up, alone or with support
- Hold his head steady and straight
- Open his mouth when he sees food coming
- Keep his tongue low and flat to receive the spoon
- Close his lips over a spoon and scrape food off as a spoon is removed from his mouth and
- Keep food in his mouth and swallow it rather than pushing it back out on his chin. By 4 to 6 months of age, the infant's tongue thrust reflex, which causes the tongue to push most solid objects out of the mouth, usually disappears.

These are signs that an infant is mature enough to begin learning to eat from a spoon. Introduction of complementary foods from a spoon is developmentally important for both breastfed and formula-fed infants to learn appropriate feeding skills for childhood. However, an infant's weight or age alone does not determine readiness for complementary foods; each infant develops at his or her own rate. As an infant's oral skills develop, the thickness and lumpiness of foods can gradually be increased. The texture of foods can progress from pureed to ground to fork-mashed and eventually to diced. Commercially prepared infant foods that progress in texture can also be purchased. Infants should only be given foods that are appropriate for their developmental age.

See Figure 1 – Sequence of Infant Development and Feeding Skills in Healthy, Full-Term Infants, pages 42–43, for more information regarding the sequence of infant development and feeding skills.

Developmental Delays Affect an Infant's Feeding Skills

An infant's development does not always match his or her chronological age. *Infants may be developmentally delayed in their feeding skills due to:*

- Prematurity
- Low-birth weight
- Multiple hospitalizations
- Failure to thrive
- Neuromuscular delay
- Abuse or neglect
- Depression
- Cleft lip or cleft palate
- Inability to feed by mouth (i.e., fed intravenously or via tube) for an extended period or
- A medical condition (e.g., Down's syndrome or cerebral palsy).

Infants with these conditions may not be developmentally ready for complementary foods at similar chronological ages as full-term, healthy infants. A caregiver of a developmentally delayed infant will need instructions on feeding techniques from the infant's health care provider or a trained professional in feeding developmentally disabled children. For more information and resources on feeding infants and children with special health care needs, contact:

- A local pediatrician;
- A registered dietitian or nutritionist specializing in this area (e.g., may be found in the State Health Department, State WIC Program, or in local hospitals);
- A State maternal and child health agency; or
- A registered dietitian or nutritionist at a university-affiliated program for developmental disabilities (contact your local or State health department for information on the nearest program).

Figure 7:
How the Recommended Sequence of Introducing Complementary Foods
Corresponds With Food Textures and Feeding Styles

Age of Infant By Month	Birth	1	2	3	4	5	6	7	8	9	10	11	12
Age Grouping	Birth through 3 months		4 months through 6 months			6 months through 8 months			8 months through 12 months				
Sequence of Introducing Foods	Breast milk or Infant Formula		** Complementary foods										
Texture of Complementary Foods			Strained/pureed (then consistency for cereal)						Mashed				
											Ground/ Finely Chopped		
											Chopped		
Feeding Style	Breastfeeding/Bottle Feeding												
			Spoon Feeding										
			Cup Feeding										
											Self Feeding/ Feeding Finger Foods		

Special Note: represents the age range when most infants are developmentally ready to begin consuming complementary foods. The American Academy of Pediatrics Section on Breastfeeding recommends exclusive breastfeeding for the first 6 months of life. The AAP Committee on Nutrition recommends that, in developed countries, complementary foods may be introduced between ages 4 and 6 months. This is a population-based recommendation, and the timing of introduction of complementary foods for an individual infant may differ from this recommendation.

** Complementary foods include infant cereal, vegetables, fruits, meat, and other protein-rich foods modified to a texture appropriate (e.g., strained, pureed, chopped, etc.) for the infant’s developmental readiness. See Figure 1 for more guidance on feeding skills and infant development.

Early Introduction of Complementary Foods

In spite of recommendations to delay introduction of complementary foods until 4 to 6 months, studies have demonstrated this practice remains very common. Incidence of early introduction of complementary foods before 4 months has been reported to be from 44 percent⁵ to 93 percent⁶ depending on the group surveyed. The practice is lower among infants who are exclusively breastfed than among those who are fed infant formula or those fed a combination of breast milk and formula.^{5,6} Racial and ethnic differences appear to play a part;⁷ Hispanic caregivers are least likely to introduce complementary foods before 4 months and African-American caregivers are most likely.^{5,6} Caregivers tend to introduce complementary foods at an early age because they feel that their infants are not satisfied with breast milk or formula alone or the foods will make their infants sleep through the night. However, infants who are fed complementary foods before they are developmentally ready for them may:

- Choke on the food
- Develop food hypersensitivities (allergies) because of an immature digestive tract or
- Consume less than the appropriate amount of breast milk or infant formula.

Contrary to popular belief among mothers, feeding complementary foods early will not help infants sleep through the night or eat fewer times in a day; the infant's ability to sleep through the night depends on his developmental maturity and ability to comfort himself when awake and not hungry.² If a caregiver complains that an infant is not satisfied with breastfeeding or the amount of infant formula provided, a nutrition assessment with additional probing questions may ascertain possible problems.

Late Introduction of Complementary Foods

At 6 months old, healthy, full-term infants should be introduced to appropriate complementary foods. By 8 months, they should be developing skills to feed themselves (see Figure 1 for the sequence of infant development and feeding skills on pages 42–43). The jaw and muscle development that occurs when an infant eats complementary foods at the appropriate age contributes to later speech development. Infants who are not introduced to complementary foods when developmentally ready for them may:

- **Reject foods when they are introduced at a later age** – This may occur because infants become comfortable with the easier feeding style necessary to suck from the breast or a bottle. The infant may then have difficulty developing skills to eat independently.
- **Consume an inadequate variety and amount of food to meet their nutritional needs** – Breast milk or infant formulas alone do not provide an adequate concentration or balance of nutrients for the older infant.

Therefore, complementary foods serve an important purpose in the daily diet of infants who are developmentally ready for them.

Importance of Gradually Introducing Each New Food

When introducing infants to complementary foods, caregivers should follow these guidelines:^{1,8}

- Introduce new foods one at a time.
- Introduce “single-ingredient” foods initially to determine the infant's acceptance to each food (e.g., try plain rice cereal before rice cereal mixed with fruit).
- Allow at least 7 days between the introduction of each new “single-ingredient” food.¹ *Some research experts acknowledge that complementary foods can be introduced at intervals of 2 to 4 days if the infant is developmentally ready.⁹*

- Introduce a small amount (e.g., about 1 to 2 teaspoons) of a new food at first (this allows an infant to adapt to a food's flavor and texture).
- Observe the infant closely for adverse reactions such as rash, wheezing, or diarrhea after feeding a new food.

By following these guidelines, an infant will have time to become acquainted with each new food and the caregiver will be able to easily identify any adverse reactions or difficulties digesting new foods. Adverse reactions to food include:¹⁰

- **Food hypersensitivities (allergies):**
 - Occur in approximately 2 percent to 8 percent of infants and children less than 3 years old
 - Involve a reaction of the immune system to a food; a reaction may occur immediately or hours after eating
 - May cause any of the following symptoms:
 - Systemic – anaphylactic shock, failure to thrive
 - Gastrointestinal – diarrhea, vomiting, abdominal pain
 - Respiratory symptoms – coughing, wheezing, ear infections
 - Cutaneous – skin rashes (like eczema)
 - Are associated most with consumption of these foods by infants: cow's milk, whole eggs (or egg white), wheat, peanuts or tree nuts, finfish (e.g., flounder, trout, cod) and shellfish (e.g., shrimp, crab, lobster, scallop, oyster, clam).

Caregivers should not feed any shellfish, peanut butter, whole eggs, or egg whites to their infants before 1 year of age.

- **Food intolerances:**
 - Involve reactions stemming from an enzyme deficiency, a toxin, or a disease (the immune system is not affected); and
 - May cause some of the similar symptoms as food hypersensitivities.

Examples of food intolerances are lactose intolerance (caused by a lack of lactase, the

intestinal enzyme that digests the sugar lactose) and celiac disease (in which gluten, a combination of proteins found in wheat, rye, oats, barley, and buckwheat, destroys the lining of the small intestine).

- **Other adverse reactions to food that do not involve the immune system include reactions to the following:** food additives (e.g., artificial food colorings), MSG (monosodium glutamate), natural substances in food such as caffeine, or substances or micro-organisms that cause food poisoning. Some infants may develop excessive intestinal gas after consuming certain foods (e.g., certain vegetables, legumes).

If the caregiver observes any of the previously discussed reactions in an infant after a feeding, they should stop feeding the infant that food immediately and consult a health care provider. If an infant appears to be having a severe reaction to a food (e.g., difficulty breathing, shock, etc.), the caregiver should call 911 or take the infant to the nearest hospital emergency room.

Note that it is now well established that antigens can pass into breast milk and some exclusively breastfed infants have been reported to have reactions to foods in their mothers' diets.¹¹ *If an exclusively breastfed infant has symptoms similar to those described above for food hypersensitivities, referral to a qualified health care provider is appropriate.*

Infants at high risk for developing allergy, identified by a strong family history of allergy – infants with at least one first-degree relative (parent or sibling) with allergic disease – should adhere to the following recommendations:¹⁰

- Complementary foods should not be introduced until 6 months of age.
- Dairy products should be delayed until the infant is 1 year old.
- Eggs should be delayed until the infant is 2 years old.
- Peanuts, nuts, and fish should be delayed until 3 years of age.

Establishing Dietary Variety and Food Preferences

Caregivers should show a positive attitude when introducing new foods to their infant. Touching the infant's lips with the spoon containing a new food will provide a taste of the new food before a full spoonful is offered.⁴ New foods that are rejected should not be force-fed to an infant but should be offered again in a week or two. Research has demonstrated that it takes up to 10 to 15 exposures to a new food for an infant to readily accept the food.^{12,13} Infants and children may accept foods previously rejected if time has elapsed since the initial rejection. It may also be helpful if the food is offered to the infant by the caregiver without pressure to accept the food. It may take time to adapt to the flavor and texture of new foods; familiarity plays a significant part in food acceptance.^{14,15} Breastfed infants have been shown to prefer rice infant cereal prepared with their mother's breast milk over infant cereal prepared with water.¹⁶ Similarly, breastfed infants tend to accept the introduction of new foods more readily than formula-fed infants.¹⁷ This affect is most likely a result of the infant's exposure to a variety of flavors in breast milk from the mother's diet.¹⁸ See page 45 for more information regarding the feeding relationship.

Types of Complementary Foods To Introduce

Infants can be fed either home- or commercially prepared infant foods. Research does not support introducing foods in a particular order; however, it is recommended to introduce one "single-ingredient" new food at a time.¹ This section reviews the different types of complementary foods commonly fed to infants. See Figure 7, page 103 and Appendix D, pages 195–196, for guidelines on feeding healthy infants.

Iron-Fortified Infant Cereal

Iron-fortified infant cereal is an appropriate first complementary food for infants because it is easy to digest and contributes important nutrients such as iron and zinc to the diet.

Iron and Zinc Needs for Exclusively Breastfed Infants

Iron and zinc are essential nutrients for all healthy, full-term infants, but are special nutrients of concern for exclusively breastfed infants. Research has shown chemical analysis of breast milk at various stages of lactation indicating that at 6 through 11 months postpartum, the zinc and iron content of breast milk alone is not sufficient for older infants.¹⁹ Consequently, the timing of introduction, content, and bioavailability of zinc and iron in complementary foods, such as protein-rich foods and fortified infant cereal, is very important for exclusively breastfed infants. See page 24 for more information regarding the iron requirements of breastfed infants.

Types of Infant Cereal To Feed

A variety of plain iron-fortified infant cereals are available. *Iron-fortified infant rice cereal is a good choice as an infant's first complementary food because it:*

- Digests easily
- Least likely to cause a hypersensitivity (allergic) reaction
- Contains important nutrients and
- Can be altered in texture to meet an infant's developmental needs. The infant's first cereal feeding should be soupy in texture with the texture becoming thicker and lumpier as feeding skills progress.

After introducing rice infant cereal, oat and barley infant cereals can be added at 1 week intervals. Wheat infant cereal should be introduced at 8 months of age. It is most likely to cause a hypersensitivity (allergic) reaction in young infants and this risk decreases by around 8 months. Mixed-grain infant cereals and infant cereal and fruit combinations may be introduced after an infant has been introduced separately to each food in the mixture or combination. Jar infant cereal usually includes multiple ingredients,

sugar, and more kilocalories; and is more expensive, ounce for ounce, than reconstituted dry boxed infant cereals. Dry infant cereal can be mixed with breast milk, infant formula, or water to prepare it to the appropriate consistency.

Avoid Adult Cereals

Ready-to-eat iron-fortified cereals designed for adults or older children are not recommended for infants because they:

- Often contain mixed grains
- Tend to contain more sodium and sugar than infant cereals
- Typically contain less iron per infant-sized serving and contain a form of iron that is not as easily absorbed by the infant as the iron in infant cereals and
- Often contain small pieces, such as raisins, dates, or nuts that are hard to chew and could cause choking.

Fruit Juice

In recent years, fruit juice has become a popular beverage to offer infants because it tastes good and infants readily accept it. Although fruit juices contain carbohydrates, may contain vitamin C, and are a source of fluid they have potentially detrimental effects.

Infants who drink excessive amounts of fruit juice from a bottle or cup may:

- Consume an inadequate quantity of breast milk, infant formula, or other nutritious foods;²⁰
- Develop gastrointestinal symptoms, such as diarrhea, abdominal pain, or bloating, from consuming an excessive amount of certain juices, i.e., fruit juices containing a significant amount of sorbitol, a naturally occurring carbohydrate. Juices containing sorbitol include prune, pear, cherry, peach, and apple juice;
- Develop malnutrition and short stature; and²¹
- Develop dental caries.

Definition of Fruit Juice

The Food and Drug Administration (FDA) mandates that a product must contain 100 percent fruit juice in order to be labeled as such. If a beverage contains less than 100 percent fruit juice its label must display a descriptive term, such as “drink,” “beverage,” or “cocktail.”²¹

Consequently, fruit juice should be fed only in moderation. Some fruit juices, such as prune, apple and pear, contain a significant amount of sorbitol, a sugar alcohol, and proportionally more fructose than glucose. Infants can only absorb a portion of the sorbitol (as little as 10 percent) and fructose in these juices.²² The unabsorbed carbohydrate is fermented in the lower intestine, causing diarrhea, abdominal pain, or bloating. These symptoms are commonly reported in infants who drink excessive amounts of juice.

The AAP has concluded that fruit juice offers no nutritional benefit for infants less than 6 months and no benefit over whole fruits for infants older than 6 months. However, 100 percent fruit juice or reconstituted juice can be consumed as part of a well-balanced.²¹

Guidelines on Introducing Fruit Juice

If fruit juices are introduced, caregivers should adhere to the following recommendations:^{1, 21}

- Wait to introduce fruit juices until the infant is 6 months or older.
- Use 100 percent fruit juice.
- Never feed infants unpasteurized juice.
- Introduce new fruit juices one at a time and not sooner than about 7 days apart, and observe the infant for adverse reactions. Introduce mixed fruit juice only after the infant has tried all the juices in the mixture.
- Avoid offering fruit juice in a bottle or spill-proof cup (sippy cup) that can easily be carried around by the infant.
- Avoid offering fruit juice at nap or bedtime.

Types of Juices Offered (Infant Juices, Citrus Juices, Canned Juices, and Unpasteurized Juices)

Juices bottled specifically for infants and toddlers do not differ from those bottled for adults and are more expensive; regular juices may be offered to infants following the guidelines outlined above.

Most canned juices manufactured in the United States are packed in cans coated with a lining designed to reduce the rate at which the can corrodes. Once a can is opened, some corrosion still occurs and may affect the juice's flavor. Thus, it is advisable to store juice from a freshly opened can in a clean glass or plastic container. Historically, there has been concern about feeding infants canned food or beverages because of the danger of lead from the can seams leaching into the food. However, the seams of cans manufactured in the United States are no longer made using lead solder. It is possible that canned imported juices, found in ethnic, specialty, and conventional food stores, may have lead seams. As a precaution, advise caregivers to avoid feeding imported canned juices to their infants. Also, fruit juices should not be stored in lead crystal containers or pottery containers, which may leach lead into the juice. See page 120 for more information regarding potential lead exposure from food.

Unpasteurized juices should never be given to infants because there is a risk of the infant being exposed to *Escherichia coli* O157:H7 (see page 37 for information on *Escherichia coli* O157:H7).²³ Unpasteurized juices may be found in the refrigerated sections of grocery or health food stores, cider mills, or farm markets. Labels on unpasteurized juices must contain the following: "WARNING: This product has not been pasteurized and therefore may contain harmful bacteria that can cause serious illness in children, the elderly, and persons with weakened immune systems."²⁴

Importance of Feeding Juice From a Cup Instead of a Bottle

Whether regular "adult" juices or infant juices are used, infants should be fed juice from a cup without a lid. Cups with lids designed to prevent spilling are not recommended, because they allow the infant or toddler to carry the cup around with them. This practice can lead to the infant consuming excessive amounts of liquid, since they have constant access to it. Unfortunately, many commercial infant juices are available in 4 and 8 ounce bottles designed so that a rubber nipple can easily be attached. Advise caregivers to pour fruit juice into a cup without a lid and never feed it from a bottle.

Vegetables and Fruits

Vegetables and fruits provide infants with carbohydrates, including fiber; vitamins A and C; and minerals. A recent comprehensive analysis of the available literature indicates that the order of introduction, fruits first or vegetables first, is not important.⁹

Introducing Home and Commercially Prepared Vegetables and Fruits

Home or commercially prepared vegetables and fruits can be fed to infants. A wide variety of vegetables and fruits should be introduced over time. However, the recommendations to introduce one single-ingredient new food at a time, wait 7 days between each new food, and watch the infant closely for adverse reactions, still apply.¹

Use of Commercially Prepared Vegetable or Fruit Infant Foods

If commercially prepared vegetable or fruit infant foods are used, plain varieties are generally preferred instead of fruit desserts or infant food mixtures with added ingredients such as sugar, nonfat dry milk, or corn syrup. Plain vegetables and fruits generally offer more nutrient value for the cost of the food compared to fruit desserts

and infant food mixtures. Commercially prepared fruit and vegetable infant foods that progress in texture can be used as the infant's developmental abilities advance. See pages 120–121 for more information regarding the safe use of commercially prepared infant foods.

A Caution About Vegetables High in Nitrates or Nitrites

The AAP recommends that spinach, beets, turnips, carrots, or collard greens prepared at home should not be fed to infants less than 6 months old because they may contain sufficient nitrate to cause methemoglobinemia.²⁵ Methemoglobinemia, also termed blue baby syndrome, is characterized by blue skin and difficulty in breathing and could lead to death. The nitrate in these vegetables is converted to nitrite before ingestion or in the infant's stomach. The nitrite binds to iron in the blood and hinders the blood's ability to carry oxygen. The potential risk of developing methemoglobinemia is only present with home-prepared high-nitrate vegetables; commercially prepared infant and junior spinach, carrots, and beets contain only traces of nitrate and are not considered a risk to the infant.²⁶ Manufacturers of infant foods select produce grown in areas of the country that do not have high nitrate levels in the soil and monitor the amount of nitrate in the final product. Thus, advise caregivers not to feed infants less than 6 months old those home-prepared vegetables potentially high in nitrates noted above. See page 37 regarding the risk to infants consuming water contaminated with nitrate.

Vegetables and Fruits That May Cause Choking

Due to the risk of choking, it is best to avoid feeding infants these vegetables and fruits:

- Raw vegetables (including green peas, string beans, celery, carrot, etc.);
- Cooked or raw whole corn kernels;

- Whole, uncut cherry or grape tomatoes;
- Hard pieces of raw fruit;
- Whole pieces of canned fruit;
- Whole, uncut grapes, berries, cherries, or melon balls (these fruits should be cut into quarters, with pits removed, before feeding); and
- Uncooked dried fruit (including raisins).

Protein-Rich Foods

Protein-rich foods are generally introduced to infants between 6 and 8 months of age. If an additional source of iron or zinc is needed and the infant is developmentally ready, protein-rich foods may be introduced between 4 and 6 months. Iron and zinc are nutrients of concern for exclusively breastfed infants and should be considered when caregivers determine a time to introduce protein-rich foods. See page 108 for more information regarding iron and zinc needs of breastfed infants. Protein-rich foods include meat, poultry, fish, egg yolks, cheese, yogurt, and legumes. See page 137 regarding protein in vegetarian diets. Home- or commercially prepared meats are a good source of iron and zinc, in addition to iron-fortified infant cereal. Introduction of protein rich foods earlier than 6 months may cause hypersensitivity (allergic) reactions. For the infant over 6 months, as with all new foods, protein-rich foods should be introduced one at a time, waiting 7 days between exposing each new food, while observing the infant closely for reactions to the foods.¹

Home-Prepared Meats, Poultry, and Fish

Infants can be offered well-cooked strained or pureed lean beef, pork, lamb, veal, chicken, turkey, liver, boneless finfish (fish other than shellfish), egg yolk, legumes, tofu, sliced or grated mild cheese, yogurt, or cottage cheese.

Concerns About Fish

Infants should be observed closely if fish is introduced because fish can cause hypersensitivity (allergic) reactions in some infants (shellfish is not recommended for infants less than 1 year old). See pages 104–105 for more information regarding food hypersensitivities. Certain fish have been found to have high levels of mercury that may harm an infant's developing nervous system.²⁷ The Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) advise pregnant and breastfeeding women, infants, and young children to avoid some types of fish and eat those that are lower in mercury.²⁸ See Figure 8, page 112, for more information regarding mercury in fish and shellfish. (Additional resource: What You Need to Know about Mercury in Fish and Shellfish at <http://www.epa.gov/waterscience/fish/files/MethylmercuryBrochure.pdf>)

Information about fish caught locally can generally be found in the State fishing regulations booklet, the local health department, or on the EPA's Fish Advisory Web site, <http://www.epa.gov/waterscience/fish/>. Information about mercury levels in specific fish can be found at the FDA food safety Web site, <http://www.cfsan.fda.gov/~frf/sea-mehg.html>.

Commercially Prepared Infant Food Meats versus Mixed Dinners

Plain commercially prepared infant food meats offer more nutrient value, ounce for ounce, compared to commercially prepared infant food mixed dinners (the mixed dinners do not contain as much protein and iron as the plain meats). Instead of using mixed dinners, the desired amounts of plain meats and plain vegetables could be mixed together. Some infants will accept meat better when it is mixed in this manner. See pages 120–121 on the safe use of commercially prepared infant foods.

Eggs

Egg yolk can be introduced to infants, but egg whites and whole egg (because it has egg white) are not recommended until 1 year of age, because they contain proteins that may cause hypersensitivity (allergic) reactions in infants. See pages 104–107 for more information regarding food hypersensitivities. All eggs and egg-rich foods must be carefully handled and properly prepared to reduce the possibility of contamination with *Salmonella enteritidis* and other bacteria. Raw eggs should never be fed to infants (or anyone else) because they may contain bacteria that can cause illness if the egg is eaten uncooked or undercooked. Recommended guidelines for selection, preparation, and storage of eggs and egg-rich foods can be found on page 118.

Cheese and Yogurt

Cottage cheese, hard cheeses, and yogurt can be gradually introduced as occasional protein foods. Since these foods contain similar proteins to cow's milk, infants should be observed closely for reactions after eating these foods. See page 104–105 for more information regarding food hypersensitivities. Cheese can be eaten cooked in foods or in the sliced form. Small slices or strips of cheese are easier and safer to eat than a chunk of cheese, which could cause choking.

Legumes (Dry Beans or Peas) and Tofu

Cooked legumes (dry beans and peas) or tofu (bean curd made from soybeans) can be introduced into an infant's diet as a protein food. Any dry beans or peas can be cooked and modified to a consistency easily eaten by an infant. It is best to introduce small quantities (1 to 2 teaspoons) of mashed or pureed and strained legumes initially (whole beans or peas could cause choking). As with any food, a caregiver should observe to see if the infant does not like them, has a reaction to the food, or appears to have difficulty digesting them. If so, they can be introduced again at a later time. Guidelines for selection, preparation, and storage of legumes and tofu can be found on page 119.

Nuts

Although nuts are a good source of protein, they are not appropriate for infants.⁸ Nut butters and foods containing nut butters should be avoided in infancy. Whole or chopped nuts and peanut or other nut butters, which can form a glob, present a choking hazard and increase the risk of food hypersensitivity (allergic) reactions. Consequently, they should never be given to infants. See pages 104–105 for more information regarding food hypersensitivities.

Feeding Water Once Protein-rich Foods Are Introduced

Protein-rich foods (e.g., home-prepared meats, commercially prepared plain meats and mixed dinners, egg yolks, cheese) have a higher renal solute load than some other foods. An infant's health care provider may recommend feeding a small amount of sterile water (~4 to 8 ounces per day) in a cup when complementary foods rich in protein are introduced. Instruct caregiver to consult their health care provider concerning their infant's water needs.

Protein-Rich Foods That May Cause Choking

Due to the risk of choking, it is best to avoid feeding infants these protein-rich foods:

- Tough or large chunks of meat;
- Hot dogs, meat sticks, or sausages;
- Fish with bones;
- Large chunks of cheese, especially string cheese;
- Peanuts or other nuts and seeds;
- Peanut and other nut/seed butters; and
- Whole beans.

Grain Products

Between 6 and 8 months old, many infants are ready to try crackers, bread, noodles, macaroni, and other grain products. By this stage in their development, infants can practice picking up these foods with their fingers. Grain products provide carbohydrates, thiamin, niacin, riboflavin, iron, other minerals, and, in the case of whole-grain products, fiber to the diet.

Examples of grain products that are appropriate for infants include: plain ground or mashed rice or barley; noodles; plain enriched or whole grain crackers, preferably low in salt; small pieces of toast or crust of bread; and zwieback, teething biscuits, or graham crackers (without honey).

Since infants may choke on cooked grain kernels (e.g., cooked rice, barley, or other grain kernels), these foods should be cooked until very soft and then pureed or finely mashed or put through a sieve before serving. It is best to mash or finely chop (½-inch pieces or smaller) cooked noodles, spaghetti, and macaroni until the infant is 8 to 10 months or older. Older infants can be fed plain crackers, teething biscuits, corn grits, soft tortilla pieces, zwieback, and small pieces of bread as well.

Figure 8:

What You Need to Know About Mercury in Fish and Shellfish

The Facts

Fish and Shellfish are an important part of a healthy diet. Fish and shellfish contain high-quality protein and other essential nutrients, are low in saturated fat, and contain omega-3 fatty acids. A well-balanced diet that includes a variety of fish and shellfish can contribute to heart health and children's proper growth and development. So, women and young children in particular should include fish or shellfish in their diets due to the many nutritional benefits.

However, nearly all fish and shellfish contain traces of mercury. For most people, the risk from mercury by eating fish and shellfish is not a health concern. Yet, some fish and shellfish contain higher levels of mercury that may harm an unborn baby or young child's developing nervous system. The risks from mercury in fish and shellfish depend on the amount of fish and shellfish eaten and the levels of mercury in the fish and shellfish. Therefore, the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) are advising women who may become pregnant, pregnant women, breastfeeding mothers, and young children to avoid some types of fish and eat fish and shellfish that are lower in mercury.



3 Safety Tips

1. Do not eat:

- Shark
- Swordfish
- King Mackerel
- Tilefish

Why?

They contain high levels of mercury.

2. Eat a variety of fish that are lower in mercury.

Five of the most commonly eaten fish that are low in mercury are shrimp, canned light tuna, salmon, Pollock and catfish.

Another commonly eaten fish, albacore ("white") tuna has more mercury than canned light tuna

3. Check local advisories about the safety of fish caught by family and friends in your local lakes, rivers, and coastal areas

Things to remember for your infant:

- Do not feed any shellfish before 1 year.
- Infants at high risk for developing allergy, identified by a strong family history of allergy, should not be introduced to fish until 3 years of age.

Visit the Food and Drug Administration's Food Safety Website www.cfsan.fda.gov or the Environmental Protection Agency's Fish Advisory Website www.epa.gov/ost/fish for a listing of mercury levels in fish.

Grain Products That May Cause Choking

Due to the risk of choking, it is best to avoid feeding infants these grain products:

- Cookies or granola bars;
- Potato/corn chips, pretzels, and similar snack foods;
- Crackers or breads with seeds, nut pieces, or whole grain kernels such as wheat berries; and
- Whole kernels of cooked rice, barley, wheat, or other grains.

Finger Foods

At about 6 months, infants develop what is known as a palmer grasp – the ability to push something into his palm using his fingers. Between 6 and 8 months, they develop the ability to hold something between their thumb and forefinger – this is called a pincer grasp. By this time, infants can begin to feed themselves with their hands and try some finger foods. These foods should be:

- Small enough for them to pick up and
- Soft enough for them to chew on.

Appropriate finger foods include: cooked macaroni or noodles, small pieces of bread, small pieces of soft, ripe peeled fruit or soft cooked vegetables, small slices of mild cheese, crackers, or teething biscuits. This is a messy stage, but allowing infants to feed themselves is very important to their development of feeding skills. Using a highchair or booster seat with a removable tray that can be washed easily or covering the area under the infant's seat with newspaper or a plastic mat will help manage the mess.

Caregivers should be alerted to the risk of infants choking and instructed to closely supervise infants while eating. See pages 124–125 regarding choking prevention. By about 10 to 12 months, most healthy, full-term infants are able to feed themselves chopped foods from the table with their fingers unassisted.

Sweetened Foods and Sweeteners

Sweeteners (e.g., sugar, syrups) eaten alone or added to foods provide additional kilocalories to the diet and, as fermentable carbohydrates, promote the development of tooth decay. Sweetened foods may be higher in sugar and fat and lower in key nutrients than other more nutritious foods, such as plain fruit. Plain fruit is a good choice as a dessert for an infant. *Advise caregivers to avoid feeding infants:*

- Commercially prepared infant food desserts, commercial cakes, cookies, candies, and sweet pastries;
- Chocolate – some infants have hypersensitivity (allergic) reactions to this food; and
- Added sugar, glucose, molasses, maple syrup, and corn syrup or other syrups in their food, beverages, or water.

Honey

Honey, including that used in cooking or baking or as found in processed foods (e.g., yogurt with honey, honey graham crackers), should not be fed to infants under 12 months of age.² Honey is sometimes contaminated with *Clostridium botulinum* spores. Foods made with honey that in the preparation process are not heated to a certain temperature, may still contain viable spores. When consumed by an infant, these spores can produce a toxin that may cause infant botulism, a foodborne illness that can result in death. The gastrointestinal tract of infants cannot destroy these spores (older children and adults can destroy the small amount of spores in honey). Corn syrup and other syrups currently on the market are not sources of *Clostridium botulinum* spores and are not associated with infant botulism; however, they are not appropriate for infant consumption.

Sweetened Foods That May Cause Choking

Due to the risk of choking, it is best to avoid feeding infants these sweetened foods:

- Hard candy, jelly beans, caramels, or gum drops/gummy candies;
- Chewing gum; and
- Marshmallows.

Beverages

Breast milk or infant formula are the only beverages that should be offered to infants less than 6 months of age. Water may be added in limited amounts once protein-rich foods are introduced (see below for more information). Similarly, juice may be added in limited amounts at the appropriate time. See pages 107–108 for guidelines on introducing juice. Other beverages do not have a place in the diets of infants. They do not provide nutrients necessary for infants and may take the place of more nutritious foods or beverages in the diet.

Water

Healthy infants fed adequate amounts of breast milk or infant formula in the first 6 months of life generally do not require additional plain water added to their diet. An infant's health care provider may recommend feeding a small amount of sterile water (~4 to 8 ounces per day) in a cup when complementary foods are introduced. See pages 28–30 for additional information regarding water, excessive water in the diet, and water safety issues.

Caffeine-Containing Beverages

Beverages containing caffeine and theobromine, a caffeine-related substance, are not recommended for infants. Caffeine and theobromine act as stimulant drugs in the body. Coffee, tea, some carbonated beverages such as colas, and hot chocolate contain these substances. In some cultures, infants are commonly fed coffee or tea as a beverage. This practice should be discouraged.

Herbal Teas

Complementary and alternative medicine is increasing in popularity, especially the use of herbal therapies. As many as 45 percent of caregivers have reported giving herbal therapies to their children; 80 percent were given on the advice of friends or relatives.²⁹ However there are few controlled trials evaluating the safety of the use of herbs in infants.³⁰ In some cultures, herbal teas have been given to infants with symptoms of colic, but certain herbal teas contain powerful substances similar to drugs and are not appropriate for infant consumption. See page 140 for more information regarding treatment for colic. Seizures, jitteriness, hyperexcitability, vomiting, and muscle twitching have been reported in infants given star anise tea, which is widely used among Latinos.³¹ Liver and neurological injury has been reported in infants fed mint tea containing pennyroyal oil.³² Because of these adverse side-effects and the lack of research data, herbal teas are inappropriate for infant consumption.

Sweetened Beverages

Sodas, fruit drinks, punches and aides, sweetened gelatin water, sweetened iced tea, and similar drinks are not recommended for infants because of their high sugar content. The sugars in these beverages are fermentable carbohydrates and thus can promote tooth decay.³³ See pages 131–132 for more information regarding tooth decay. Some caregivers may feed sweetened beverages to their infants when ill. This practice could be dangerous if the infant has symptoms that could lead to dehydration (e.g., diarrhea or vomiting). Infants with symptoms such as diarrhea, vomiting, or signs of dehydration (shown on page 30), should be referred to a health care provider. Caregivers should only use an appropriate oral electrolyte solution to treat vomiting or diarrhea when prescribed by their infant's health care provider.

Artificially Sweetened “Low Calorie” Beverages (or Foods)

Since infants are growing rapidly and require energy for growth, there is no need for “low

calorie” beverages in their diets. Further, artificial sweeteners have not been proved safe specifically for consumption by infants. Therefore, beverages such as sodas, iced tea, and fruit punch mixes that contain artificial sweeteners, such as saccharin, aspartame, or Splenda are not recommended for infants or young children.⁸ Similarly, it is also not recommended to feed infants artificially sweetened foods or add artificial sweetener to their foods or beverages.⁸

Food Selection, Preparation, and Storage

Infants are more susceptible to harmful effects from contaminated food than older children or adults. General cleanliness, proper food selection, and sanitary food preparation and storage are important to preventing foodborne illnesses in infants. The following sections provide general information on selection, cleanliness, equipment to use, preparation, safety, and storage of foods, both home-prepared and commercially manufactured for infant consumption.

Home-Prepared Infant Food

Foods prepared for an infant at home can be equally nutritious and more economical than commercially prepared infant food. The caregiver using home-prepared infant foods has more control over the variety and texture of food than with commercially prepared infant foods. However, home-prepared infant foods must be appropriately modified for infants to safely consume. As an infant’s feeding skills progress, the thickness and lumpiness can gradually be increased. Food texture can progress from pureed to ground, fork mashed, and eventually diced.

Care must be taken in preparing an infant’s food at home to ensure that the food is:

- Prepared and stored safely
- Appropriate in texture
- Cooked using methods that conserve nutrients and
- Prepared without adding unnecessary ingredients, such as sugar and salt.

General Guidelines To Follow When Preparing Infant Foods at Home

Cleanliness. Because infants have immature immune systems, they are particularly sensitive to disease-producing micro-organisms and toxins that may contaminate food. Therefore, it is important to clean anything (e.g. hands, surfaces, utensils, equipment) that might come in contact with food before starting preparation.

Key concepts to convey to caregivers on general cleanliness and reducing contamination of food include the following:

- Wash hands with soap and hot water and rinse thoroughly:
 - Before breastfeeding, formula feeding, or preparing any food or bottles;
 - Before handling any food or food utensils;
 - After handling raw meat, poultry, or fish;
 - After changing an infant’s diaper and clothing;
 - After using the bathroom or assisting a child in the bathroom;
 - After sneezing or coughing into tissues or hands or wiping noses, mouths, bottoms, sores, or cuts; and
 - After handling pets or other animals or garbage.
- Before preparing food, wash all working surfaces used to prepare food such as counter tops or tables with soap and hot water, and then rinse thoroughly with hot water.
- Before preparing food, wash all equipment, such as a blender, food mill, food processor, infant food grinder, utensils, pots, pans, and cutting boards carefully with soap and hot water. Rinse thoroughly with hot water and allow to air dry. Separate cutting boards should be used for animal foods (i.e., meat, poultry, fish) and non-animal foods (i.e., vegetables, fruits, breads).

Preparation. Common kitchen equipment is all that is necessary to make infant foods at home. A simple metal steamer, available in most supermarkets, can be used to cook fruits and vegetables and will reduce the loss of vitamins in cooking.

These types of equipment can be used to process food into an appropriate texture:

- **Blender or food processor** – purees foods, including meats, vegetables, and fruit, to a very smooth consistency, if desired;
- **Fine mesh strainer** – purees very soft cooked vegetables and ripe or cooked fruits – the food would be pushed through the strainer with the back of a spoon;
- **Infant food grinder or food mill** – purees most foods to a smooth consistency and purees meats to a coarser consistency; and
- **A kitchen fork or knife** – foods can be mashed with a fork or chopped finely with a knife, for older infants.

After pureeing food, liquid (cooking liquid, plain water, breast milk, infant formula, or fruit juice) can be added for a thinner consistency. As an infant gets older and progresses in the development of feeding skills, the consistency and texture of foods can be altered accordingly. Avoid adding sugar or salt to an infant's food. When cooking foods for the family, the infant's portion can be separated out before adding those ingredients.

Strongly discourage caregivers from chewing table foods in their mouths and then feeding the food to their infants. Saliva from the caregiver's mouth contaminates the food with bacteria and dilutes its nutrient content.

Serving and Storage. Home-prepared infant foods should be used immediately and quickly stored in a properly functioning refrigerator or frozen for longer storage.

Vegetables and Fruits

Recommended guidelines for the preparation of vegetables and fruits include the following:

- Select high-quality fresh vegetables and fruits or plain frozen vegetables and fruits (e.g., without added salt or sauces). Fresh or frozen vegetables or fruits are preferable over canned vegetables or fruits, which may contain added salt or sugar.
- If canned products are used due to their lower

cost, those without salt or syrup or packed in their own juice are preferable.

- Wash fresh vegetables and fruits with clean water to remove dirt. Remove pits, seeds, and inedible peels and other parts. Edible skins and peels can be removed either before or after cooking.
- When cooking is needed, cook the vegetables or fruit in a covered saucepan on a stove; either boil with a small amount of water or steam until just tender enough to be pureed or mashed. A microwave oven can also be used to initially cook these foods. Avoid excessive cooking of vegetables and fruits in order to limit destruction of vitamins. After cooking is finished, the food should be allowed to cool slightly (10 to 15 minutes). Then it can be pureed or mashed with liquid until it reaches the desired smoothness. Vegetables puree easier in large quantities in a blender or food processor. Previously prepared vegetables or fruits can be reheated before serving on the stove or in a microwave oven. If a microwave oven is used, the food should be allowed to sit for a few minutes, stirred thoroughly, and tested for temperature before serving.
- Examples of vegetables that can be used to make infant foods include: asparagus, broccoli, brussel sprouts, cabbage, carrots, cauliflower, collard greens, green beans, green peas, green peppers, kohlrabi, kale, plantain, potatoes, spinach, summer or winter squash, and sweet potatoes. However, watch the infant for reactions after feeding any of these as new foods. Do not feed home-prepared spinach, beets, turnips, carrots, or collard greens, which are high in nitrates, to infants under 6 months old. See page 109 for more information concerning nitrate-containing vegetables.
- These fresh fruits can be mashed (after peeling) without cooking if ripe and soft: apricots, avocado, bananas, cantaloupe, mango, melon, nectarines, papaya, peaches, pears, and plums. Stewed pitted dried fruits can be pureed or mashed. Apples, pears, and dried fruits usually need to be cooked in order to puree or mash them easily. Watch the infant for reactions after feeding any of these fruits as new foods.

- It is not necessary to add salt, sugar, syrups, oil, butter, margarine, lard, or cream to vegetables and fruits prepared for an infant. Honey should never be added to an infant's foods because of the risk of infant botulism. See page 113 for more information concerning honey.

Meats, Poultry, and Fish

Recommended guidelines for the preparation, use, and storage of meats, poultry, and fish for infant food include the following:^{34, 35, 36, 37}

- **Food storage** – Meats, poultry, and fish should either be stored in a refrigerator or cooked as soon as possible after purchase. These foods should not be allowed to sit out at room temperature. Store these uncooked foods in the coldest part of the refrigerator and prepare them quickly. Cook or freeze fresh poultry, fish, ground meats, and variety meats (like tongue or other organs) within 2 days; other beef, veal, lamb, or pork should be cooked or frozen within 3 to 5 days.
- **Thawing foods** – If bought frozen, thaw meat, poultry, and fish in a refrigerator, submerged in a leak-proof bag in cold water which is changed every 30 minutes, or in a microwave oven. If thawed in a microwave oven, cook immediately. Do not thaw these foods on a kitchen counter or in standing room temperature or hot water; bacteria grow rapidly as food thaws at room temperature.
- **Reduce the risk of contamination of other foods** – To avoid bacterial contamination of other foods, do not allow raw or partially cooked meat, poultry, fish, or their juices, to come in contact with other foods or the surfaces, serving plates, or utensils used to serve or prepare other foods. For example, do not use a fork to test a piece of meat, poultry, or fish while cooking and then use the fork to mix a cold vegetable dish. Wash hands well with soap and hot water after touching raw or partially cooked meat, poultry, or fish to avoid contaminating other foods and cooking surfaces. Separate cutting boards should be used for animal foods (i.e., meat, poultry, fish) and non-animal foods (e.g., vegetables, fruits, breads). Regardless of the type of board used, make sure it is thoroughly cleaned with soap and hot water and well rinsed or sanitized with a solution of 1 teaspoon chlorine bleach in 1 quart of water prior to use.
- **Preparation before cooking** – Always wash hands thoroughly before preparing these foods. Remove the fat, skin, and bones from meat, poultry, and fish before cooking. Take particular care in removing all the bones, including small ones, from fish. It is more difficult to find all the bones after cooking; and bacteria from your hands are destroyed by heat if bones are removed before cooking. After cooking, additional tough inedible parts and remaining visible fat can be removed.
- **Cooking guidelines** – Cook meat, poultry, and fish properly and thoroughly to kill any bacteria that might be present in the food and to improve the digestibility of the protein. Color is not a reliable indicator of the safety or doneness of meat, poultry, or fish. *A food thermometer should be used to cook food to the following temperatures:*³⁸
 - Ground meats – 160 degrees Fahrenheit;
 - Ground poultry – 165 degrees Fahrenheit;
 - Beef, veal, and lamb steaks, roasts, and chops – 145 degrees Fahrenheit (medium rare); 160 degrees Fahrenheit (medium)
 - All cuts of fresh pork – 160 degrees Fahrenheit (medium);
 - Whole poultry – 165 degrees Fahrenheit; in the thigh;
 - Egg dishes – 160 degrees Fahrenheit; and
 - Fish – 145 degrees Fahrenheit.
- **The best cooking methods include: broiling, baking or roasting, pan broiling, braising, pot roasting, stewing, or poaching (for fish).** Oven cooking at temperatures below 325 degrees Fahrenheit is not recommended because temperatures below that level may not heat internal parts of the food sufficiently to kill bacteria.
- **Never feed partially cooked or raw animal foods.** Never feed infants partially cooked or raw meat, poultry, or fish because these foods may contain harmful micro-organisms that could cause serious food poisoning. Ground beef may contain the potential serious

bacteria *Escherichia coli* O157:H7.23 While most types of *E. coli* are harmless, this strain produces a toxin that can cause severe bloody diarrhea and abdominal cramps. In infants and children under ⁵, a serious illness called hemolytic uremic syndrome (HUS) may result, leading to kidney failure. Cook pork and lamb until well done to destroy parasites (*Trichinella spiralis* and *Toxoplasma gondii*) that may also be present in these meats. Raw fish may harbor parasites and high levels of bacteria.

- **Preparation after cooking** – After cooking, cut the deboned meat, poultry, or fish into small pieces and puree to the desired consistency. Warm meat is easier to blend than cold meat; chicken, turkey, lamb, and fish are the easiest to puree. Also, meats are easier to puree in a blender or food processor in small quantities. Make sure to clean the blender or food processor thoroughly before using it to make infant food. As an infant's feeding skills mature, meats, poultry, fish, and legumes can be served ground or finely chopped instead of pureed. Caregivers should not add gravy or sauces to the infant's food or masticate (chew) meats before feeding them to the infant (saliva from the caregiver's mouth will contaminate the food with bacteria and dilute its nutrient content).
- **Meats to avoid feeding infants** – Due to their high salt and/or fat content, hot dogs, sausage, bacon, bologna, salami, luncheon meats, other cured meats, fried animal foods, and the fat and skin trimmed from meats are not generally recommended for infants. Hot dogs, bologna, and luncheon meats are also not recommended as they may contain harmful bacteria unless they are heated thoroughly until steaming hot. Lean meat, poultry, and fish are preferable.
- **Storage after cooking** – After cooking, it is very important to either use animal foods immediately or store them in a properly functioning refrigerator (for no longer than 24 hours) or freezer (for no longer than 1 month). Cooked meats held at room

temperature provide the perfect medium for bacterial growth. Discard any meat, poultry, or fish that has been left unrefrigerated for more than 2 hours (1 hour if the temperature is above 90 degrees Fahrenheit), including serving time.

Eggs and Egg-Rich Foods³⁹

- Buy grade AA or A eggs with clean, uncracked shells. Do not buy unrefrigerated eggs.
- Refrigerate eggs in the original carton, preferably in the main section of the refrigerator, which is colder than refrigerator door sections.
- Use eggs within 3 to 5 weeks. Hard-cooked eggs may be eaten for up to 1 week if they have been properly refrigerated.
- Cook eggs thoroughly to kill possible bacteria. Boil eggs until the yolk is firm and not runny, and then separate the yolk from the white. Feed infants only the yolk part. The hard egg yolk can be mashed with some liquid, such as water or infant formula, to the desired consistency. Casseroles and dishes containing eggs should be cooked to a temperature of 160 degrees Fahrenheit but are inappropriate for infants if prepared with whole eggs because of the risk of the infant having an allergic reaction. See page 104–105 for more information regarding food hypersensitivities (allergies) or intolerances.
- Refrigerate eggs or egg-rich foods immediately after cooking or keep them hot. Discard eggs or egg-rich foods if kept out of the refrigerator for more than 2 hours, including serving time.
- Do not feed infants raw or partially cooked eggs or foods that contain them, such as homemade ice cream, mayonnaise, or eggnog. Although most commercial ice cream, mayonnaise, and eggnog are usually made with pasteurized eggs, these products are inappropriate for infants if made with whole eggs because of the risk of the infant having an allergic reaction. See page 104–105 for more information regarding food hypersensitivities (allergies) or intolerances.

Legumes (Dry Beans or Peas) and Tofu

Home-prepared dry beans or peas are more economical and lower in sodium than canned beans. However, if canned beans are used, drain the salty water and rinse the beans with clean water before using. Instructions for cooking dry beans and peas can be found on the package label and in many basic cookbooks.

Tofu (bean curd) can also be mashed and fed to infants. Caregivers should select fresh tofu; i.e., tofu prepared daily if made fresh, or aseptically packaged, water-packed tofu that has not exceeded the expiration date. Aseptically packaged tofu may be shelf stable for up to 9 months. *Fresh or aseptically-packaged tofu that has been opened should be:*⁴⁰

- Stored in the refrigerator immersed in fresh cold clean water. The water should be changed at least every other day;
- Used within 5 to 7 days;
- Discarded if the expiration date has passed;
- Frozen for future use if not consumed within 7 days - to freeze tofu, drain all water, wrap it in plastic, foil, or freezer wrap and store in the freezer for up to 5 months; and
- Cooked for a short time (e.g., boil in clean water for about 5 minutes), then allow to cool before feeding to an infant.

Guidelines for serving and storage of home-prepared infant foods

Recommended guidelines for serving and storage of home-prepared infant foods after cooking and pureeing include:

- If planning to use immediately, serve freshly cooked food to an infant shortly after preparation is completed. Allow the food to cool for a short period (10 to 15 minutes) to avoid burning the infant's mouth. Test the temperature of the food before feeding it to the infant.
- Do not allow freshly cooked foods to stand at room temperature or between 40 degrees and 140 degrees Fahrenheit – the temperature

zone most of the bacteria causing foodborne illnesses thrive in. The temperature in a properly functioning refrigerator should be 40 degrees Fahrenheit or below and can be verified with a refrigerator thermometer.

- Refrigerate or freeze home-prepared foods that will not be eaten immediately after cooking. Discard the foods if left unrefrigerated for 2 hours, including serving time. Remember the concept “If in doubt, throw it out.” That is, if there is any possibility that a perishable food was left unrefrigerated for over 2 hours, discard it. It is not wise to taste the food to see if it is safe because a food can contain disease-producing micro-organisms yet taste normal.
- Use freshly prepared refrigerated food within 48 hours (except meats and egg yolks, which should be used within 24 hours).
- Two easy methods of storing infant food (after it has cooled) in serving-size quantities in the freezer include:
 - **Ice cube tray method** – Pour cooked pureed food into sections of a clean ice cube tray; cover with plastic wrap, a lid, or aluminum foil; and place into the freezer. When frozen solid, the cubes can be stored in a freezer container or plastic freezer bags in the freezer.
 - **Cookie sheet method** – Place 1 to 2 tablespoons of cooked pureed food in separate spots on a clean cookie sheet, cover with plastic wrap or aluminum foil, and place into the freezer. When frozen solid, the frozen food pieces can be stored in a freezer container or plastic freezer bags in the freezer.
- Label and date the bags or containers of frozen food and use them within 1 month. The temperature in a properly functioning freezer should be 0 degrees Fahrenheit or below. Since freezers may be opened regularly, the temperature may not always be 0 degrees Fahrenheit. Freezer temperature can be checked with a special thermometer. If frozen foods start melting or getting soft, this is an indication to have the freezer checked.

- When ready to use the frozen infant food, thaw the desired amount of food in refrigerator or under cold running water. Do not thaw frozen infant food at room temperature. Thoroughly reheat refrigerated or frozen home-prepared infant foods before feeding them to an infant. Reheating is important to kill bacteria, which can grow slowly while a food is in the refrigerator or freezer or during thawing. Test the temperature of the food before feeding it. Discard any uneaten leftover food.
- Do not refreeze infant food. Store thawed food in the refrigerator and use it within 48 hours (24 hours for meats, poultry, or fish) or discard it.

Caregivers should give explicit instructions for warming, feeding, and handling bottles and food before leaving an infant in the care of a babysitter or family member.

Food Preparation Techniques To Lower Choking Risk

You can lower an infant's risk of choking on food by taking the proper precautions. When preparing food for infants, make sure it is in a form that does not require much chewing. *The following preventive preparation techniques are recommended:*

- Cook food until soft enough to easily pierce with a fork.
- Cut soft foods into small pieces (cubes of food not larger than ¼ inch) or thin slices that can easily be chewed.
- Cut soft round foods, such as soft cooked carrots, into short strips rather than round pieces.
- Substitute foods that may cause choking with a safe substitute, such as thinly sliced meat or hamburger instead of hot dogs.
- Remove all bones from poultry and meat and especially from fish.
- Cut small round foods (e.g. grapes, cherry tomatoes, grape tomatoes) in quarters.
- Remove pits and seeds from very ripe fruit and cut the fruit into small pieces.

- Grind or mash and moisten food for young infants.
- Cook and finely grind or mash whole grain kernels of wheat, barley, rice, etc., before feeding to an infant. Do not feed infants raw or cooked whole grain kernels (i.e., grains in the whole form).

Reducing Lead Exposure from Food

To reduce an infant's possible exposure to lead from foods, these guidelines are recommended.⁴¹

- Do not feed the infant any canned imported foods or beverages – these cans may have lead seams (lead in seams can enter the food).
- In preparing, cooking, storing, or serving foods for an infant:
- Avoid using ceramic ware or pottery, especially if imported from another country, for cooking or storing food or beverages;
 - Do not use leaded crystal bowls, pitchers, or other containers to store foods or beverages;
 - Never cook or store foods in antique or decorative ceramic or pewter vessels or dishes;
 - Do not use antique utensils for preparing or serving foods; and
 - Store foods or beverages in plastic or regular glass containers.

Commercially Prepared Infant Food

Commercially prepared infant foods are safe, sanitary, and nutritious alternatives for a caregiver to use when not preparing an infant's foods at home. Infant food is available in jars or plastic tubs of varying sizes. If refrigeration is not available to a caregiver, the smallest size infant food containers should be selected and any leftover food should be discarded.

In general, single-ingredient foods are preferred over combination foods or dinners. When introducing infants to complementary foods, caregivers should introduce single-ingredient

foods initially to determine the infant's acceptance to each food before combining different ingredients. Combination foods or dinners are more expensive ounce for ounce and usually have less nutritional value by weight than single-ingredient foods. Older infants who are ready for foods with a chunkier texture can be shifted to mashed or finely chopped home-prepared foods instead of infant food combination dinners. It is not necessary to feed infant food desserts such as puddings, custards, and cobblers, which contain added sugar. Infants can be fed more nutritious and naturally sweet foods such as plain fruit as a dessert.

Encourage caregivers to read the ingredient list on the food label of infant foods. Ingredients are listed on the label in order of those present in the largest amount to the smallest amount. The label can help the caregiver determine important information such as, which infant foods have more food and less water than others or which contain no added sugar and salt.

Selection, Serving, and Storage of Commercially Prepared Infant Foods

Advise caregivers to use these safety guidelines when selecting commercially prepared infant foods:

- **Avoid sticky or stained jars/containers.** Sticky or stained jars/containers of infant food may be cracked, exposing the food to bacteria, or have glass particles on them from being packed with other cracked jars.
- **Observe “use-by” dates for purchase and pantry storage of unopened infant food.** If the date has passed, do not use the food.
- **Discard jars with chipped glass or rusty lids.**
- **Wash or wipe off the jar or container of infant food before opening.**
- **Check the container's vacuum seal.** Infant food jars have a button or depressed area in the center of the lid, which is an indicator of whether the vacuum seal has been broken. Do not select or use any jar of infant food with the vacuum seal already broken (the button popped out). A popping or “whoosh” noise should be heard when the vacuum seal

is broken. To facilitate opening the jar, run it under warm water for a few minutes. Do not tap the jar lid with a utensil or bang it against a hard surface; this could break glass chips into the food. If a grating sound is heard when opening the jar lid, check if there are any glass particles under the lid. Also, always examine the food for any abnormal particles (glass, etc.).

These safety guidelines are important to remember when serving and storing commercially prepared infant foods:

- **Serve food from a bowl.** Do not feed infant food directly from jars or containers. Infants usually do not finish a container of infant food in one feeding. If a spoon used for feeding is put back into the container, the infant's saliva could cause subsequent contamination and spoil the remainder of the food. It is preferable to remove the desired amount of food from the container using a clean spoon and put it into a bowl for serving.
- **Discard leftover food.** Always discard any leftover food in a bowl and do not put it back into the container.
- **Immediately store an opened jar of unused food and use it quickly.** After a container of infant food is opened, immediately store it in a refrigerator and use the food within 48 hours, except for infant food meats and egg yolks, which should be used within 24 hours. If not used within these time periods, discard the food.
- **Do not microwave containers of infant food.** Even though the label on some infant food containers indicates that they can be heated in a microwave, this is not recommended because the food may be heated unevenly and some parts of the food may burn the infant's mouth. Instead, remove food from the container; heat it until it is warm on a stove, in a food warmer, or in a microwave oven. Then stir it and test its temperature before feeding. If a microwave oven is used to heat food removed from a container, let the food sit for a few minutes, stir thoroughly, and test its temperature.

Food Safety Resources

The U.S. Department of Agriculture (USDA) operates a toll-free Meat and Poultry Hotline to address specific food safety concerns. The Hotline is staffed by both English-speaking and Spanish-speaking food safety specialists who can address questions on topics such as proper food handling, how to tell if a particular food is safe to eat, and how to better understand food labels. The nationwide toll-free number is 1-888-MPHotline (1-888-674-6854) or for the hearing impaired (TTY) 1-800-256-7072; to talk with a food safety specialist directly, call between 10 a.m. and 4 p.m. Eastern Standard Time (EST), Monday through Friday. At other times, callers have access to an extensive selection of prerecorded messages on food safety. Information can also be accessed on the U.S. Department of Agriculture's Food Safety and Inspection Service Web site at <http://www.fsis.usda.gov/> hundreds of publications for consumers are available on the Web site. Consumers can also email questions to mpholine.fsis@usda.gov. The local Cooperative Extension Service office, listed in the phone book under county government, is also an excellent source of food safety information as are State environmental health agencies or programs.

Practical Aspects of Feeding Complementary Foods

This section reviews appropriate methods to use when feeding complementary foods to an infant, approximate amounts of the different foods to feed, how and when to feed using a cup, appropriate positioning of an infant, equipment to use in feeding complementary foods, and information on choking prevention. The information in this section is designed for the healthy full-term infant. Developmentally delayed infants may require special seating, feeding utensils, bowls, and feeding methods. These infants should be referred to a health care provider.

General Guidelines for Feeding Complementary Foods

Wash an infant's hands before eating. Caregivers should wash an infant's hands and face frequently and especially before he or she eats. An infant's hands can pick up harmful micro-organisms, lead paint dust, etc., which may be consumed during eating if not washed away.

Position the infant appropriately. To feed an older infant safely, the infant should be sitting straight up in a comfortable high-chair (or similar chair) and be secured in the chair. This practice reduces the risk that the infant will choke on the food or fall out of the chair. An infant who is lying down with food or eating while playing, walking, or crawling can easily choke. The caregiver should sit directly in front of the infant while feeding him or her.

Feed the infant using a spoon. The most appropriate method of feeding pureed or mashed foods to infants is using a spoon. Some caregivers may add cereal or other foods to the bottle. However, the practice of feeding complementary foods using a bottle is inappropriate for these reasons:

- **It replaces breast milk or infant formula in the infant's diet with food that may not be needed to meet nutritional requirements.**
- **The infant is taught to eat complementary foods incorrectly.** Often the bottle is used to start an infant on complementary foods before he or she is developmentally ready to eat those foods from a spoon. Infants benefit developmentally from the experience of eating from a spoon. Different tongue and lip motions are involved in sucking from a nipple than for eating from a spoon.
- **An infant may choke more easily.** Often, when cereal is fed in a bottle, the nipple hole will be cut larger. A wider nipple allows the liquid and cereal or other food to flow through faster, which promotes choking.

For similar reasons, “infant feeders” are not recommended for feeding infants. An infant feeder is a hard plastic receptacle with a spout at one end and a plunger at the other end. It allows a caregiver to push a slurry of liquid mixed with food into an infant’s mouth.

Note: A health care provider may recommend the addition of infant cereal to a bottle for infants or children with certain types of medical conditions (such as gastroesophageal reflux).²⁶ This practice should not be followed unless specifically recommended by the infant’s health care provider.

Using a spoon, bowl, and fingers for eating.

Feed a young infant with a small spoon that easily fits into his mouth, and place the food in a small plastic unbreakable bowl or dish with edges that are not sharp. Spoons should be made of unbreakable material that will not splinter if the infant bites them. However, infants should be permitted to “explore” their food with their hands as they get older; by doing so they will have an easier time learning to feed themselves. Although a spoon and bowl may be used for the older infant, it is appropriate to allow these infants to pick up food and eat it with their fingers. Encourage caregivers to be patient and accept that their infants will make a mess when eating; this is a natural part of learning for an infant. See page 103, Figure 7: How Recommended Sequence of Introducing Foods Corresponds With Food Textures and Feeding Styles.

Recommended Amounts of Complementary Foods

When an infant is ready to begin complementary foods, the caregiver can start with small servings of 1 to 2 teaspoons of individual foods once a day and gradually increase the serving size to 2 to 4 tablespoons or more per feeding. A 4 to 6 month old infant may start out with one meal per day including complementary foods, and then gradually work up to about three meals and two to three snacks per day.

Since an infant’s appetite influences the amount of food eaten on a particular day, there is day-to-day variation in the quantity of food consumed. If fed commercially prepared infant foods, most infants will not be able to finish an entire container of food in one meal. It is not appropriate to encourage or force infants to finish what is in their bowl or to eat a whole container of infant food if they indicate that they are full. Encourage caregivers to let their infants determine how much they eat. Infants indicate that they are interested in consuming additional complementary foods by opening their mouths and leaning forward. They indicate that they are full and satisfied by:

- Pulling away from the spoon
- Turning their heads away
- Playing with the food
- Sealing their lips
- Pushing the food out of their mouths or
- Throwing the food on the floor.

The quantity of food an infant takes varies between infants and from meal to meal or day to day for an individual infant. Infants may want to eat less food when teething or not feeling well and more food on days when they have a very good appetite. The best guide for how much to feed an infant is following his indications of hunger and fullness. See Appendix D for Guidelines to Feeding a Healthy Infant, pages 195–196.

Weaning From a Bottle

Weaning an infant from a bottle to a cup is a gradual process requiring the infant to learn new skills. Some infants learn to drink from a cup more easily than others. To make weaning easier, a cup can be introduced in place of a bottle at the feeding of least interest or at mealtimes when other family members are drinking from cups. Generally, the infant will not consume the same quantity of fluid from a cup as from a bottle at one sitting. Caregivers should try to totally wean their infants off bottles and onto a cup by about 12 to 14 months old.⁴² Those who are still feeding from a bottle after this age may be at risk for early childhood caries (formerly called nursing

bottle caries).⁴² See pages 132–133 for more information regarding early childhood caries.

Drinking From a Cup

Some infants, 4 to 5 months of age, may be able to drink or suck small amounts of liquid from a cup when held by another person. At about 6 months, most infants develop the ability to, with assistance, drink from a cup with some liquid escaping from their mouths. After 8 months old, when infants begin to curve their lips around the rim of a cup, they are able to drink from a cup with less spilling. Reassure caregivers that spills and some mess normally occur as an infant learns to use a cup, and that maintaining patience during this time is important.

Caregivers can help their infants learn how to drink from a cup by:

- Introducing small amounts (1 to 2 ounces) of infant formula, breast milk, pasteurized 100 percent juice, or water in a “baby-sized” regular plastic cup. Cups with spill-proof lids (sippy cups) are not recommended since they may encourage the infant to carry the cup and drink more often. Frequent sips of infant formula or juice put children at higher risk for developing early childhood caries. The American Academy of Pediatric Dentistry recommends avoiding frequent, repetitive consumption of any liquid containing fermentable carbohydrates (such as infant formula, milk, juice, or sweetened beverages) from a bottle or no-spill training cup.⁴² See pages 131–136 for more information regarding oral health and early childhood caries.
- Holding the cup for the young infant; and
- Feeding very slowly; i.e., tilting the cup so that a very small amount of liquid (one mouthful) leaves the cup; then, the infant can swallow without hurry.

Choking Prevention

Choking is a major cause of fatal injury in infants and young children. Food items are associated with approximately 40 percent of fatal choking

incidents and approximately 60 percent of nonfatal choking episodes in children.⁴³ Candy and chewing gum are the foods most often implicated. Normally when eating, the airway to the lungs is blocked off as food passes to the esophagus on its way to the stomach. This prevents food from passing into the airway. However, in infants or young children, choking can occur more easily because the airway is not always blocked off properly when swallowing, allowing food to enter the airway and prevent breathing. Choking may also occur when food is inhaled directly into the airway. To avoid the risk of an infant choking, only foods that can be easily dissolved with saliva and do not require chewing should be fed to infants.

Since choking can occur anywhere and anytime an infant is eating, strongly encourage caregivers to do the following:

- Use correct feeding (see pages 122-123) and food preparation techniques (see pages 115–120).
- Feed small portions and encourage infants to eat slowly.
- Avoid teething pain medicine before meals since this may anesthetize the mouth.
- Maintain a calm atmosphere during eating time (i.e., avoid too much excitement or disruption during eating).
- Avoid eating in the car since the driver cannot assist a choking infant and may be the only adult in the car.
- Closely supervise mealtimes.

Certain eating behaviors increase an infant’s risk of choking on food and should be avoided.

These include:

- Propping a bottle in an infant’s mouth;
- Feeding using a bottle with a nipple with a large hole;
- Feeding complementary foods to an infant who is not developmentally ready for them;
- Feeding an infant too quickly;
- Feeding an infant while he is lying down, walking, talking, crying, laughing, or playing;
- Feeding difficult-to-chew foods to infants

- with poor chewing and swallowing abilities;
- Feeding complementary food to an older infant without close supervision; and
- Feeding foods that may cause choking.

A food's potential to cause choking is usually related to one or more of the following characteristics:

- **Size** – Both small and large pieces of food may cause choking. Small hard pieces of food (such as nuts and seeds, small pieces of raw hard vegetables) may get into the airway if they are swallowed before being chewed properly. Larger pieces may be more difficult to chew and are more likely to completely block the airway if inhaled.
- **Shape** – Food items shaped like a sphere or cylinder may cause choking because they are likely to block the airway more completely than other shapes. Some examples are whole grapes, hot dog-shaped products (including meat sticks and string cheese), and round candies.
- **Consistency** – Foods that are firm, smooth, or slick may slip down the throat. Some examples are whole grapes, nuts, hard candy, hot dog-like products, string cheese, large pieces of fruit with skin, whole pieces of canned fruit, and raw peas. Dry or hard foods may be difficult to chew and easy to swallow whole. Some examples are popcorn, nuts and seeds, small hard pieces of raw vegetable, cookies, pretzels, and potato chips. Sticky or tough foods (e.g., peanut butter, dried fruit, tough meat, sticky candy) may not break apart easily and may be hard to remove from the airway.

In summary, the following foods are not recommended for infants because they are associated with choking:

- Tough or large chunks of meat;
- Hot dogs, meat sticks or sausages;
- Fish with bones;
- Large chunks of cheese, especially string cheese;

- Peanuts or other nuts and seeds;
- Peanut and other nut/seed butters;
- Whole beans;
- Cooked or raw whole-kernel corn;
- Whole uncut cherry or grape tomatoes;
- Raw vegetable pieces (e.g., carrots, green peas, string beans, celery, etc.) or hard pieces of partially cooked vegetables;
- Whole (uncut) grapes, berries, cherries or melon balls, or hard pieces of raw fruit;
- Whole pieces of canned fruit (cut them up instead);
- Fruit pieces with pits or seeds;
- Uncooked raisins and other dried fruit;
- Plain wheat germ;
- Whole grain kernels;
- Popcorn;
- Potato/corn chips and similar snack foods;
- Pretzels;
- Hard candy, jelly beans, caramels, or gum drops/gummy candies;
- Chewing gum; and
- Marshmallows.

The American Heart Association (<http://www.americanheart.org/>) American Lung Association (<http://www.lungusa.org/>), and the American Red Cross (<http://www.redcross.org/>) all conduct classes and provide training and educational materials on first aid, choking prevention and emergency treatment and cardiopulmonary resuscitation (CPR). Information on classes held locally can be found on their websites. The American Heart Association has a wall poster entitled “Heartsaver First Aid for the Choking Infant” (#70-2283) appropriate for posting in offices or waiting rooms, with description and illustration of emergency treatment. It is available for purchase by phone 1-800-611-6083 or through their Web site at <http://www.americanheart.org/presenter.jhtml?identifier=3026000>. The AAP also has a pamphlet on first aid, choking, and CPR which can be ordered on their Web site (<http://www.aap.org/>) or may be available from a local pediatrician.

References:

1. Complementary Feeding. In: Kleinman RE, editor. *Pediatric Nutrition Handbook*. 5th ed. Elk Grove Village, IL: AAP; 2004: 103-115.
2. Dietz WH, Stern L. *AAP Guide to Your Child's Nutrition: Making peace at the Table and Building Healthy Eating Habits for Life*. New York: Villard Books; 1999.
3. Committee on Nutrition, AAP. On the feeding of supplemental foods to infants. *Pediatrics* 1980;65:1178-1181.
4. Satter E. *Child of Mine: Feeding With Love and Good Sense*. Boulder, CO: Bull Publishing Company; 2000.
5. Crocetti M, Dudas R, Krugman S. Parental beliefs and practices regarding early introduction of solid foods to their children. *Clinical Pediatrics* 2004;43(6):541-547.
6. Bronner YL, Gross SM, Caulfield L, Bentley ME, Kessler L, Jensen J, et al. Early introduction of solid foods among urban African-American participants in WIC. *Journal of the American Dietetic Association* 1999;99:457-461.
7. Goldberg DL, Novotny R, Kieffer E, Mor J, Thiele M. Complementary feeding and ethnicity of infants in Hawaii. *Journal of the American Dietetic Association* 1995;95(9):1029-1031.
8. Blum-Kemelor DM. *Feeding Infants: A Guide for Use in the Child Nutrition Programs* Alexandria, VA: U.S. Department of Agriculture, Food and Nutrition Service; 2001.
9. Butte NF, Cobb K, Graney L, Heird WC, Rickard KA. The Start Healthy Feeding Guidelines for Infants and Toddlers. *Journal of the American Dietetic Association* 2004;104:442-454.
10. Food Sensitivity. In: Kleinman RE, editor. *Pediatric Nutrition Handbook*. 5th ed. Elk Grove Village, IL: AAP; 2004:593-607.
11. Lawrence RA, Lawrence RM. *Breastfeeding: A Guide for the Medical Profession*. 6th ed. Philadelphia, PA: Mosby, Inc., 2005.
12. Sullivan SA, Birch LL. Pass the sugar, pass the slat: Experience dictates preference. *Developmental Psychology* 1990;26(4):546-551.
13. Birch LL, Gunder L, Grimm-Thomas K. Infants' consumption of a new food enhances acceptance of similar foods. *Appetite* 1998;30:283-295.
14. Mennella J, Griffin CE, Beauchamp G. Flavor programming during infancy. *Pediatrics* 2004;113(4):840-845.
15. Gerrish C, Mennella J. Flavor variety enhances food acceptance in formula-fed infants. *American Journal of Clinical Nutrition* 2001;73:1080-1085.
16. Mennella J, Beauchamp G. Mother's milk enhances the acceptance of cereal during weaning. *Pediatric Research* 1997;41(2):188-192.
17. Sullivan SA, Birch LL. Infant dietary experience and acceptance of solid foods. *Pediatrics* 1994;93(2):271-277.
18. Mennella J, Jagnow CP, Beauchamp G. Prenatal and postnatal flavor learning by human infants. *Pediatrics* 2001; 107(6):e88. Available from <http://www.pediatrics.org/cgi/content/full/107/6/e88>.

19. Institute of Medicine of the National Academies, Food and Nutrition Board. WIC Food Package: Time For A Change. Washington, DC: National Academy of Sciences; 2006.
20. Marshall TA, Levy SM, Broffitt B, Eichenberger-Gilmore JM, Stumbo PJ. Patterns of beverage consumption during the transition stage of infant nutrition. *Journal of the American Dietetic Association* 2003;103(10):1350-1353.
21. Committee on Nutrition, AAP. The Use and Misuse of Fruit Juice in Pediatrics. *Pediatrics* 2001;107(5):1210-1213.
22. Lifschitz CH. Carbohydrate Absorption From Fruit Juices in Infants. *Pediatrics* 2000;105(1):e04
23. Centers for Disease Control and Prevention. *Escherichia coli* O157:H7 and drinking water from private wells. 2003 (accessed September 10, 2007). Available at: <http://www.cdc.gov/ncidod/dpd/healthywater/factsheets/ecoli.htm>.
24. US Food and Drug Administration, Center for Food Safety and Applied Nutrition. What consumers need to know about juice safety. 1998 (accessed September 10, 2007). Available at <http://www.cfsan.fda.gov/~dms/juicsafe.html>
25. Committee on Nutrition, AAP. Infant methemoglobinemia: the role of dietary nitrate. *Pediatrics* 1970;46(3):475-478.
26. Shelov SP. AAP Your Baby's First Year. 2nd ed. New York: Bantam Books; 2005.
27. Goldman LR, Shannon MW; The Committee on Environmental Health, AAP. Technical report: mercury in the environment: implications for pediatrics. *Pediatrics* 2001;108(1):197-205.
28. U.S. Department of Health and Human Services and U.S. Environmental Protection Agency. What you need to know about mercury in fish and shellfish. 2004 (accessed September 10, 2007), Available at: <http://www.cfsan.fda.gov/~dms/admehg3.html>.
29. Lanski SL, Greenwald M, Perkins A, Simon HK. Herbal therapy use in a pediatric emergency department population: expect the unexpected. *Pediatrics* 2003;111(5):981-985.
30. Woolf AD. Herbal remedies and children: do they work? Are they harmful? *Pediatrics* 2003;112(1):240-246.
31. Ize-Ludlow D, Ragone S, Bruck IS, Bernstein JN, Duchowny M, Garcia Pena BM. Neurotoxicities in infants seen with the consumption of star anise tea. *Pediatrics* 2004;114(5):e563. Available from <http://pediatrics.aappublications.org/cgi/content/abstract/114/5/e653>.
32. Bakerink J, S.M. G, Eldridge M. Multiple organ failure after ingestion of pennyroyal oil from herbal tea in two infants. *Pediatrics* 1996;98(5):944-947.
33. Marshall TA, Levy SM, Broffitt B, Warren JJ, Eichenberger-Gilmore JM, Burns TL, et al. Dental caries and beverage consumption in young children. *Pediatrics* 2003; 112(3):e184-e191. Available from <http://pediatrics.aappublications.org/cgi/content/full/112/3/e184>.
34. Food Safety and Inspection Service, U.S. Department of Agriculture. Basics for Handling Food Safely. 2006 (accessed September 5, 2007) Available at: http://www.fsis.usda.gov/Fact_Sheets/Basics_For_Handling_Food_Safely/index.asp.
35. Food Safety and Inspection Service, U.S. Department of Agriculture. Focus on: chicken. 2006 (accessed September 5, 2007) Available at: http://www.fsis.usda.gov/Fact_Sheets/Chicken_Food_Safety_Focus/index.asp.

36. Food Safety and Inspection Service, U.S. Department of Agriculture. Beef...From Farm to Table. 2003 (accessed September 10, 2007). Available at: http://www.fsis.usda.gov/fact_sheets/Beef_from_Farm_to_Table/index.asp.
37. Food Safety and Inspection Service, U.S. Department of Agriculture. Focus on Ground Beef. 2002 (accessed September 10, 2007). Available at: http://www.fsis.usda.gov/Fact_Sheets/ground_beef_and_food_safety/index.asp.
38. U.S. Department of Agriculture. Temperature Rules! Cooking for Food Service. 2003 (accessed September, 10 2007). Available at: http://www.fsis.usda.gov/oa/thermy/fsposter_alt.htm.
39. Food Safety and Inspection Service, U.S. Department of Agriculture. Egg Product & Food Safety. 2006 (accessed September, 10 2007). Available at: http://www.fsis.usda.gov/fact_sheets/Egg_&_Egg_Product_Safety/index.asp.
40. Soy Foods Association of North America. Tofu. (accessed September, 10 2007). Available at: <http://www.soyfoods.org/products/soy-fact-sheets/tofu/>.
41. Farley D; U.S. Food and Drug Administration. Dangers of lead still linger FDA Cosumer, 1998. Available at: <http://www.cfsan.fda.gov/~dms/fdalead.html>.
42. American Academy of Pediatric Dentistry. Policy on early childhood caries (ECC): classifications, consequences, and preventive strategies. 2007 (accessed September, 10 2007). Available at: http://www.aapd.org/media/Policies_Guidelines/P_ECCClassifications.pdf.
43. Gotsch K, J.L. A, Holmgreen P, Gilchrist J. Nonfatal choking-related episodes among children - United States, 2001. *Morbidity and Mortality Weekly Report* 2002;51(42):945-948.



CHAPTER 6: SPECIAL CONCERNS IN INFANT FEEDING

This chapter will discuss special concerns in feeding infants, including oral health, vegetarian diets, common gastrointestinal problems, and prevention of overweight and obesity. Counseling points related to the information presented in this chapter are found in Chapter 8, pages 176–177.

Oral Health

Tooth decay is the most common chronic childhood disease. It is the most common chronic infectious disease that does not respond to antibiotics and does not heal itself. Good nutrition, use of proper feeding techniques, and careful attention to keeping the mouth and teeth clean are all important for assuring that an infant develops and maintains healthy, strong teeth. Infants from low-income families whose mothers have low educational levels and who eat sugar-containing foods have been shown to be 32 times more likely to have dental caries at age 3.¹ Similarly, statistics from the United States Government Accountability Office indicate that children from low-income families are 5 times more likely to have untreated tooth decay and experience 12 times more activity restricted days due to dental problems than children from higher-income families. This section reviews tooth development, dental caries, early childhood caries, dental care for infants, and teething. Refer to pages 26–27 for information regarding fluoride supplementation for infants, as related to preventive dental care.

Tooth Development

The primary teeth and many permanent teeth begin forming inside the jawbones before birth. The primary teeth, which erupt over the first 2½ years of the infant's life, are important as are the permanent teeth that follow. The primary teeth are critical for chewing and eating food, normal development of the jaw bones and muscles, proper placement of the permanent teeth, the appearance of the face, and proper speech development. The first primary teeth to

erupt are the central and lateral incisors (the front four teeth on the lower and upper sections of the mouth). The first teeth may erupt at about 6 months old or later. Since the primary teeth are not fully replaced by permanent teeth until a child is 12 to 14 years old, keeping them healthy and intact during this period is of particular importance.

The nutrients necessary for proper tooth development include protein and the minerals calcium, phosphorus, and fluoride. Protein provides the foundation for the teeth and the minerals are deposited in this foundation to form a hard tooth structure. Fluoride, when incorporated during tooth development and after the teeth erupt, makes tooth enamel significantly more resistant to the acid attack that produces dental caries. Thus, a nutritionally adequate diet, along with adequate fluoride, is important for both the development and maintenance of healthy, strong teeth. Yet, even if a nutritious diet is consumed, as soon as any of the primary teeth begin to appear, they can decay under certain conditions.

Dental Caries (Tooth Decay)

Three variables contribute to the development of dental caries – susceptible teeth, specific bacteria in the mouth, and fermentable carbohydrates (sugars and starches). Tooth decay begins when fermentable carbohydrates from food or beverages are metabolized to organic acids by bacteria, primarily *Streptococcus mutans* (*S. mutans*), in the mouth. The *S. mutans* bacteria that normally live in the mouth adhere to the tooth surfaces and form dental plaque, the sticky, colorless material that accumulates around and between the teeth and gums and in the pits and grooves of the chewing surfaces of the teeth. The sticky plaque enables the bacteria and the acids they produce to remain on the tooth surface instead of being washed away by saliva. The longer plaque is allowed to stay undisturbed on the tooth surfaces, the greater is the likelihood that the bacteria will

produce acids from carbohydrates. The acids demineralize or destroy the enamel on teeth and create dental caries.

If any of the primary teeth are lost prematurely to decay, surrounding teeth can move into the empty space. Then, permanent teeth may erupt not having sufficient room to be placed properly. They will then come in crooked, making them more difficult to clean and thus more susceptible to decay. Proper feeding practices, appropriate fluoride intake, and regular care of an infant's teeth help to prevent dental caries from occurring.

Evidence indicates that the primary source of *S. mutans* in the mouth of infants is their mother's saliva.² *S. mutans* is transferred from mother to infant or child (through shared eating utensils or toothbrushes) and increases the risk of the child developing dental caries, especially if a mother has untreated dental caries.² *For this reason, it is advisable for mothers or other intimate caregivers to do the following:*²

- Avoid exposing their infant or child to their saliva by sharing eating utensils or toothbrushes, cleaning a dropped spoon or pacifier with their saliva, or chewing food themselves and then feeding it to their infants.
- Take care of their mouths with regular toothbrushing, flossing, and dental care.
- Use fluoridated toothpaste and rinse daily with a fluoridated mouth rinse.
- Avoid or limit foods that promote development of dental caries. The American Academy of Pediatrics (AAP) recommends that if infants must consume fruit juice parents offer pasteurized 100 percent fruit juice to their infants only at meals and avoid offering all carbonated beverages until the infant is 30 months old.³
- Use of xylitol-containing chewing gum by mothers has been associated with a decrease in the development of caries in their child by reducing the mother-child transmission of *S. mutans*.⁴
- Obtain treatment for any existing dental caries.

Early Childhood Caries (Nursing Bottle Caries or Baby Bottle Tooth Decay)

Early childhood caries (formerly called nursing bottle caries or baby bottle tooth decay) is a specific form of severe tooth decay of an infant's primary teeth.

*Severe dental caries of this type are characterized by these distinguishing features:*²

- Begin soon after tooth eruption
- Progress rapidly
- Decay occurs on smooth surfaces, generally considered to be at low risk of decay. In the case of early childhood caries, the decay is usually seen on the four maxillary incisors (the upper four front teeth) – these teeth are among the first to erupt and are bathed in liquids first while the lower teeth are protected in part by the infant's tongue. As the decay progresses, these teeth become brown or black and may be completely destroyed. If inappropriate practices continue, the other teeth may also undergo similar decay and
- Have a lasting harmful affect on dentition throughout childhood.⁵ The impact of early childhood caries is seen in increased hospitalizations and emergency room visits, increased treatment time and costs, poor growth, increased school absence or activity restriction, and poor learning ability.

Early childhood caries develop when bacteria is present and an infant's teeth are bathed in liquids containing fermentable carbohydrates (such as infant formula, other milks, fruit juice, sweetened water, or other sweetened beverages) for prolonged periods of time during the day or night.² Taking a bottle of these liquids to bed should be discouraged. Decreased cleaning movements of the tongue and lower production of saliva (resulting in reduced cleansing of the teeth) during sleep contribute to the development of caries, as does extended and repetitive use of a no-spill “tippy” training cup. Breastfed infants may also be vulnerable to early childhood caries. Breastfeeding mothers should be alerted to the need for oral hygiene after feedings, especially

when the infant's first teeth have begun to emerge. See Figure 9, page 135, which illustrates healthy teeth and cases of early childhood caries.

Prevention of Early Childhood Caries

To prevent early childhood caries and caries development in general, these steps are recommended:

- Use bottles for feeding iron-fortified infant formula or expressed breast milk. Do not feed juice or sweetened beverages in a bottle.
- Feed pasteurized 100 percent fruit juice only in a cup. Drinking from a cup will be messy at first. Be patient and allow the infant to learn this skill.
- Feed bottles of infant formula or breast milk to the infant only at feeding time; do not allow an infant to suck on a bottle while sleeping (i.e., bedtime or naptime). If an infant should fall asleep during a feeding, move the infant around slightly to stimulate swallowing before putting him or her down to sleep.
- Do not feed sweetened beverages to infants in either a bottle or a cup. These beverages include: water sweetened with sugar or honey (honey should never be fed to infants because of the risk of contamination with *Clostridium botulinum* spores – See page 113); soda; sweetened iced tea; fruit drinks, punches, or ades; sweetened gelatin or other sweetened drinks. Infants should be fed nutritious beverages that will help them grow, such as breast milk or infant formula (pasteurized 100 percent fruit juice can be fed but in small amounts). If your infant is having diarrhea, contact your health care provider for advice on what to feed him to eat and drink.
- Do not allow the infant to walk around or sit alone (e.g., playpen) with a bottle or spill-proof cup for extended periods.
- Avoid adding sweeteners to the infant's food or feeding the infant concentrated sweet foods such as lollipops, sweet candies, candy bars, sweet cookies or cakes, or sweetened cereals.
- Never give the infant a pacifier dipped in honey (honey should never be fed to infants because of the risk of contamination with *Clostridium botulinum* spores – See page

113), syrup, sugar, or other sweetened substance.

- Gradually begin shifting bottle feedings to cup feedings anytime between 6 and 12 months old. As an infant advances from a bottle to a cup, the infant's chances of developing early childhood caries are reduced. Strongly encourage caregivers of healthy, full-term infants to wean their infants from a bottle to a cup by about 1 year of age.
- Follow the advice of your medical or dental health care provider regarding the infant's fluoride needs.
- Clean the infant's teeth regularly (See pages 133-134 for recommended steps to follow to keep an infant's teeth clean).

The best approach to help a caregiver improve or correct improper bottle feeding practices is to offer practical alternatives. *For example, if an infant has become accustomed to a bottle in bed or a sweetened pacifier, suggest that the caregiver try the following alternatives:*

- Demonstrate love for her child, not with the bedtime bottle or sweetened pacifier, but rather by using a security blanket or teddy bear, singing or playing music, holding or rocking her child, or reading a story to her child.⁶
- Shift a bedtime bottle feeding to 1 hour before the bedtime or naptime.
- Give a plain pacifier only.

Caring for an Infant's Mouth and Teeth

Because the primary teeth are susceptible to decay as soon as they erupt, it is essential that care of the teeth and gums begin in early infancy.

The following steps are recommended to keep the teeth clean and prevent dental caries:^{3, 2}

- Before teeth appear, clean your infant's mouth beginning from the first day of life. Wipe out the mouth gently and massage the gums with a clean damp gauze pad or washcloth after feedings or at least twice a day, including before bedtime. More frequent cleaning may be recommended by a health care provider.

- Begin cleaning the infant's teeth as soon as they appear through the gums. Teeth should be brushed or wiped with a soft, clean washcloth twice a day (morning and evening). A very small, child-size toothbrush with soft, rounded-end bristles may be used with extreme care. Continue using a clean gauze pad or washcloth to clean those areas in the mouth without teeth. More frequent cleaning may be recommended by a health care provider, especially if there are beginning signs of tooth decay. Caregiver should check with their health care provider regarding the use of toothpaste.
- After teeth erupt, 100 percent, pasteurized fruit juice can be offered in limited amounts and preferably during meals. Carbonated beverages should be excluded. Frequent or excessive consumption of liquid should be discouraged. After a meal, the infant's mouth should be wiped with a damp cloth.
- Infants and children should have exposure to optimal levels of fluoride through the water supply or appropriate supplements. See Chapter 1, pages 26–27 for guidelines regarding fluoridation.

Dental Care

To assure that any dental problems are discovered and treated before becoming serious problems, the American Academy of Pediatric Dentistry (AAPD) and AAP recommend that infants receive an oral health risk assessment by a qualified pediatric health care professional by 6 months of age.³ Those infants at significant risk of developing dental caries should be evaluated by a dentist between 6 and 12 months. Infants should be taken for their first dental visit by 12 months of age.⁷

*During early dental checks, a dentist or health care provider can:*⁸

- Examine the teeth for decay, demineralization, plaque, or gingivitis;
- Evaluate environmental factors that contribute to the development of caries including fluoride exposure, consumption of

simple sugars or foods strongly associated with caries, socioeconomic status of the caregiver, and regular use of dental care; and

- Evaluate general health conditions, including those of children with special health care needs.

Other health care providers can provide appropriate anticipatory guidance to establish good oral health.⁹ Infant dental checks should be seen as the beginning of a life of regular dental care that prevents a child from experiencing the negative effects of dental disease. If an infant or child seems to have dental problems or decay at any time, refer him or her to a medical or dental health care provider as soon as possible. If left untreated, dental caries can become very serious, possibly requiring the extraction of teeth at a very early age.

Teething

Teething occurs when the erupting primary teeth make an infant's gums sore or tender. Caregivers may notice that, during teething, the infant's gums are red and puffy and may see or feel the emerging tooth.

Some methods of alleviating an infant's discomfort when teething include:

- Chilling a clean favorite rattle, teething ring, pacifier, or a spoon in the refrigerator and offering it to the infant to chew on; and
- Cleaning the infant's mouth 2 to 3 times per day with a damp clean gauze pad or washcloth.

It is not recommended to give an infant hard, raw vegetables like carrots or ice chips to chew on (they can choke on these) or to rub brandy or other alcoholic beverages on the teeth. Even small amounts of an alcoholic beverage can have adverse effects on infants. It is not advisable to give infants teething pain relief medicine before mealtime because it may interfere with chewing.

Figure 9:
Examples of Healthy Teeth and Early Childhood Caries

Photograph of Healthy teeth



Photographs below show teeth with mild to severe cases of early caries



Photographs courtesy of: Dr. Norman Tinoff, DDS, MS, Professor, University of Connecticut Health Center, School of Dental Medicine, Department of Pediatric Dentistry, Farmington, Connecticut

Resource materials on oral health for infants and young children include:

- National Maternal and Child Oral Health Resource Center
<http://www.mchoralhealth.org>
- WIC Works Resource System http://www.nal.usda.gov/wicworks/Topics/Oral_health.html

Vegetarian Diets

Families or individuals choose vegetarian diets for religious, philosophical, economic, ecological, health, or personal reasons. A vegetarian diet is generally defined as a diet that includes primarily or only plant foods (i.e., fruits, vegetables, legumes, nuts and seeds, and grains) and excludes certain or all animal foods (e.g., meats, poultry, fish, eggs, and dairy products).

Classifications of Vegetarian Diets

Vegetarian diets have been classified into the following subdivisions, based on the types of animal foods included in the diet. Within each classification, there may be variations of the food eaten. *The various classifications of vegetarian diets are listed as follows:*

- **Lacto-vegetarian diet** – plant foods and dairy products;
- **Lacto-ovo-vegetarian diet** – plant foods, dairy products, and eggs;
- **Semi-vegetarian diet** – plant foods and may include dairy products, eggs, fish, and/or poultry;
- **Vegan diet** – plant foods only and no foods from animal sources at all. This diet can place an infant's health and nutritional status at risk if not carefully planned;
- **Macrobiotic diet** – unpolished rice and other whole grains, legumes, seaweed, fermented foods, nuts and seeds, vegetable oils, fruits and vegetables, fish, and occasionally red meat if caught in the wild; this diet includes various stages of increasingly severe dietary restriction that excludes some of these foods. Generally, dairy products, red meat, and poultry are excluded from this diet. This diet can be dangerous to the health of infants and children; and

- **Fruitarian** – fruits, nuts and seeds, fermented cereals, olive oil, and honey. This diet can be very dangerous to the health of infants and children.

Adequacy of Vegetarian Diets

Most infants are on a lacto-vegetarian diet (milk/cereal/vegetables/fruit) during the first 4 to 6 months of life, with no risk to their health. For an infant whose caregiver desires a vegetarian diet, breast milk or soy-based infant formula alone provides adequate nutrition for approximately the first 6 months. Growth of infants fed soy-based infant formula is comparable to growth of infants fed breast milk or cow's milk-based infant formula. The AAP has indicated soy-based infant formula is appropriate for infants whose caregivers are seeking a vegetarian diet.¹⁰ Little data is available on the growth of older infants maintained on a vegetarian diet; there is some indication that growth rates may be slower early in childhood, but catch up in later childhood.^{11,12} Both the AAP and the American Dietetic Association (ADA) have stated that vegan diets can meet the needs of older infants if attention is paid to specific nutrients.^{13,14}

Risks of Some Vegetarian Diets

As vegetarian diets become more restrictive, the nutritional and health risks of vegetarian diets for infants increase. Infants of any age on a restrictive vegetarian diet, such as macrobiotic or fruitarian, are placed at significant risk for growth abnormalities, serious nutritional deficiencies, and health problems. Inadequate vegetarian diets may lead to failure to thrive, iron deficiency anemia, megaloblastic anemia due to lack of vitamin B12, (which is often masked by high folic acid levels, which may lead to eventual neurologic problems), and vitamin D deficiency rickets. *In working with caregivers of infants on restrictive vegetarian diets, it is appropriate to:*

- Inform the caregivers about the limits and potential detriments of restrictive diets;
- Discourage use of very restrictive vegetarian diets;
- Refer the infant to a health care provider for a medical evaluation and advice on supplementation if the caregiver decides to keep the infant on a restrictive diet; and

- Provide nutrition assessment and initial and follow-up nutrition counseling (if a caregiver decides to keep his or her infant on a vegan diet).

Guidelines for Nutrition Counseling

In providing nutrition counseling to caregivers of infants on vegetarian diets, these guidelines are recommended:

1. Assess the diet for adequacy, including nutritional deficiencies and excesses, and determine if the diet is appropriate for the infant's developmental level.
 2. Discuss with the caregiver the appropriate amounts and types of foods needed to supply adequate energy, protein, vitamins, and minerals. Be mindful that the dietary preferences of vegetarian clients may be based on deeply held beliefs and cultural food habits. Work with the caregiver at initial and follow-up nutrition counseling sessions to assure that the diet is nutritionally adequate. Adequacy of these nutrients should be closely evaluated:
- **Energy content** – Since many vegetable- and cereal-based foods have a low-energy and high-fiber content, an infant's foods need to be chosen wisely to assure that sufficient kilocalories and nutrients can be consumed daily. Although a small amount of fiber in an infant's diet should not be harmful, a high-fiber diet tends to fill an infant's stomach and limit the amount of foods the infant can physically consume during meals. Vegan infants are most vulnerable to inadequate energy intake during the weaning period; providing some refined grain products, peeled fruits and vegetables, and fruit juice can help provide adequate calories without adding significant fiber.¹² A high-fiber diet can also reduce the availability of the minerals, iron, calcium, and zinc from foods in the diet. Thus, encourage caregivers to select a variety of foods, including those with a moderate- or low-fiber content (e.g., cheese, yogurt, and tofu).

- **Protein** – The protein needs of a lacto- or lacto-ovo-vegetarian infant are easily met if the diet includes sufficient quantities of high-quality protein foods (e.g., yogurt, cheese, egg yolks). A vegan diet must be planned carefully to ensure that a sufficient quality and quantity of protein is provided. Advise caregivers who decide to keep their infants on a vegan diet to:

- Breastfeed or use soy-based infant formula.¹⁵ Soy-based infant formulas are nutritionally balanced. Soy-based beverages (sometimes described as soy drinks or soy milks) or rice beverages (rice milk), sold in grocery and specialty food stores, are grossly lacking in key nutrients needed by infants (calcium, niacin, vitamins D, E, and C) and should not be fed as substitutes for infant formula. Full-fat soymilk may be offered to vegan infants starting at 12 months.¹⁵
- Feed combinations of plant foods (e.g., beans and rice) to infants consuming complementary foods during the course of each day.

Combinations of plant foods to feed during the day that meet the protein needs of the older vegetarian or vegan infant include:

- Cooked, mashed tofu and ground or mashed rice;
 - Iron-fortified infant cereal and soy-based infant formula;
 - Cooked pureed kidney beans with ground or mashed rice, mashed noodles, or a piece of whole-wheat bread; and
 - Other combinations of different legumes and cereal grains (e.g., rice, wheat, barley) prepared with the appropriate texture.
- **Vitamin B12** – Since vitamin B12 is only found in animal foods and some obscure food sources (e.g., nutritional yeast), infants who do not consume animal foods or vitamin B12-fortified foods can develop a deficiency in this vitamin. Thus, assess the diet of any vegetarian infant to determine whether sources of vitamin B12 are included,

either from infant formula or indirectly in the diet of the infant's lactating mother. Caregivers who choose a vegan diet for their infants should be advised to breastfeed or use commercial soy-based infant formula. Since the vitamin B12 content of breast milk is influenced by the breastfeeding mother's diet, a B12 deficiency can develop in an exclusively breastfed infant whose mother is on a vegan diet. Breastfed infants of vegan mothers should receive supplemental vitamin B12 in the amount of 0.4 µg per day up to 6 months of age and 0.5 µg per day beginning at 6 months of age.¹⁶ Alternatively, vegan breastfeeding mothers can consume vitamin B12-fortified foods or take a supplement containing vitamin B12 to ensure that their breast milk has adequate vitamin B12 stores. If a mother provides breast milk deficient in this vitamin to an exclusively breastfed infant for a period of time, the infant can develop neurological damage. Refer the infant and mother to a health care provider for assessment of vitamin B12 status.

- **Vitamin D** – Vitamin D needs of vegetarian infants do not differ from those of infants fed foods of animal origin. See page 19 for information regarding the vitamin D needs of breastfed infants and recommended levels of supplementation. Vegetarian infants who are not breastfed should be fed soy-based infant formula. Soy-based infant formulas provide adequate vitamin D in the first 4 to 6 months and as the vegetarian infant's milk beverage in the second 6 months of life.
- **Calcium** – Calcium needs are easily met if an infant is consuming adequate quantities of breast milk or infant formula, both rich sources of calcium. Calcium, in smaller amounts and a less available form, is also in soybeans and other legumes, grain products, and dark green leafy vegetables (including chard, kale, collard greens, and spinach). However, do not feed home-prepared spinach or collard greens, which are high in nitrate, to infants under 6 months old. See page 109 for more information regarding nitrate-containing vegetables.
- **Iron** – Most healthy, full-term infants are born with iron stores that are not depleted until about 4 to 6 months old. A vegetarian infant who consumes an appropriate amount of iron-fortified infant formula daily and iron-fortified cereal starting between 4 and 6 months should receive an adequate amount of iron in the first year of life. Alternate sources of iron need to be provided to infants age 6 months or older who are exclusively breastfed. See page 24 for more information regarding iron sources for breastfed and formula-fed infants. Iron sources, besides meat, poultry, and fish, include iron-fortified infant cereal and other enriched and whole-grain products, cooked dried beans and peas, and cooked dried fruits. Since these plant foods contain poorly absorbed nonheme iron, it is recommended to feed vitamin C-rich foods at the same meal with those foods to increase iron absorption. See page 21 and Appendix C, page 191 for examples of vitamin C-rich foods. Refer infants who may be iron-deficient, based on dietary intake or hematological tests, to a health care provider for assessment, monitoring, and advice on supplementation.
- **Zinc** – Breast milk or infant formulas consumed in appropriate amounts provide sufficient zinc for young infants. After 6 months of age, food sources of zinc should be added to the diet. Zinc sources, besides meat, poultry, fish, and egg yolks, include whole-grain cereals, breads, and other fortified or enriched grain products; cheese; yogurt; and legumes. Zinc bioavailability may be improved by using yeast-leavened whole-grain breads and fermented soy products.¹⁷ Although some experts recommend zinc supplementation for vegan infants during the weaning period,^{18, 19} the AAP does not because clinical signs of zinc deficiency are rarely seen in vegetarians.¹³
- **Riboflavin (vitamin B2)** – Dairy products are one of the major sources of riboflavin in an infant's diet. Infants who are not fed breast milk, milk-based infant formula, or other

dairy products can obtain riboflavin from soy-based infant formula; enriched, fortified, and whole-grain breads or cereals; dark green leafy vegetables; legumes; broccoli; and avocado.

3. Emphasize the importance of following general guidelines on introducing new foods and watching for hypersensitivity (allergic) or other reactions that an infant may have to new foods. Honey should never be fed to infants because of the risk of contamination with *Clostridium botulinum* spores.
4. Discuss with the caregiver the importance of modifying the texture of foods to meet the infant's needs. Some foods commonly included in vegetarian diets may be coarse and hard to digest and/or may require teeth for chewing. Guidelines to ensure certain foods are suitable for infants to consume include the following:
 - Puree or mash cooked whole dried beans and peas. Legumes should be pressed through a sieve to remove skins.
 - Grind up or finely mash cooked whole grain kernels, such as rice, wheat berries, barley, etc. Avoid these grain products that require chewing and can cause choking: granola-type cereals, cooked whole grain kernels, and plain, dry wheat germ.
 - Do not feed whole or chopped nuts and seeds to infants. Discourage the use of nut/seed butters because they can stick to the roof of the mouth possibly causing choking and may cause hypersensitivity (allergic) reactions. In families with a strong family history of allergy, peanuts and other nuts should not be introduced until 3 years of age.²⁰ See pages 104–105 for more information regarding hypersensitivity reactions.
 - Follow standard recommendations regarding home preparation of fruits, vegetables, and grains for infants. See pages 115–120 for more information regarding home preparation of infant foods.

If the above concerns are appropriately addressed when feeding a vegetarian infant, it should be

possible for the infant to receive an adequate balance of nutrients and, thus, achieve optimum growth and development. See Appendix D, pages 195–196 for general guidelines on feeding healthy infants.

Common Gastrointestinal Problems

Spitting Up and Vomiting

It is normal for young infants to spit up a small amount of breast milk or infant formula after feedings. The muscle located between the stomach and the esophagus may not be sufficiently developed to keep all the food in an infant's stomach after eating. Usually about a teaspoon or less of breast milk or infant formula will come out of an infant's mouth after feeding when the infant is burped or allowed to lie flat down on his or her side or back. Although some caregivers may want to lay their infant on his or her stomach to prevent spitting up, infants should only be put to sleep lying on their back, without any pillows, blankets, or toys to prop the infant. Following these guidelines will help prevent Sudden Infant Death Syndrome (SIDS).⁶

A more severe form of spitting up is called gastroesophageal reflux (GER). Reflux is defined as the spontaneous, effortless regurgitation of material from the stomach into the esophagus. GER may be caused by the immature gastrointestinal tract and seems to be related to a delay in stomach emptying; up to half of the cases may be related to cow's milk protein allergy.²¹ Although thickening breast milk or infant formula has been prescribed as a treatment for GER, the effectiveness of this therapy is controversial.²² The addition of infant cereal to breast milk or infant formula or the use of infant formula with added rice cereal should only be done if prescribed by the infant's health care provider.

Infants with GER who have wheezing, recurrent pneumonia or upper respiratory infections, symptoms of esophagitis (an irritation of the esophagus), irritability during feeding, or failure to thrive are at particular risk and should be referred to a health care provider immediately.

Methods to reduce excessive spitting up include the following:

- Burp the infant several times during a feeding. Burping is generally done during normal breaks in a feeding; it slows a feeding and can lessen the amount of air swallowed.
- Hold the infant in an upright position after a feeding for about 15 to 30 minutes.
- Avoid excessive movement or play right after eating.
- Avoid forcing the infant to eat or drink when full and satisfied.

Vomiting refers to the forceful discharge of food through the esophagus and involves a more complete emptying of the stomach's contents. It can occur as a symptom of a reaction to food eaten, a minor or major medical condition, or use of certain medications. Vomiting can also result from stimulation to the inner ear from being in a moving vehicle or even from excitement or nervousness. Vomiting can place an infant at risk of dehydration. See page 29 for signs of dehydration.

Refer an infant to a health care provider for medical evaluation if the caregiver notes that the infant is vomiting or that his or her spitting up is unusual in terms of volume, contents, or accompanying symptoms.

Colic

Up to one fifth of all infants experience colic in the first few months of life. Colic is described as prolonged, inconsolable crying that appears to be related to stomach pain and discomfort (infants may pull their legs up in pain) often in the late afternoon or early evening.⁶ It usually develops between 2 to 6 weeks of age and may continue until the infant is 3 to 4 months old. Formula-fed infants seem to experience colic more often than breastfed infants; the cause of colic is unknown. A systematic review of a variety of therapies used to manage colic indicates no clearly effective treatments.²³ Some evidence indicates that breastfed infants may benefit from breastfeeding mothers eliminating milk products

or other allergenic foods from their diet; similarly some benefit has been shown with the use of hypoallergenic infant formula.²³ Colic has also been associated with infants fed sorbitol-containing fruit juices, such as apple, white grape, and pear juice.²⁴

Diarrhea

Diarrhea is defined as the frequent passage of loose, watery stools. Diarrhea should not be confused with the normal stools of breastfed infants. Diarrhea in infants can be caused by a reaction to a food, excessive juice consumption, use of certain medications, medical conditions or infections, malabsorption of food, or consuming contaminated food or water. Proper infant formula preparation and storage techniques are very important in assuring that infant formula is not contaminated and a potential cause of diarrhea.

If untreated, diarrhea in an infant can rapidly lead to dehydration, which can be life-threatening; diarrhea is the most common cause of hospitalizations in otherwise healthy infants. Chronic diarrhea may lead to nutrient deficiencies because food passes through the gastrointestinal tract too quickly to be digested and nutrients cannot be absorbed. Thus, refer an infant to a health care provider for medical evaluation if the caregiver notes that the infant is having diarrhea.

Use of ordinary beverages to treat diarrhea may actually worsen the condition and lead to further dehydration.²⁵ In most cases of acute diarrhea, and clearly when dehydration is not present, continued feeding of the infant's usual diet is the most appropriate treatment.²⁵ This is true whether the infant's usual intake is breast milk, milk-based infant formula, soy-based infant formula, or any of these milks along with complementary foods. Caregivers should consult with the infant's health care provider about the treatment of diarrhea and not self-treat diarrhea by feeding ordinary beverages such as carbonated beverages, sport drinks, fruit juice, tea, or chicken broth.

The Centers for Disease Control and Prevention (CDC) and the AAP recommend the following during diarrhea.^{26 27}

- Breast-fed infants should continue to breastfeed on demand.
- Formula-fed infants should continue to be fed usual amounts of infant formula immediately following rehydration (if indicated).
- Low lactose or lactose-free infant formula is usually not necessary.
- Infant formula should not be diluted during diarrhea.
- The use of soy-based formulas is not necessary.
- Infants eating complementary foods should continue to receive their usual diet during diarrhea.
- Simple sugars (as found in soft drinks, juice, and gelatin) should be avoided; solid food intake should emphasize complex carbohydrates.
- Withholding food for >24 hours or feeding highly specific diets (for example the BRAT diet [bananas, rice, applesauce, tea]) is inappropriate.

Depending on an infant's condition, a health care provider may prescribe an appropriate oral rehydration solution to prevent and treat dehydration resulting from diarrhea. **Oral rehydration solutions should be used only under the supervision of physicians or other trained health personnel.**

Constipation

Constipation is generally defined as the condition when bowel movements are hard, dry, and difficult to pass. Although some believe that constipation is related to the frequency or the passage of stools, this may not be as important as the consistency of the stools. Part of the difficulty in determining whether an infant is constipated is that each caregiver may have a different perception of how often an infant should have a bowel movement and whether an infant's stool is “too hard.” True constipation is not very common among breastfed infants who receive

adequate amounts of breast milk or formula-fed infants who consume adequate diets. Some caregivers believe iron causes their infant to be constipated, but studies have demonstrated no relationship between iron-fortified infant formula and gastrointestinal distress, including constipation.²⁸ Formula-fed infants tend to have firmer stools, but this does not indicate constipation.

Constipation can be caused by a variety of factors or conditions, including:

- Dietary influences, such as:
 - inadequate breast milk, infant formula, complementary foods, or fluid intake;
 - improper dilution of infant formula;
 - early introduction of complementary foods; or,
 - excessive cow's milk in older infants.
- Abnormal anatomy or neurologic functioning of the digestive tract;
- Use of certain medications;
- A variety of medical conditions and hormonal abnormalities;
- Stool withholding due to rectal irritation from thermometers, vigorous wiping, etc.;
- Excessive fluid losses due to vomiting or fever;
- Lack of movement or activity; or
- Abnormal muscle tone.

If a caregiver complains that an infant is constipated, refer the infant to a health care provider for medical evaluation. If the health care provider determines that the infant's diet is inappropriate and a factor influencing the constipation, it is appropriate to assess the infant's diet, with particular focus on:

- The adequacy of intake of breast milk or infant formula
- Proper infant formula preparation and dilution if formula-fed
- Whether appropriate types and amounts of complementary foods are consumed (see Appendix D, pages 195–196 for guidelines on feeding healthy infants) and
- Premature introduction of complementary foods if the infant is less than 4 months old.

Overweight and Obesity Prevention

Overweight has been defined on the basis of population norms as body mass index (BMI) at or above the 95th percentile for age on the appropriate gender-specific CDC growth chart.²⁹ BMI between the 85th and 95th percentiles has been defined as at risk for overweight. Body mass index is calculated as weight in kilograms divided by the square of height in meters. BMI-for-age growth charts are not available for infants and children under 2 years. For infants and children less than 2 years old, overweight has been defined as weight-for-length at or above the 95th percentile on gender-specific NCHS growth charts.³⁰

The prevalence of overweight among American children has been rising rapidly. Data from the National Health and Nutrition Examination Surveys (NHANES) II and III show an increase in overweight 6 to 23 month olds from 7.2 percent in 1976–1980 to 11.6 percent in 1999–2000.³² Similarly, an increase in overweight 2 to 5 year olds occurred, from 5.0 percent in 1976–1980 to 10.4 percent in 1999–2000.³¹ In 1998, 13.2 percent of children participating in the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) were overweight.³² Within this population, the rates of prevalence varied by ethnic group; Hispanic children 16.4 percent, Native American children 18.6 percent, Asian 12.5 percent, black 12.2 percent, and white 11.1 percent. The incidence of Type 2 diabetes in children is increasing at the same time.³³

The following factors related to infant feeding may play a part in the development of childhood obesity:

- **Breastfeeding** – Multiple studies indicate a protective effect of breastfeeding on the later development of obesity,^{34, 35, 36} however, research is still ongoing. Longer duration of breastfeeding has been associated with a reduced risk of becoming overweight.³⁶
- **Weaning from the bottle later than 18 months of age** – Each additional month of bottle use corresponds to a 3-percent increase

in the likelihood of being in a higher BMI category (85th to 95th percentile or > 95th percentile).³⁷

- **Rapid weight gain in infancy** – Rapid weight gain in the first 4 to 6 months is associated with a higher incidence of overweight and obesity in later childhood and adolescence.^{38,39, 40, 41}
- **Maternal control** – There is conflicting evidence about whether controlling or restricting a child's intake affects the development of obesity. Breastfeeding through the first year has been associated with lower levels of maternal control over the child's intake.^{42,43} The child's ability to respond to internal cues of hunger and satiety, rather than respond to parental pressure or restriction, may be less likely to lead to obesity^{44,45} Some reports indicate that maternal control is not associated with a higher BMI in children;^{46,47} others indicate the relationship is complex and may be influenced by the child's predisposition to obesity⁴⁷ or the parent's hunger, history of eating disorders, or place of birth outside the United States.⁴⁸
- **Dietary choices** – Some clinicians and researchers believe that emphasizing lower dietary fat intake may lead to excess carbohydrate intake, resulting in excessive weight gain.⁴⁹ A more reasonable approach may be a moderate fat intake for children, emphasizing dietary variety.⁵⁰

The AAP states that early recognition of excessive weight gain in relation to linear growth is important for initiating early intervention. They advocate a dietary approach that encourages moderate consumption of healthful food choices, rather than over consumption or restriction. The AAP's recommendations for health supervision of infants to prevent overweight and obesity include the following:⁵¹

- Identify and track patients at risk by virtue of family history, birth weight, or socioeconomic, ethnic, cultural, or environmental factors.
- Encourage, support, and protect breastfeeding.

- Encourage parents and caregivers to promote healthy eating patterns by offering nutritious snacks, such as vegetables and fruits, low-fat dairy foods, and whole grains; encouraging children's autonomy in self-regulation of food intake and setting appropriate limits on choices; and modeling healthy food choices.
- Routinely promote physical activity, including unstructured play at home, in school, in child care settings, and throughout the community.

Discourage television viewing for children younger than 2 years, and encourage more interactive activities that will promote proper brain development, such as talking, playing, singing, and reading together.

References:

1. Nowak AJ, Warren JJ. Infant oral health and oral habits. *Pediatric Clinics of North America* 2000;47:1043-1066.
2. Tinanoff N, Palmer CA, 2000. Dietary determinants of dental caries and dietary recommendations for preschool children. *Journal of Public Health Dentistry* 60(3): 197-206.
3. Section on Pediatric Dentistry, American Academy of Pediatrics. Oral health risk assessment timing and establishment of the dental home. *Pediatrics* 2003;111(5):1113-1116.
4. Isokanges P, Soderling E, Pienihakkinen K, Alanen P. Occurrence of dental decay in children after maternal consumption of xylitol chewing gum, a follow-up from 0 to 5 years of age. *Journal of Dental Research* 2000;79:1885-1889.
5. US Department of Health and Human Services. Oral Health in America: A Report of the Surgeon General. U.S. Department of Health and Human Services, Rockville, MD; 2000. (accessed September 6, 2007). Available at: <http://www.surgeongeneral.gov/library/oralhealth/>.
6. Shelov SP, Hannemann RE. *Caring for Your Baby and Young Child: Birth to Age 5*. 4th ed. USA: Bantam Books; 2004.
7. American Academy of Pediatric Dentistry. Policy on the Dental Home. 2004 (accessed September 6, 2007). Available at: http://www.aapd.org/media/Policies_Guidelines/P_DentalHome.pdf.
8. American Academy of Pediatric Dentistry. Policy on use of a caries-risk assessment tool (CAT) for infants, children, and adolescents. 2006 (accessed September 6, 2007). Available at: http://www.aapd.org/media/Policies_Guidelines/P_CariesRiskAssess.pdf.
9. Casamassimo P. *Bright Futures in Practice: Oral Health*. Arlington, VA: National Center for Education in Maternal and Child Health; 1996.
10. Committee on Nutrition, American Academy of Pediatrics. Soy protein-based formulas: Recommendations for use in infant feeding. *Pediatrics* 1998;101(1):148-153.
11. Sanders TAB. Vegetarian diets and children. *Pediatric Clinics of North America* 1995;42(4):955-965.
12. Mangels R. Nutrition for the Vegetarian Child. In: Nevin-Folino N, editor. *Pediatric Manual of Clinical Dietetics*. 2nd ed. Chicago: American Dietetic Association; 2003:99-111.
13. Nutritional Aspects of Vegetarian Diets. In: Kleinman RE, editor. *Pediatric Nutrition Handbook*. 5th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2004:191-203.
14. Position of the American Dietetic Association and the Dietitians of Canada. Vegetarian diets. *Journal of the American Dietetic Association* 2003;103:748-765.
15. Mangels R, Messina V. Considerations in planning vegan diets: Infants *Journal of the American Dietetic Association* 2001;101(6):670-677.
16. Institute of Medicine, Food and Nutrition Board. Dietary Reference Intakes for Thiamin, Riboflavin, Niacin, Vitamin B6, Folate, Vitamin B12, Pantothenic Acid, Biotin, and Choline. Washington, D.C.: National Academy Press, 1998.
17. Gibson RS, Yeudall F, Drost N, Mtitimuni B, Cullinan T. Dietary interventions to prevent zinc deficiency. *American Journal of Clinical Nutrition* 1998;68 (suppl):484-487.

18. Krebs NF. Zinc supplementation during lactation. *American Journal of Clinical Nutrition* 1998;68(suppl):509S-512S.
19. Allen LH. Zinc and micronutrient supplements for children. *American Journal of Clinical Nutrition* 1998;68(suppl):495S-498S.
20. Kleinman RE. Food Sensitivity. In: Kleinman RE, editor. *Pediatric Nutrition Handbook*, 5th ed. Elk Grove Village: American Academy of Pediatrics; 2004.
21. Salvatore S, Vandenplas Y. Gastroesophageal reflux and cow milk allergy: is there a link? *Pediatrics* 2002;110(5):972-984.
22. Kleinman RE. Gastrointestinal Disease. In: Kleinman RE, editor. *Pediatric Nutrition Handbook*, 5th ed. Elk Grove Village: American Academy of Pediatrics; 2004.
23. Garrison M, M., Christakis DA. A systematic review of treatments for infant colic. *Pediatrics* 2000;106(1):184-190.
24. Duro D, Rising R, Cedillo M, Lifshitz F. Association between infantile colic and carbohydrate malabsorption from fruit juices in infancy. *Pediatrics* 2002;109(5):797-805.
25. Oral Therapy for Acute Diarrhea. In: Kleinman RE, editor. *Pediatric Nutrition Handbook*. 5th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2004:471-479.
26. Centers for Disease Control and Prevention. Managing acute gastroenteritis among children: oral rehydration, maintenance, and nutritional therapy. *Morbidity and Mortality Weekly Report* 2003;52(RR-16).
27. American Academy of Pediatrics, Statement of Endorsement. Managing acute gastroenteritis among children: oral rehydration, maintenance, and nutritional therapy. *Pediatrics* 2004;114(2):507.
28. Committee on Nutrition, American Academy of Pediatrics. Iron fortification of Infant Formulas. *Pediatrics* 1999;104(1):119-123.
29. National Center for Chronic Disease Prevention and Health Promotion. Use and Interpretation of the CDC Growth Charts - An Instructional Guide. Atlanta: Centers for Disease Control and Prevention; 2004 (accessed September 10, 2007). Available from: http://www.cdc.gov/nccdphp/dnpa/growthcharts/guide_intro.htm.
30. Institute of Medicine. WIC Nutrition Risk Criteria: A Scientific Assessment. Washington D.C.: National Academy Press; 1996.
31. Ogden CL, Flegal KM, Carroll MD, Johnson CL. Prevalence and trends in overweight among U.S. children and adolescents, 1999-2000. *Journal of the American Medical Association* 2002;288(14):1728-1732.
32. U.S. Department of Agriculture, Office of Analysis, Nutrition and Evaluation. The Prevalence of Overweight Among WIC Children. 2001 (accessed February 23, 2005). Available at: <http://www.fns.usda.gov/oane/menu/Published/WIC/WIC-archive.htm>.
33. Bloomgarden ZT. Type 2 diabetes in the young. *Diabetes Care* 2004;27(4):998-1010.
34. Gillman MW, Rifas-Shiman SL, Camargo CA, Berkey CS, Lindsay FA, Rockett HR, et al. Risk of overweight among adolescents who were breastfed as infants. *Journal of the American Medical Association* 2001;285(19):2461-2467.

35. Hediger ML, Overpeck MD, Kuczmarski RJ, Ruan WJ. Association between infant breastfeeding and overweight in young children. *Journal of the American Medical Association* 2001;285(19):2453-2460.
36. Grummer-Strawn LM, Zuguo M. Does breastfeeding protect against pediatric overweight? Analysis of longitudinal data from the Centers for Disease Control and Prevention Pediatric Nutrition Surveillance System. *Pediatrics* 2004;113(2):e81-e86. Available at: <http://pediatrics.aappublications.org/cgi/content/full/113/2/e81>.
37. Bonuck K, Kahn R, Schechter C. Is late bottle-weaning associated with overweight in young children? Analysis of NHANES III data. *Clinical Pediatrics* 2004;43(535):540.
38. Stettler N, Zemel BS, Kumanyika SK, Stallings VA. Infant weight gain and childhood overweight status in a multicenter cohort study. *Pediatrics* 2002;109(2):194-199.
39. Lindsay RS, Cook V, Hanson RL, Salbe AD, Tataranni A, Knowler WC. Early excess weight gain of children in the Pima Indian population. *Pediatrics* 2002;109(2):e33. Available from <http://pediatrics.aappublications.org/cgi/content/full/109/2/e33>.
40. Stettler N, Kumanyika SK, Katz SH, Zemel BS, Stallings VA. Rapid weight gain during infancy and obesity in young adulthood in a cohort of African Americans. *American Journal of Clinical Nutrition* 2003;77:1374-1378.
41. Gunnarsdottir I, Thorsdottir I. Relationship between growth and feeding in infancy and body mass index at the age of 6 years. *International Journal of Obesity* 2003;27:1523-1527.
42. Fisher JO, Birch LL, Smiciklas-Wright H, Picciano MF. Breast-feeding through the first year predicts maternal control in feeding and subsequent toddler energy intakes. *Journal of the American Dietetic Association* 2000;100:641-646.
43. Taveras EM, Scanlon KS, Birch LL, Rifas-Shiman SL, Rich-Edwards JW, Gillman MW. Association of breastfeeding with maternal control of infant feeding at age 1 year. *Pediatrics* 2004;114(5):e577-e583. Available from <http://pediatrics.aappublications.org/cgi/content/full/114/5/e577>.
44. Birch LL, Davison KK. Family environmental factors influencing the developing behavioral controls of food intake and childhood overweight. *Pediatric Clinics of North America* 2001;48(4).
45. Satter EM. Internal regulation and the evolution of normal growth as the basis for prevention of obesity in children. *Journal of the American Dietetic Association* 1996;96(9):860-864.
46. Robinson TN, Kiernan M, Matheson DM, Haydel KF. Is parental control over children's eating associated with childhood obesity? Results from a population-based sample of third graders. *Obesity Research* 2001;9(5):306-312.
47. Faith MS, Berkowitz RI, Stallings VA, Kerns J, Storey M, Stunkard AJ. Parental feeding attitudes and styles and child body mass index: prospective analysis of a gene-environment interaction. *Pediatrics* 2004;114(4):e429-e436. Available from <http://pediatrics.aappublications.org/cgi/content/abstract/114/4/e429>.

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48. Duke RE, Bryson S, Hammer LD, Agras WS. The relationship between parental factors at infancy and parent-reported control over children's eating at age 7. *Appetite* 2004;43:247-252.
 49. Slyper AH. The pediatric obesity epidemic: causes and controversies. *Journal of Clinical Endocrinology and Metabolism* 2004;89(6):2540-2547.
 50. Satter E. A moderate view on fat restriction for young children. *Journal of the American Dietetic Association* 2000;100(1):32-36.
 51. Committee on Nutrition American Academy of Pediatrics. Prevention of pediatric overweight and obesity. *Pediatrics* 2003; 112(2):424-430.



CHAPTER 7: PHYSICAL ACTIVITY IN INFANCY

Physical activity, defined as any bodily movement produced by skeletal muscles resulting in energy expenditure, is an important part of overall health and maintenance of a healthy body weight. Physical activity must be balanced with dietary intake; recommendations on activity have been included in the United States Dietary Guidelines since 1995. The most recent guidelines, issued in 2005, continue to emphasize the importance of activity in the maintenance of a healthy weight and the prevention of chronic diseases such as type 2 diabetes and heart disease. Physical activity in late infancy and throughout childhood has been linked to lower BMI and less body fat.^{1, 2, 3, 4} The 2005 guidelines recommend that children and adolescents engage in at least 60 minutes of physical activity on most, preferably all, days of the week.⁵ This chapter will discuss the development of motor skills, guidelines for physical activity, and common concerns related to activity in infancy.

Counseling points related to the information presented in this chapter are found in Chapter 8, page 177.

Developing Motor Skills

Activity for infants focuses on the development of motor skills. Gross motor skills involve the large muscle groups, such as those in the arms and legs, while fine motor skills involve smaller muscles like those in the hands and fingers. In early infancy, movement is controlled by involuntary reflexes but, as muscles develop, voluntary movements are gained. During this period, key connections are made between the brain and muscles. Early activity serves as the basis for skillful movement for activities such as sports, dance, and exercise in later childhood and adulthood. Early motor skill confidence and competence and enjoyment of physical activity may also contribute to later participation in physical activity.

Infants develop motor skills in the same order, but at different rates – each infant’s rate of development is unique. See Table 3, page 150 for more information regarding the average age at which skills are acquired.

Caregivers can help their infant to develop the skills needed to be physically active. Providing a stimulating environment that encourages the infant to move and explore affects the rate of motor skill development. Similarly, the way an infant is held; how much time he spends in infant equipment such as infant seats, swings, and walkers; the amount of time an infant spends on their stomach during play; and the toys he plays with can all affect motor skill development.

*Caregivers should be encouraged to:*⁶

- Nurture their infant’s motor skill development and encourage physical activity;
- Participate in parent-infant play groups;
- Provide toys and activities that encourage infants to move and do things for themselves in a safe environment. Place toys just out of reach and encourage the infant to move to get to them. See Appendix E, page 197 for activities appropriate for infants;
- Gently move their infant (rolling, bouncing, swaying, turning) to encourage muscle development and connections between the brain and muscles;
- Avoid rough activities and pay attention to whether their infant is distressed and cries when played with too vigorously. Infants should never be severely or violently shaken since this may cause brain damage, blindness or eye injuries, damage to the spinal cord, and delay in normal development (known as Shaken Baby Syndrome);⁷

Table 3: Motor Skill Development During Infancy

Motor Skill	Mean	Age Range
Holds head erect and steady	1.6 months	0.7–4 months
Sits with support	2.3 months	1–5 months
Lifts head, shoulders, and forearms while lying down	3.5 months	2–4.5 months
Sits momentarily without support	5.3 months	4–8 months
Reaches with one hand	5.4 months	4–8 months
Rolls over from back to front	6.4 months	4–10 months
Crawls and pulls on objects to achieve upright position	8.1 months	5–12 months
Walks and handholds (“cruises”)	8.8 months	6–12 months
Stands momentarily without support	11 months	9–16 months
Walks independently	11.7 months	9–16 months

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- Avoid extended periods (more than 60 minutes) of inactivity for the infant, such as in an infant seat or swing, or being held excessively;⁸ and
- Assist their infant’s development of head and neck control by: placing the infant in their lap facing them; holding the infant’s hands and encouraging the infant to stand; pulling the infant to a standing position; and gently swaying the infant side to side if the standing position can be maintained.

Guidelines for Physical Activity

The National Association for Sport and Physical Education has developed the Active Start physical activity guidelines for infants through 5 years old. They recommend that all children, birth to age 5, should engage in physical activity that promotes health-related fitness and movement skills.

The following guidelines have been developed specifically for infants⁹

- Infants should interact with parents or caregivers in daily physical activities that are dedicated to promoting the exploration of their environment.
- Infants should be placed in safe settings that facilitate physical activity and do not restrict movement for prolonged periods of time.
- Infants’ physical activity should promote the development of movement skills.
- Infants should have an environment that meets or exceeds recommended safety standards for performing large muscle activities. The caregiver should closely supervise the infant’s activity using a wide variety of age-appropriate and developmentally appropriate equipment. In addition, the infant should be placed on a rug or blanket at least 5’ x 7’ in size.
- Individuals responsible for the well-being of infants should be aware of the importance of physical activity and facilitate the child’s movement skills.

Common Concerns

Use of Walkers and Other Infant Equipment

Infant walkers are associated with thousands of injuries or deaths each year, most often as a result of an infant falling down stairs in a walker. The American Academy of Pediatrics (AAP) has recommended a ban on the use and manufacture of infant walkers.¹⁰ The misuse of other infant equipment, including infant seats, highchairs, swings, bouncers, exersaucers, and similar equipment has been associated with significant delays in motor skill development.^{11,12} Caregivers should be encouraged to limit use of infant equipment and encourage their infant’s movement in a safe environment.

Sleeping and Play Positions

Infants should always be put to sleep on their back throughout the entire first year to minimize the risk for Sudden Infant Death Syndrome (SIDS).^{7,13} However, infants need to spend supervised time playing in the prone position (on their stomach), sometimes referred to as “tummy time.” This position encourages development of important motor skills and head and trunk control.¹³ Infants who spend minimal awake time in the prone position demonstrate significantly later gross motor development.¹⁴ The phrase “Back to Sleep and Prone to Play” has been suggested as a way to educate caregivers about the importance of both these positions to infant safety and development.¹⁴ Advise caregivers that “tummy time” should only occur when the infant is awake and supervised. Caregivers should consult their health care provider regarding the appropriate age to place an infant on his or her stomach.

Infant Exercise and Swimming Programs

Exercise and swimming programs designed for infants and toddlers are popular. However, these programs are not necessary for the development of motor skills in infancy. In addition, they may put an infant at greater risk for injury to

bones that are not fully developed or for risk of drowning if a false sense of security around water is fostered.

The AAP makes the following recommendations about infant exercise or swimming programs:^{15, 16}

- Structured infant exercise programs should not be promoted as being therapeutically beneficial for development of healthy infants.
- Caregivers should provide a safe, nurturing, and minimally structured play environment for their infant.
- Children are generally not developmentally ready for formal swimming lessons until after their fourth birthday.
- Aquatic programs for infants and toddlers should not be promoted as a way to decrease the risk of drowning.

Media Use and Inactivity

Activities like watching television or videotapes and playing computer or video games do not promote physical activity. These activities may make up a significant part of an infant or toddlers' day. Data from the National Longitudinal Study of Youth indicates that 17 percent of infants 0–11 months old and 48 percent of toddlers 12–23 months old watched at least 1 hour of television daily.¹⁷ Almost a quarter of the 12–23 month old toddlers watched 3 or more hours daily.

*The AAP recommends the following guidelines for television viewing for infants and young children:*¹⁸

- Television viewing is discouraged for infants and children younger than 2 years. Instead, interactive activities that stimulate brain development, such as talking, playing, singing, and reading together should be encouraged.
- For children 2 and older, total entertainment media time (television, videotapes, and videogames) should be limited to no more than 1 to 2 hours of quality programming daily.

References:

1. Wells J, Ritz P. Physical activity at 9–12 months and fatness at 2 years of age. *American Journal of Human Biology* 2001;13:384-389.
2. Trost S, Sirard JR, Dowda M, Pfeiffer K, Pate R. Physical activity in overweight and nonoverweight preschool children. *International Journal of Obesity* 2003;27:834-839.
3. Moore LL, Gao D, Bradlee ML, Cupples LA, Sundarajan-Ramamurti A, Proctor MH, et al. Does early physical activity predict body fat change throughout childhood? *Preventive Medicine* 2003;37:10-17.
4. Datar A, Sturm R. Physical education in elementary school and body mass index: evidence from the Early Childhood Longitudinal Study. *American Journal of Public Health* 2004;94(9):1501-1506.
5. U.S. Department of Health and Human Services and U.S. Department of Agriculture. Dietary Guidelines for Americans, 2005. 2005 (accessed September 10, 2007) Available at: <http://www.healthierus.gov/dietaryguidelines/>.
6. Patrick K, Spear B, Holt K, Sofka D. Bright Futures in Practice: Physical Activity Arlington, VA: National Center for Education in Maternal and Child Health; 2001.
7. Shelov SP, Hannemann RE. Caring for Your Baby and Young Child: Birth to Age 5. 4th ed. USA: Bantam Books; 2004.
8. Kellogg Company, National Association for Sport and Physical Education, The President's Council on Physical Fitness and Sports. Kids in Action: Fitness for Children Birth to Age Five. Battle Creek, MI: Kellogg Company; 2004.
9. National Association for Sport and Physical Education. Active Start: A Statement of Physical Activity Guidelines for Children Birth to Five Years. Reston, VA: American Alliance for Health, Physical Education, Recreation and Dance; 2002.
10. Committee on Injury and Poison Prevention, American Academy of Pediatrics. Injuries associated with infant walkers. *Pediatrics* 2001; 108(3):790-792.
11. M. G, McElroy A, Staines A. Locomotor milestones and babywalkers: cross sectional study. *British Medical Journal* 2002;324:1494.
12. Abbott A, Bartlett D. Infant motor development and equipment use in the home. *Child: Care, Health and Development* 2001;27(3):295-306.
13. Task Force on Sudden Infant Death Syndrome, American Academy of Pediatrics. The changing concept of Sudden Infant Death Syndrome: Diagnostic coding shifts, controversies regarding the sleeping environment, and new variables to consider in reducing risk. *Pediatrics* 2005;116(5):1245-1255.

14. Salls JS, Silverman LN, Gatty CM. The relationship of infant sleep and play positioning to motor milestone achievement. *American Journal of Occupational Therapy* 2002;56:577-580.
15. Committee on Sports Medicine, American Academy of Pediatrics. Infant exercise programs. *Pediatrics* 1988;82(5):800.
16. Committee on Sports Medicine and Committee on Injury and Poison Prevention, American Academy of Pediatrics. Swimming programs for infants and toddlers. *Pediatrics* 2000;105(4):868-870.
17. Certain LK, Kahn RS. Prevalence, correlates and trajectory of television viewing among infants and toddlers. *Pediatrics* 2002;109(4):634-642.
18. Committee on Public Education, American Academy of Pediatrics. Children, Adolescents, and Television. *Pediatrics*



CHAPTER 8: SUMMARY OF KEY POINTS IN PREVIOUS CHAPTERS

This chapter summarizes many of the key points on infant feeding that are covered in this publication. This section can be used to plan nutrition education sessions (e.g., face-to-face [individual or group], telephone, or electronic [e.g., kiosk, internet, or computer-based]) or develop nutrition education materials on infant feeding. This chapter does not provide a summary of all the possible topics to cover with caregivers on infant nutrition and feeding. Furthermore, it does not provide a summary of all the information covered in this handbook.

To best use this chapter in planning nutrition education sessions, consider these points:

- Base topics to be covered during an individual nutrition education session on:
 - Nutrition education needs (desired knowledge, skills, and behaviors to be learned) identified through the nutrition assessment process and other sources (e.g., through consultation with auxiliary health care and other personnel providing care to the infant); and
 - The caregiver's expressed needs identified during the assessment.
- Carefully select the information covered to include a manageable number of the most important concepts. Discuss these concepts as messages that encourage the participant to set individual, simple, and attainable goals. Provide clear and relevant "how to" actions to accomplish those goals.
- Use counseling methods/teaching strategies (e.g., participant-centered learning, motivational negotiation, facilitated group discussion, etc.) that are relevant to the participant's nutritional risk and are easily understood by the participant.
- At follow-up, assess participant's progress from previous session; additional topics can be discussed depending on the time available.
- Involve the participant in planning any feeding and other changes to improve the infant's nutritional status and health. If possible, also involve other family members or

friends if they have any impact on the feeding and care of the infant.

- Adapt the wording of the points covered to be conversational and to accommodate the needs, learning skills, cultural and ethnic background, and language ability of the caregiver.

Additional information on planning nutrition education sessions can be found in the WIC Works Educational Materials Database online at <http://www.nal.usda.gov/wicworks/Databases/index.html>.

Nutritional Needs of Infants

Energy

- Energy needs (calories) and growth patterns of infants are individual. The best indicator that an infant is getting enough calories is his growth rate in length, weight, and head circumference. An infant's growth should be evaluated by plotting his anthropometric data on a CDC growth chart.

Carbohydrates

- Carbohydrates serve as primary sources of energy to fuel normal day-to-day activities.
- Infants need carbohydrates to gain weight and grow properly.
- Some fruit juices, especially apple, pear, white grape, and prune juice, contain sugars that can cause diarrhea in infants. They should not be given until after 6 months of age.
- During the second 6 months of life, infants should be gradually introduced to fiber-containing foods, such as whole-grain cereals, vegetables, and legumes.

Protein

- Breast milk and infant formula are good sources of protein. No other source of protein is needed in the first 6 months of life. In later infancy after complementary foods are

introduced, sources of protein in addition to breast milk and infant formula include meat, poultry, fish, egg yolks, cheese, yogurt, and legumes.

Lipids

- Breast milk and infant formula provide about 50 percent of their calories from lipids.
- Lipids allow for the absorption of the fat-soluble vitamins A, D, E, and K
- Lipids provide essential fatty acids that are required for normal brain development, healthy skin and hair, normal eye development, and resistance to infection and disease.
- Fat and cholesterol should not be limited in the diet of infants.

Vitamin D

- Breastfed infants should receive 200 IU of supplemental vitamin D daily to prevent rickets.
- Breastfed infants who drink at least 500 mL of infant formula do not need supplemental vitamin D.

Iron

- Full-term, breastfed infants need approximately 1 mg/kg/day of supplemental iron at 4 to 6 months of age, preferably from complementary foods (e.g., iron-fortified infant cereal and/or meats).
- An average of 2 servings of iron-rich complementary food (½ oz or 15 g of dry cereal per serving), in addition to breast milk or infant formula are needed to meet the daily iron requirement.
- All formula-fed infants should receive only iron-fortified infant formula during the first year of life.
- Infants should not drink cow's milk, goat's milk, or soy-based beverages because they contain a small amount of iron that is poorly absorbed by infants. Consumption of these milks may lead to iron deficiency anemia.

Fluoride

- Infants less than 6 months of age do not need fluoride supplements.
- Infants older than 6 months of age, whose community drinking water contains <0.3 ppm fluoride, should receive 0.25 mg sodium fluoride per day.

Water

- Always follow correct infant formula preparation procedures (see Figures 6a, 6b, and 6c, pages 93–95).
- Commercially available “nursery” water, plain water, or other liquids (e.g., fruit juices; soda; diluted fruit punches, drinks, or ades; tea; broth; or gelatin water) should not be used to treat diarrhea, fever, vomiting, or any other illness. Do not self-treat an infant with an oral rehydration (electrolyte) solution unless recommended by a health care provider.
- Do not substitute a bottle of water or dilute beverages (fruit juice, sweetened beverages, tea, etc.) as a feeding in place of infant formula or breast milk. Do not offer water to an infant after breastfeeding or infant formula feedings. These practices can lead to water intoxication which can be life-threatening for an infant.
- Do not allow the infant to drink at will from a bottle of water or dilute liquid all day or for extended periods. Young infants need to be fed a sufficient amount of breast milk, infant formula, and appropriate complementary foods to meet their calorie and other nutrient needs.
- If a caregiver's water comes from a private or community well, they should have their water tested annually for contaminants.

Development of Feeding Skills

- Each infant develops feeding skills at his or her own rate.
- A good feeding relationship exists when an infant can express his or her needs and the

caregiver responds to them. Developing a good feeding relationship is important to the growth and development of the infant. When this relationship is not going well, infants can either be underfed or overfed.

- Caregivers need to learn and pay attention to their infant's hunger and satiety cues.

Breastfeeding

Benefits of Breastfeeding

For the infant, breast milk or breastfeeding provides:

- The right balance of nutrients that should be the only source of nutrition for the first 6 months of life;
- Unique bioactive factors that improve the infant's immune system and are associated with cognitive development; and
- Protection from illnesses like gastrointestinal illnesses, respiratory illnesses, and ear infections.

For the mother, breastfeeding:

- Helps speed the recovery from childbirth and suppresses ovulation for many women;
- May protect against breast and ovarian cancer;
- Is less expensive, more convenient, and takes less time than bottle feeding; and
- Stimulates hormones that make mothers feel more relaxed and at peace.

Making the Decision To Breastfeed

- Factors that affect a mother's decision to breastfeed include the attitudes of healthcare providers; the mother's support network; hospital practices, such as providing infant formula to breastfeeding newborns; a mother's personal experience; and workplace environment.
- Research has shown that the common barriers to breastfeeding are embarrassment, lack of social support, lack of time, and competing demands on the mother.

Characteristics of Breast Milk

- The first breast milk, called colostrum, is thick and yellow and contains antibodies that help fight diseases and are very healthy for the infant.
- The milk that comes in later is called mature breast milk and looks more watery. It tends to look opaque and thicker at the end of the feeding. This milk also contains important antibodies and is very nutritious for the infant.

Feeding Positions

- Find a place that is comfortable where you can relax while breastfeeding.
- You should try different positions to breastfeed your infant. These positions include:
 - Lying down or side lying
 - Across the lap or cradle hold
 - Football hold or clutch hold

Normal Fullness of Breasts

- During the first 1 to 2 weeks after birth, the breasts will usually enlarge. By the end of the second week, the swelling may go down – this is natural and does not mean that you are losing your milk.

Attaching to and Coming off the Breast

- Wash your hands before starting to breastfeed.
- When attaching your infant to the breast, hold him or her close to you and rub the infant's chin or lower lip with the nipple. As the infant opens his or her mouth wide and the tongue is on the floor of the mouth, quickly bring the infant toward the breast and get the whole nipple and most of the dark circular part of the breast (the areola) into the infant's mouth. Hold the breast using a "C- Hold."
- Infants often come off the breast on their own. But, if you want your infant to come off the breast, slide a little finger between the corner of the infant's mouth and the breast to gently break the suction between the two.

Breastfeeding Frequency and Duration

- Breastfeed your infant often during the day and night to:
 - Allow your body to make enough milk for your infant (the more you breastfeed, the more milk your body makes);
 - Prevent your breasts from becoming engorged (full and hard); and
 - Help your infant grow.
- Breastfeed your infant when he or she is hungry (the infant may wake and toss, suck on a hand, cry or fuss, or make smacking sounds). Follow your infant's lead on when and how long to breastfeed.
- Newborn infants generally breastfeed every 1½ to 3 hours during the day and night. If your infant does not seem hungry, continue to attempt to breastfeed about every 2–3 hours. Wake your very young infant to breastfeed if he or she sleeps longer than 4 hours.

Indicators of Whether an Infant Is Getting Enough Milk

- Your exclusively breastfed infant is likely drinking enough if he or she:
 - Is gaining weight steadily even if slowly (this is a very important indicator);
 - Breastfeeds an appropriate number of times per day;
 - Can be heard swallowing regularly while breastfeeding (in a quiet room); and
- Has plenty of wet and soiled diapers (bowel movements) with pale yellow or nearly colorless urine; at least 4–8 wet and 3 soiled diapers per day in the first 3–5 days of life, 6 or more wet and 3–4 soiled diapers per day by 5–7 days of age (while not being given any extra fluids besides breast milk).

Relieving Common Breastfeeding Problems

Sore Nipples

To prevent or relieve sore nipples:

- Care for your breasts by:
 - Keeping your nipples dry between feedings – Air dry your nipples after

breastfeeding and place dry nursing pads or similar dry breathable cloth into your bra or leave the bra flaps open (if you wear a bra). Change the pads or cloths as soon as they become wet.

- When you wash your breasts, use clean water to wash the nipples. Soap or shampoo on the nipple and areola removes natural oils from them. Rinse off soap or shampoo that drips onto the nipples and areola during a bath or shower. Avoid rubbing the nipples with a washcloth or other cloth.
- Vary the positions used to breastfeed your infant. See page 57-58, for different feeding positions.
- Newborn infants should be fed every 1–3 hours; if fed less often:
 - The infant may be so hungry that he or she suckles vigorously and hurts the nipples; or
 - The breast may become so full with milk that the infant can not attach onto the breast adequately and just suckles the nipple.
- Have a WIC breastfeeding expert assess if your infant is held, positioned on the breast, and suckling correctly during breastfeeding. Make sure to hold your infant in the “chest to chest, chin to breast” position and that most of the areola (the dark part of the breast) is far into his or her mouth during breastfeeding.

Engorged Breasts

If your breasts become painfully full and firm (engorged), take these steps:

- Place warm, moist cloths or towels on your breasts or take a hot shower for about 10–20 minutes before a feeding to facilitate the milk ejection reflex.
- Express some milk to soften the areola (the dark part of the breast) and breast and allow the nipple to protrude easily so the infant can latch on.
- Massage the breasts to encourage the flow of milk and to relieve fullness.

- Apply cold compresses (e.g., a washcloth chilled and rinsed under cold water) to the breast after feedings to reduce swelling and pain.
- Breastfeed frequently and effectively every 1 to 3 hours to prevent engorgement.
- Contact your health care provider or a WIC breastfeeding expert if this problem does not go away.

Plugged Milk Duct

If you develop a tender area on your breast or a painful lump that can be felt in the breast (these symptoms usually indicate that there is a plugged milk duct), take these steps:

- Place warm, moist cloths on the lump and the rest of the breast or take a hot shower before a feeding.
- Massage the breast from the plugged area down to the nipple before and during breastfeeding.
- Breastfeed frequently (at least every 2 hours) and vary the positions used to feed the infant.
- Make sure your bra is not too tight; pressure on the breast can cause plugged milk ducts.
- Breastfeed with the infant's chin positioned toward the plugged duct and start breastfeeding on the affected breast first.
- Get plenty of rest.
- Contact your health care provider if this problem does not go away.

Mastitis

If either of your breasts becomes red or tender and you develop flu-like symptoms (body aches, headache, nausea, fever, chills, malaise), you may have mastitis. If you do have any of these symptoms, take these steps:

- See your health care provider immediately if you think you have a breast infection or your infant has an untreated infection. If your health care provider prescribes antibiotics for you, they will be the kind that does not harm your infant.
- Continue breastfeeding. Breastfeed frequently and use both breasts at each feeding.

- Make sure that your infant is positioned on the breast correctly.
- Get lots of rest to clear up the infection.

Breast Care

- Keep nipples dry between feedings. Some experts suggest expressing a few drops of breast milk on the nipples after breastfeeding and allowing them to air dry to prevent sore nipples.
- Avoid using harsh soaps and detergents on your nipples and areolae. If soap or shampoo gets on them during a shower or bath, rinse it off with plain, clean water. Too much soap on the nipples and areolae washes off protective oils and dries them out.
- Do not try to “toughen” the nipples by rubbing them with a towel or other cloth. This practice removes skin layers from the breast and irritates the nipples.
- Do not dry your nipples with a hair dryer or in heat lamp. This practice dries out the natural moisture of the skin and delays healing of sore or cracked nipples.
- Do not use creams, ointments, or oils on the nipples or areolae on a routine basis to heal sore nipples, abrasions, or cracks.
- Talk to a WIC breastfeeding expert if dry nipples are a problem and before using creams, ointments, or oils on the nipples or areolae.

Complementary Bottles

- If you plan to exclusively breastfeed your infant, avoid feeding complementary bottles of infant formula or water, or using pacifiers for the first 2 to 4 weeks of an infant's life. This will make it easier for the newborn infant to learn to suckle properly on the breast in the early weeks.
- It is possible to combine both breastfeeding and formula feeding. However, as a woman increases the amount of infant formula fed and decreases the number of feedings, her breast milk production will decrease, possibly resulting in total weaning.

Appetite/Growth spurts

- Appetite or growth spurts are short periods of time when the infant breastfeeds more frequently than normal.
- Although a mother may feel she has an insufficient milk supply, the infant is actually signaling the mother's body to produce more milk to meet his growing needs.
- Frequent feeding during this period will increase her milk supply to meet her infant's needs during this period and eventually he or she will resume a more normal feeding pattern.
- Periods when appetite spurts usually occur are 8 to 12 days, 6 weeks, 3 months, and 6 months. However, the length of time an infant goes through an appetite spurt may vary.

Expressing Breast Milk

Breast milk can be expressed by hand or with a breast pump. Read the pump's instructions or ask a WIC breastfeeding expert to show you how.

In preparing to express milk:

- Wash your hands first;
- Express the milk by hand or using a very clean pump; and
- Collect the milk in a very clean container (plastic or glass containers are the best).

In storing expressed milk:

- Store bottles of breast milk in a properly working refrigerator or freezer after you collect the milk and until ready to use (the temperature of the refrigerator should be 39 degrees Fahrenheit or below and the freezer should be 0 degrees Fahrenheit or below; these temperatures can be checked using special thermometers for refrigerators and freezers). If either is not available (e.g., at work or school), the milk can be stored for a short time in a cooler packed with ice or an ice gel pack.
- Use refrigerated bottles of milk within 48 hours from the time they were prepared.

- If planning to freeze breast milk, freeze it immediately in portions generally needed for a single feeding.
- Preferably, use clean glass or hard plastic bottles for storing and cap them tightly after filling.
- Use a bottle brush to clean bottles and nipples in hot soapy water. Rinse thoroughly. If your infant is less than 3 months old, sterilize those items by boiling them in water for 5 minutes or clean them in a dishwasher, as shown in Figures 6a, 6b, and 6c, pages 93–95, before reusing.
- Frozen breast milk can be stored for up to 1 month in a properly working self-contained freezer unit attached to a refrigerator or 3 to 6 months in a separate low-temperature freezer that maintains 0 degrees Fahrenheit or less.
- Label the container of milk for storage with the collection date. Use the oldest milk first.
- Once frozen breast milk is thawed, use it within 24 hours and do not refreeze it. Do not add warm milk to cold or frozen milk. Each time a liquid is added to frozen milk, a thin layer of milk thaws – germs can grow in this warmer layer.

On traveling with expressed milk:

- Store bottles of expressed breast milk in a cooler with ice or a cold pack.
- Do not travel with bottles of milk kept at room temperature.

When thawing and warming expressed breast milk:

- Thaw and warm only as much breast milk as you think the infant will need for a feeding. Milk should be thawed quickly.
- Thaw and warm a bottle of frozen expressed milk by:
 - Holding it under running cool water and then under running warm water; and
 - Shaking the bottle gently to mix (breast milk separates into a fatty layer and a watery layer when it is stored).
 - Do not set breast milk out to thaw at room temperature. Do not heat breast milk on a stove.

- Never use a microwave oven to thaw or warm breast milk – this is dangerous. Microwave heating can result in your infant’s mouth being burned from hot milk, a bottle exploding, or damage to special substances in the milk.
- Always test the temperature before feeding to make sure that it is not too hot or cold (test by squirting a couple of drops onto the back of your hand).

Planning for Time Away From Your Infant

If you decide to go back to work or school or be away from your infant for some time, your infant can continue breastfeeding successfully. If you choose to work, go to school, or leave your infant temporarily in someone else’s care, try these steps (for more detail on the steps, see pages 69–70):

- If possible, delay the return to work or school until the infant is at least 4 to 6 weeks old.
- Learn how to express breast milk by hand or by using a breast pump; try to begin expressing milk several weeks before you return to work or school (see above on expressing milk).
- Breastfeed the infant when home; pump milk during the day if possible. Some mothers go to their infant or have the infant brought to them for breastfeeding at lunch time. If you cannot express milk, infant formula prescribed by your health care provider can be provided to your infant when you are away.
- Make arrangements for safely storing expressed breast milk while away from home. It helps if a refrigerator is available for storage at work or school. If not, some mothers store their milk in a cooler packed with ice or an ice gel pack (see above for information on storage of breast milk).
- When making arrangements for child care for your infant (e.g., a babysitter or a day care center), try to choose a babysitter or day care center that is supportive of breastfeeding and, in the case of the center, allows you to

breastfeed if you visit. Instruct the babysitter or center on:

- How to use frozen breast milk; and
- How much expressed breast milk (or infant formula) the infant usually eats and how often he or she usually eats. The person taking care of the infant should still be encouraged to follow the infant’s lead in deciding when and how much to feed.
- Introduce your infant to drinking from a bottle and to being fed by someone else besides you – some recommend introducing a bottle 2 weeks before returning to work or school.
- Breastfeed regularly on weekends and evenings. As the week progresses, some breastfeeding mothers may find that there seems to be less milk to express – this is normal. You will make enough milk if you:
 - Breastfeed (or pump) often (six or more times a day during the week and more on weekends);
 - Get adequate rest; and
 - Eat a well-balanced, nutritious diet.

Alcohol, Cigarette Smoking, Caffeine, and Other Drugs

- Avoid drinking alcoholic beverages. If needed, ask clinic staff for information on services to limit your intake of alcohol.
- Avoid drinking more than 2–3 cups of coffee (caffeinated), hot chocolate, tea, or soft drinks containing caffeine (e.g., colas) per day.
- If you smoke, try very hard to quit smoking.
- Your smoking harms your health and the health of your infant and children. Ask clinic staff for information on services to help you quit smoking. If you are unable to quit smoking, take these steps:
 - Cut down on the number of cigarettes smoked;
 - Do not smoke while breastfeeding or around your infant (nicotine from the cigarette smoke enters your infant’s system from the air – the smoke can make your infant very sick); and

- Refrain from smoking until right after a feeding so that nicotine levels will have time to decrease before the next feeding.
- Ask other smokers you know to avoid smoking around your infant or other children.
- Tell your health care provider that you are breastfeeding and check with him or her before taking any drugs or medicines, even over-the-counter drugs like aspirin and cold medicines. Also, consult with your health care provider before taking any vitamin-mineral supplements.
- Avoid using any recreational or illicit drugs. If you use illicit drugs, ask clinic staff for information on services to help you stop using drugs.

Weaning

- If weaning a breastfed infant, try to do so gradually.
- You can wean your infant by replacing feedings from the breast with feedings of infant formula (or whole cow's milk if the infant is over 1 year old). The first feeding to replace is the one which the infant is least interested in or when the breasts do not feel full. Gradually, other feedings can be dropped and you can go from breastfeeding once per day to every other day.
- If your infant is over 6 months old and you wish to wean from the breast, the infant can be weaned to a cup or bottle. It may be easier to use powdered infant formula since it allows easy preparation of single feedings without wasting infant formula.
- Even though mostly weaned, an infant can still be breastfed just for comfort or to relax.

Infant Formula Feeding

Types of Infant Formula

- Iron-fortified cow's milk-based infant formula is the most appropriate choice for infants who are not breastfed. There are no known medical conditions for which the use of iron-fortified infant formula is contraindicated.
- Soy-based infant formulas are a safe and appropriate alternative to cow's milk infant formula. Soy-based infant formulas are indicated when:
 - The infant has galactosemia or hereditary lactase deficiency;
 - Caregivers choose a vegetarian diet for their infant; or,
 - Infants have documented IgE-mediated cow's milk protein allergy.
- DHA and ARA are long chain polyunsaturated fatty acids that are added to some infant formulas to mimic the composition of breast milk. Research demonstrating better cognitive function in breastfed infants has led some to support the addition of ARA and DHA to infant formula. The American Academy of Pediatrics (AAP) has not taken a position on the addition of DHA and ARA to infant formula.

When and How Much To Feed Your Infant

- Newborn infants may initially feed 8 to 12 times per day (every 3 to 4 hours) and may drink from 2 to 3 ounces at a feeding. As your infant gets older, he or she will gradually drink more infant formula at each feeding, feed fewer times per day, and drink a larger total amount of infant formula in a day.
- Feed your infant when he or she shows signs of hunger (the infant may wake and toss, suck on a fist, cry or fuss, or look like he or she is going to cry to show hunger). Respond to the early signs of hunger; do not wait until the infant is upset or crying from hunger.
- Continue to feed until your infant indicates fullness. Signs of fullness include: sealing the

lips, a decrease in sucking, spitting out the nipple, and turning away from the bottle.

- Between 6 and 12 months old, most infants begin eating more complementary foods thus decreasing their amount of infant formula intake.

Preparing for Feeding

- Hold, rock, or play with your infant when fussy or crying before concluding that it is time for a feeding. It is important to show love, comfort, cuddle, and talk to your infant during feedings but also between feedings.
- Gently and slowly calm your infant to get ready for feeding.

How To Feed With a Bottle

- Wash your hands with soap and hot water before feeding.
- Feed in a smooth and continuous fashion following your infant's lead on when to feed, how long to feed, and how much to feed.
- Hold your infant during bottle feedings. Tip the bottle so that milk fills the nipple and air does not get in. Hold your infant's head a little higher than the rest of the body to prevent milk from backing up in the inner ear and causing an ear infection.
- Make sure the nipple hole is large enough so that if you hold the bottle upside down, falling drops follow each other closely but do not make a stream. Also, adjust the nipple ring so that some air can get into the bottle to avoid a collapsing nipple.
- Do not prop the bottle – this can cause ear infections and choking, and it deprives the infant of important cuddling and human contact.

Burping

- Wait for your infant to pause or stop eating before burping. Burp by gently patting or rubbing the infant's back while he or she is held against the front of your shoulder and chest or held in a sitting position in your lap.

Do not be surprised if your infant brings up some milk along with the swallowed air or if he or she does not burp.

Do Not Feed a Bottle While Napping or Sleeping

- Do not offer the bottle at nap or bedtime. Allowing an infant to go to sleep with a bottle may lead to choking or early childhood tooth decay.

Drinking From a Cup

- Infant formula can be offered from a cup as your infant gets older. Infants will consume less infant formula from the bottle as their intake of complementary foods and drinking from a cup increases.
- Try to wean your infant off the bottle and onto a cup by about 12 months of age.

Purchasing, Preparing, and Storing Infant Formula

Infant Formula Selection

- In selecting cans of infant formula, check the formula's expiration date on the label, lid, or bottom of the can. If the date has passed, do not select that can.
- Do not select cans of infant formula that have dents, leaks, bulges, puffed ends, pinched tops or bottoms, or rust spots.
- Store cans of infant formula in a cool, indoor place – not in vehicles, garages, or outdoors.
- Before opening a can of infant formula, wash the can lid with soap and water to remove dirt that could contaminate the infant formula.

Infant Formula Preparation

- Prepare concentrated, ready-to-feed, or powdered infant formulas properly according to directions on the container or to instructions given to you by clinic staff. (Instructions for preparation of standard milk-based and soy-based infant formulas are also provided in figures 6a, 6b, and 6c, pages 93–95).

Sterilization of Water and Bottles

- If your infant is less than 3 months old, first clean bottles well using soap, hot water, and bottle and nipple brushes, and then either sterilize bottles and their parts (nipples, caps, rings) in boiling water for 5 minutes or wash them in a properly working dishwasher.
- If disposable plastic bottle liners are used, discard the bags after one use and either sterilize the nipples, rings, and caps in boiling water, or wash them in a dishwasher until the infant is at least 3 months old.
- After 3 months old, unless otherwise indicated by a health care provider, bottles and bottle parts can be washed using soap and hot water, and bottle and nipples brushes, or in a dishwasher.
- Preboil water for infant's formula until infant is 3 months old. Ask your health care provider about whether to boil the water used to prepare infant formula after infant is 3 months old.
- Water for infant formula preparation should be brought to a rolling boil, boiled for 1–2 minutes, and then cooled.

Safety of the Water Supply

- If you're pregnant or have an infant or child, it is a good idea to have your water tested for contaminants (e.g., lead, nitrates, and bacteria) which may be in some water supplies. If you use well water or water from a questionable source, it is important to have the water tested to check its quality. For more information on water safety and water testing, you can contact:
 - Your local health department
 - Your State drinking water office or
 - The Environmental Protection Agency's (EPA) Safe Drinking Water Hotline at 1-800-426-4791, from 9:00 a.m. to 5:30 p.m., Monday through Friday, Eastern Time.

If your water is contaminated, talk to your health care provider about finding an alternate source of clean, safe water for your infant. See pages 35–39 for more information on the safety of

water (including on lead, nitrates, and copper in water, well water, bottled water, and home water treatment units).

Storage of Infant Formula

- When preparing infant formula for storage, pour the infant formula into bottles in single feeding portions (e.g., pour 26 ounces of standard dilution infant formula into five bottles each containing 4 to 6 ounces).
- Store bottles of prepared infant formula in a properly functioning refrigerator until ready to use. Bacterial growth is reduced when infant formula is kept in a refrigerator, at temperatures at or below 40 degrees Fahrenheit.
- In general, it is recommended that caregivers:
 - Use refrigerated bottles of concentrated or ready-to-feed infant formula within 48 hours of preparation; or
 - Use refrigerated bottles of powdered infant formula within 24 hours of preparation.
- Do not freeze infant formula.
- Do not leave prepared bottles of infant formula out at room temperature longer than 1 hour.
- Throw out any infant formula left in a bottle after a feeding. The mixture of infant formula with an infant's saliva promotes the growth of disease-causing germs.

Traveling With Infant Formula

- When traveling with a formula-fed infant, take along a can of powdered infant formula and separate water in a clean bottle (or sterilized bottle if your infant is less than 3 months old). Then, the infant formula can be mixed up to make single bottles when needed. Alternately, single servings of infant formula could be used.
- Do not travel with bottles of unrefrigerated infant formula kept at room temperature.

Warming Infant Formula

- If your infant prefers a warmed bottle, warm the bottle of infant formula immediately before serving by holding it under running warm water.

- Warm only as much infant formula as you think your infant will need for a feeding. Test the temperature of the liquid in the bottle before feeding to make sure it is not too hot or cold. Shake the bottle well before testing the temperature. Test the temperature by squirting a couple of drops of the liquid onto the back of your hand.
- Never use a microwave oven to warm bottles – this is dangerous. Microwave heating can result in your infant’s mouth being burned from hot infant formula or a bottle exploding.

When Leaving Infant With a Temporary Caregiver

- If you leave your infant in the care of a babysitter or family member, give that person specific instructions for warming, feeding, and handling bottles of infant formula.

Introducing Complementary Foods

Signs of Developmental Readiness

- Introduce complementary foods when your infant is developmentally ready, which means that the infant can:
 - Hold his or her head up and sit in a chair with support;
 - Keep food in his or her mouth and swallow it; and
 - Close his or her lips over a spoon and scrapes food off as a spoon is removed from the mouth.

Appropriate Age for Complementary Foods

Between 4 to 6 months of age, most infants should be developmentally ready to consume complementary foods. The introduction of complementary foods should not be delayed beyond 8 months old.

How To Introduce Complementary Foods

- Wash your infant’s hands and face frequently and especially before he or she eats. An infant’s hands can pick up germs, lead paint dust, etc., which could be harmful.

- Feed complementary foods using a small spoon and a small unbreakable bowl.
- Do not feed infant cereal or other complementary foods in a bottle or an “infant feeder.” Infants who are not ready to eat from a spoon are not ready to eat complementary foods. Putting complementary foods in a bottle is a form of force feeding and is not recommended.
- During mealtime, your infant should be sitting comfortably in a sturdy highchair (or similar chair) that can safely secure him or her and prevent falls.
- When feeding your infant sit directly in front of your infant and offer the spoon straight ahead. Wait for the infant’s mouth to open before putting the spoon to the infant’s lips.
- At first, your infant may force much of the food out of his or her mouth, but gradually he or she will learn to move the food to the back of the mouth for swallowing. Over time, your infant will increase the amount of food eaten.
- Infants touch their food and play in it and should be expected to be messy. Be patient and do not scold your infant for spilling foods or beverages. Fabric or newspapers can be placed under the high chair to make cleaning up easier.
- Do not feed your infant while he or she is crawling or walking – eating while moving could cause choking.

How Much and How Often To Feed

- Let your infant be your guide as to how much food to feed. You may start with 1 to 2 teaspoons of each food once a day and gradually find that your infant will eat 2 to 4 tablespoons of each food at meals. At 4 to 6 months-old, the infant may start out with one meal per day that includes complementary foods, then gradually work up to about 3 meals and 2 to 3 snacks per day.
- Do not force your infant to finish a serving of food. Feed until your infant indicates fullness by:
 - Pulling away from the spoon.
 - Turning his or her head away.

- Playing with the food.
- Sealing his or her lips.
- Pushing the food out of his or her mouth.
- Throwing the food on the floor.
- Try to follow your infant's lead on how often and fast to feed, food preferences, and amount of food. Be patient and allow your infant time to adapt to the new textures and flavors of complementary foods.

Watching for Reactions to Food

- Introduce new foods gradually. Introduce only one new food at a time. Wait at least 7 days between introducing new foods so that you can watch for any reactions to the food. Observe your infant closely for reactions after feeding a new food.
- Introduce a small amount (e.g., about 1 to 2 teaspoons) of a new food at first (this allows the infant to adapt to a food's flavor and texture).
- Use single-ingredient foods at first so you can see how infant accepts them (e.g., try plain rice infant cereal before rice infant cereal mixed with fruit).
- Symptoms of a reaction to food may include diarrhea, vomiting, coughing and wheezing, respiratory symptoms, ear infections, shock, abdominal pain, hives, skin rashes (like eczema), and extreme irritability. Stop feeding those foods that your infant has a reaction to and ask your health care provider about the reaction. If your infant seems to be having a severe reaction to food (e.g., difficulty breathing, shock), contact 911 or take the infant to the nearest emergency room immediately.
- If your infant does not like the taste of a new food at first, try offering it again later. It takes up to 10 to 15 exposures to a new food for an infant to readily accept the food.

Water Needs When Complementary Foods Are Introduced

- An infant's health care provider may recommend feeding a small amount of sterile

water (–4 to 8 ounces per day) in a cup when your infant has started eating a variety of complementary foods especially protein-rich complementary foods (e.g., home-prepared meats, commercially-prepared plain meats and mixed dinners, egg yolks, cheese).

Vitamin/Mineral Supplements

- Do not give your infant vitamin drops unless your health care provider recommends them.
- Keep all vitamin/mineral pills or drops, and any other pills, medicines, poisons, etc., locked in a secure place out of your infant's reach.

Preparing Infant Foods at Home

Cleanliness

- Wash hands with soap and hot water and rinse thoroughly:
 - Before breastfeeding, bottle feeding, or preparing any food or bottles;
 - Before handling any food or food utensils;
 - After handling raw meat, poultry, or fish;
 - After changing an infant's diaper and clothing;
 - After using the bathroom or assisting a child in the bathroom;
 - After sneezing or coughing into tissues or hands or wiping noses, mouths, bottoms, sores, or cuts; and
 - After handling pets or other animals or garbage.
- Before preparing food, wash all working surfaces used to prepare food, such as countertops or tables, with soap and hot water and then rinse well with hot water.
- Before preparing food, wash all equipment, such as a blender, food mill, food processor, etc. carefully with soap and hot water. Rinse thoroughly with hot water and allow to air dry. Separate cutting boards should be used for animal foods (i.e., meat, poultry, and fish) and nonanimal foods (i.e., vegetables, fruits, breads).

Types of Food To Use

- Start with quality, fresh foods, if possible, when making infant foods. Plain, frozen foods, with no added sugar, salt, or sauces are also a good choice. If canned foods are used, select those without salt or syrup and packed in their own juice (if regular canned foods are used, pour off syrup or salty water and rinse the food with clean water).

Equipment

- Common kitchen equipment is all that is needed to make infant foods at home. The texture of foods can be changed to meet your infant's needs using a blender, food mill, food grinder, or strainer, or by mashing with a fork.

Food Preparation

In preparing the food:

- Wash, peel, and remove the seeds or pits from vegetables and fruits. Cook vegetables and hard fruits, like apples, until tender. Edible skins and peels can be removed either before or after cooking.
- Remove bones, fat, and gristle from meats, poultry, and fish. Meats, poultry, fish, dried beans or peas, and egg yolks (not egg whites) should be well cooked. Baking, boiling, broiling, poaching, and steaming are good cooking methods.
- Blend, grind, or mash the food to a texture and consistency that is appropriate for your infant's stage of development. Food texture should progress from being pureed to mashed to diced. Providing new textures encourages the infant's further development.
- If using the same foods that the family eats, the infant's portion should be separated before adding salt, sugar, syrup, gravy, sauces, etc. Infant food may taste bland to you, but it is fine for your infant.

Reducing Lead Exposure From Food

- Do not feed your infant canned imported foods or beverages – these cans may have lead seams (lead in seams can enter the food).
- In preparing, storing, or serving foods for your infant:
 - Avoid using ceramic ware or pottery, especially if imported from another country, for cooking, storing, or serving food or beverages.
 - Do not use leaded crystal bowls, pitchers, or other containers to store foods or beverages.
 - Never cook or store foods in antique or decorative ceramic or pewter vessels or dishes.
 - Do not use antique utensils for preparing or serving infant's foods.
 - Store foods or beverages in plastic or regular glass containers.

Serving Food

- Serve freshly cooked food to your infant shortly after preparing it. Allow the food to cool for a short time so that it does not burn your infant's mouth. Before feeding, test the temperature of foods.
- Foods should not be chewed by someone else. Saliva from another person can add harmful bacteria to an infant's food.

Storage of Food

- If freshly cooked food is not served to the infant, immediately refrigerate or freeze it. (Use a special thermometer to test if your refrigerator is 40 degrees F or below and your freezer is 0 degrees F or below.) Do not allow cooked foods to stand at room temperature; harmful germs can grow in the food at this temperature.
- Throw out foods that are left unrefrigerated for 2 hours. Remember the concept "If in doubt, throw it out." That is, if you think that you may have left your infant's food unrefrigerated for 2 or more hours, throw it out. Do not taste the food to see if it is safe because a food can contain harmful germs yet taste and smell normal.

- Two easy methods of storing infant food in serving-size amounts (after it has cooled) in the freezer include the ice cube tray method and the cookie sheet method:
 - Pour cooked pureed food into sections of a clean ice cube tray; cover with plastic wrap, a lid, or aluminum foil; and place into the freezer (ice cube tray method).
 - Place 1 to 2 tablespoons of cooked pureed food in separate spots on a clean cookie sheet, cover with plastic wrap or aluminum foil, and place into the freezer (cookie sheet method).
 - When frozen solid, the frozen food cubes or pieces can be stored in a freezer container or plastic freezer bags in the freezer. Label and date the bags or containers of frozen food and use them within 1 month.
 - When ready to use, the desired number of cubes or pieces can be removed from the bag or container and reheated.
 - Thaw food in the refrigerator or under cold running water. Do not thaw frozen infant food at room temperature. See page 120 for more detailed instructions.

Using Stored Food

- Use freshly prepared refrigerated food within 48 hours (except meats and egg yolks which should be used within 24 hours). Use frozen foods within 1 month.
- Thaw food in refrigerator or under cold running water and use it within 48 hours.
- Thoroughly reheat refrigerated or frozen home-prepared infant foods before feeding them to your infant. Reheating kills harmful germs that can grow slowly while a food is in the refrigerator or during thawing. Test the temperature of the food before feeding it to your infant.
- Throw out any leftover food that your infant does not eat.
- Do not refreeze infant food that has been removed from the freezer and allowed to thaw.

Purchasing, Serving, and Storing Commercially-Prepared Infant Food

Single-Ingredient Infant Foods Provide More Nutrition for Your Money

- Single-ingredient infant foods (like plain fruits, vegetables, and meats) provide more nutrition for your money than combination foods or mixed dinners.
- Older infants who are ready for foods with a chunkier texture can be transitioned to mashed or finely chopped home-prepared foods instead of infant food combination dinners; this helps the infant learn new eating skills.

Read Food Labels

- Read the ingredient list on the food label. Ingredients are listed on the label in order of those present in the largest amount to the smallest amount. Labels help you to tell, for example, which foods contain more water than others, and which contain added sugar and salt.

Selecting Commercially-Prepared Infant Foods

- Select containers that are clean, have no cracks, have no rust on the lid, and are not sticky or stained. Sticky jars may be cracked or have glass on them from cracked jars they were packed with.
- Observe “use-by” dates for purchase and pantry storage of unopened containers. If the date has passed, do not use the food.

Opening Containers

- Wash the container with soap and hot water before opening it.
- Make sure the vacuum seal on a jar or tub of infant food has not been broken before using the food.
- To make it easier to open the jar, run it under warm water for a few minutes. Do not tap the jar lid with a utensil or bang it against a hard surface; this could break glass chips into the food. If a grating sound is heard when opening the jar lid, check to see if there are any glass particles under the lid.

Heating the Food

- If you need to heat the food, a safe way to do so is by removing it from a container, heating it in a pan on the stove, stirring it, and testing its temperature before feeding.
- Never heat containers of infant food in a microwave oven. Even though some infant food jars indicate that they can be heated in a microwave, this could be dangerous. A microwave oven may heat the food unevenly so that some of the food is hot enough to burn the infant's mouth.

Serving the Food

- Remove the desired amount of food from the infant food container using a clean spoon and put it into a bowl for serving. Do not use the jar or tub as a serving dish. Most infants cannot finish a small container of infant food at one feeding. Always examine the food for abnormal particles when transferring it from the container to the bowl.
- If a spoon used for feeding is placed in a jar of food that will be stored and used for another feeding, the infant's saliva could contaminate and spoil the rest of the food.
- Throw away any leftover food in the bowl. Do not put leftover food back into the container because it could add germs to the food in the container.

Storing the Food

- Once a container is opened, store it in the refrigerator and use the food within 48 hours, except for infant food meats and egg yolks, which should be used within 24 hours. If food is not used within these time periods, throw it out.

When Leaving Infant With a Temporary Caregiver

- If you leave your infant in the care of a babysitter or family member, give that person specific instructions for warming, feeding, and handling the infant's food. Do not assume the person knows how to appropriately handle infant foods.

Use of Specific Types of Foods

(See Chapter 5 for more detailed information on the purchase, preparation, serving, and storage of the below foods.)

Infant Cereal

- Infant cereal can be introduced between ages 4 and 6 months if the infant is developmentally ready. Feed cereal to the infant using a spoon, not a bottle.
- Start with rice infant cereal as the first cereal introduced, followed by oat and barley cereals. Wait at least 7 days between trying each new cereal.
- Wait to introduce wheat infant cereal until your infant is 8 months old, when the infant is less likely to have an allergic reaction to wheat. Mixed grain infant cereals and infant cereal-and-fruit combinations may be tried after your infant has been introduced to each food separately in the mixture. Feed your infant cereal that is designed for infants. Avoid feeding your infant ready-to-eat cereals designed for adults and older children (these cereals do not contain the right amount of vitamins and minerals for an infant and may cause choking).
- Mix dry-pack infant rice cereal with expressed breast milk, infant formula, water, or pasteurized 100 percent fruit juice (if the infant has already tried it and had no reactions to it) to produce a smooth mixture. The consistency of all cereals can be thickened by adding less liquid as your infant matures. Measure the desired amount of dry cereal before adding the liquid.

Fruit Juice

- Juice offers no nutritional benefit over whole fruits and vegetables. If offered, it should be in a cup.
- Introduce pasteurized 100 percent fruit juice only when your infant is able to drink it from a cup with help. Do not feed fruit juice in a bottle because this practice increases the risk of developing early childhood tooth decay.

- Offer your infant only pasteurized 100 percent fruit juice. Avoid feeding your infant any fruit-flavored drinks, punches or aides, soda pop, gelatin water, or other beverages that are high in sugar and contain few nutrients. Read food labels carefully. Introduce single varieties of fruit juice first. If your infant has no reactions, then mixed juices, containing the single varieties of juice already tried, can be introduced.
- Watch for any reactions in your infant when introducing citrus (orange, tangerine, or grapefruit), pineapple, or tomato juices and delay introducing them until the sixth month or older – these juices may cause allergic reactions in some infants. If canned juices are used, pour the juice into a glass or plastic container for storage after the can is opened. Once the can is opened and air enters the can, the can begins to corrode, which can affect the juice’s flavor.
- Avoid feeding your infant imported canned juices because the seams of these cans may contain lead.
- Do not self-treat diarrhea or illness in your infant with fruit juices or sweetened beverages. Contact your health care provider.

Vegetables and Fruits

- Vegetables and fruits can be introduced between 4 and 6 months old if the infant is developmentally ready. Almost any soft-cooked fruit or vegetable can be fed as long as it is prepared in a consistency that the infant can safely eat. As your infant gets older, the thickness and lumpiness of vegetables and fruits can gradually be increased.
- Remember to wait at least 7 days between introducing each vegetable or fruit and observe your infant carefully for reactions to the food.
- These vegetables, for example, can be prepared as infant foods: asparagus, broccoli, brussels sprouts, cabbage, carrots, cauliflower, collard greens, green beans, green peas, green peppers, kohlrabi, kale, plantain, potatoes, spinach, summer or winter squash, and sweet potatoes. Fresh vegetables generally need to be cooked until just tender enough to be pureed or mashed.
- Do not feed home-prepared spinach, beets, turnips, carrots, or collard greens to your infant if less than 6 months old. These vegetables all tend to be high in nitrates (from the soil) which could harm very young infants.
- These fruits, for example, can be mashed (after peeling) without cooking if ripe and soft: apricots, avocado, bananas, cantaloupe, mango, melon, nectarines, papaya, peaches, pears, and plums. Stewed pitted dried fruits can be pureed or mashed. Apples, pears, and dried fruits usually need to be cooked in order to be pureed or mashed easily. Older infants who are developmentally ready can be given small pieces of ripe, soft fruit, such as ripe peeled peach, nectarine, or banana.
- Avoid feeding these vegetables and fruits to your infant due to the risk of choking: raw vegetables (including green peas, string beans, celery, carrot, etc.), cooked or raw whole corn kernels, whole grape or cherry tomatoes, whole grapes, berries, cherries, or melon balls, uncooked dried fruit (including raisins), fruit pieces with pits, whole pieces of canned fruit, and hard pieces of raw fruit.
- If commercially prepared infant food is used, plain vegetables and fruit provide more nutrition for your money than fruit desserts and mixtures.
- If vegetables and fruits are prepared at home, try to select high quality fresh or plain frozen produce to prepare infant’s food. If canned foods are used, select those without salt or syrup, or packed in their own juice (if regular canned foods are used, pour off syrup or salty water and rinse the food with clean water).
- Store opened jars of infant food vegetables or fruit for no longer than 48 hours in the refrigerator.

Protein-Rich Foods

- Infants can be introduced to these foods between 6 and 8 months old: cooked strained or pureed lean meat, chicken, or fish, cooked egg yolk, cooked dried beans or peas, tofu, mild cheese, cottage cheese, or yogurt.
- If using commercially prepared infant food meats, single-ingredient containers of meat (like beef, lamb, chicken) contain more nutrients for your money than mixed meat dinners (like chicken noodle, vegetable beef, or turkey rice dinner).
- After purchasing meats, poultry, fish, or eggs, get them home quickly and store them in the refrigerator or freezer. Keep juices from raw meat, poultry, and fish away from other foods (the juices that drip may have germs).
- If home-cooked meats are prepared, it is best to bake, broil, poach, stew, or boil the meat, poultry, or fish. After cooking, puree or finely chop the food. There is no need to add gravies or sauces to meats prepared for your infant.
- Cook meat, poultry, and fish until they are done:
 - Ground meats – 160 degrees Fahrenheit;
 - Ground poultry – 165 degrees Fahrenheit;
 - Beef, veal, and lamb steaks, roasts, and chops – 145 degrees Fahrenheit (medium rare), 160 degrees Fahrenheit (medium);
 - All cuts of fresh pork – 160 degrees Fahrenheit (medium);
 - Whole poultry, poultry parts – 165 degrees Fahrenheit; in the thigh;
 - Egg dishes – 160 degrees Fahrenheit; and
 - Fish – 145 degrees Fahrenheit.
- Store freshly cooked or opened containers of plain strained meats and egg yolks for no longer than 24 hours in a refrigerator.
- Avoid feeding your infant these foods:
 - Egg white, whole egg (because of the egg white), or shellfish before 1 year old – infants are often allergic to these foods;
 - Hot dogs, sausage, luncheon meats, bacon, or other cured meats – these meat products contain high levels of salt and fat; and
 - The fat and skin trimmed from meats.
- Never feed your infant any raw or partially cooked eggs, meat, poultry, or fish or products that contain them. These foods may contain harmful germs that could make your infant very sick.
- Watch closely for any reactions in your infant when introducing any fish. Fish may cause allergic reactions in some infants. Contact your State department of health or natural resources about the safety of local fresh water sport fish before feeding them to your infant. Avoid feeding your infant these fish: shark, swordfish, king mackerel, and tilefish (tilapia). Check for and carefully remove bones before cooking fish.
- Do not use eggs that are broken in the egg carton.
- Only feed the yolk of an egg to your infant. Do not feed egg whites to your infant until 1 year or older.
- Cottage cheese, hard cheeses, and yogurt can be gradually introduced as occasional foods. Cheese can be eaten cooked in foods or as slices (do not feed chunks of cheese, which could cause choking). Observe your infant closely for reactions after he or she eats these foods.
- Cooked legumes (dry beans and peas) or tofu (bean curd made from soybeans) can be introduced into an infant's diet as a protein food. It is best to introduce small quantities (1 to 2 teaspoons) of mashed or pureed legumes at first (whole beans or peas could cause choking). Observe to see if your infant does not like them, has a reaction to them, or appears to have difficulty digesting them. If so, they can be introduced again later.
- Tofu (bean curd) can also be mashed and fed to infants. Select fresh tofu; i.e., tofu prepared daily if made fresh or water-packed tofu that has not expired.
- When your infant starts on any of the above protein-rich foods, give him or her some water (about 4 to 8 ounces) to drink each day.

Grain Products

- Around 6 to 8 months old, infants can try plain crackers, teething biscuits, whole-grain or enriched bread, plain cooked noodles, macaroni, ground or mashed rice, corn grits, soft tortillas, zwieback, and graham crackers. An infant's risk of having a reaction to wheat decreases at this age. These foods can be introduced as snacks, finger foods, or as additional foods at meals.
- Avoid feeding your infant highly seasoned snack crackers or those with seeds; snack potato or corn chips, pretzels, cheese twists, breads with nut pieces, or whole-grain kernels of cooked rice, barley, wheat, or other grains. Infants can choke on these foods.

Finger Foods

- Between 6 and 8 months old, infants begin to feed themselves with their hands and can start to eat some foods that they can pick up and eat easily without choking.
- Good finger foods include dry toast, dry breakfast cereal, small pieces of soft, ripe, peeled fruits (like banana) or soft cooked vegetables, small slices of mild cheese, crackers, or teething biscuits. Make sure that the infant eats biscuits, toast, or crackers (and other foods) in an upright position.

Sweetened Foods and Sweeteners

- **Avoid feeding your infant these foods:**
 - Chocolate, before 1 year old – some infants are allergic to this food;
 - Commercially prepared infant food desserts or commercial cakes, cookies, candies, and sweet pastries – these foods tend to be high in sugar;
 - Sugar, maple syrup, molasses, corn syrup, glucose, or other syrups added to the infant's food or beverages, or put onto a pacifier; and
 - Foods, beverages, or powders containing artificial sweeteners.

- **Never feed honey – plain, in cooking or baking, or as part of processed foods – to your infant.** Honey sometimes contains dangerous spores which can cause a serious illness in an infant, called infant botulism.

Avoid Feeding Your Infant Excessive Amounts of Water

Do not feed your infant large amounts of water. Remember these points to make sure your infant does not take in too much water:

- Do not dilute your infant's formula with extra water in order to "stretch" it. Make and dilute infant formula correctly (see pages 91–92 and Figures 6a, 6b, and 6c, pages 93–95).
- If you have run out of the infant formula you get from WIC or CSFP and need more to feed your infant:
 - Ask the WIC or CSF Program staff about providing you with powdered infant formula which makes more formula per day than the concentrated or ready-to-feed infant formula; and
 - Contact the WIC or CSF Program staff or a social worker for help in getting extra formula for your infant.
- Do not feed your infant plain water or dilute liquids (e.g., fruit juice, sweetened beverages, and tea) in place of breast milk or infant formula. Water and fruit juice are meant to be fed in small amounts (about 4 to 8 ounces per day for water).
- Do not let your infant suck on or feed from a bottle of water or dilute liquids (e.g., fruit juice, sweetened beverages, tea) all day or for long periods of time. Young infants need to be fed enough breast milk, infant formula, and appropriate complementary foods to meet nutrition needs.
- Do not self-treat your infant if he has diarrhea or any other illness. See your health care provider immediately.
- Do not routinely feed water to your infant right after breastfeeding or formula feedings.
- An infant who drinks too much water and not enough breast milk, infant formula, or complementary food can get very sick.

Avoid feeding your infant any of these beverages:

- Coffee, regular or herbal teas, or hot chocolate – these beverages contain substances that may harm your infant;
- Whole cow's milk, goat's milk, soy or rice drinks or beverages, imitation milks, coffee creamers – these beverages do not have the right amount of nutrients needed by your infant.

Choking Prevention

Infants can choke easily. To decrease your infant's risk of choking:

- Hold your infant while feeding a bottle. Never “prop” a bottle for your infant at any age. Do not leave a bottle in infant's crib or playpen. (Older infants can hold the bottle while feeding but they should be sitting in your arms or in a highchair or similar chair and the bottle should be taken away when the feeding is finished).
- Make sure the hole in the nipple of your infant's bottle is not too large, to avoid the liquid from flowing through too rapidly.
- Supervise your infant's mealtimes and snacks and do not leave the infant alone when eating. Make sure your infant is sitting still and in an upright position during meals. Encourage your infant to eat slowly.
- Feed small portions.
- Avoid using teething pain relief medicine before mealtime since it may interfere with chewing.
- Serve foods that are the appropriate texture for your infant's development. Prepare food so that it is soft and does not require much chewing.
- Puree, blend, grind, or mash and moisten food for young infants.
- For the older infant close to 1 year old, who can chew cut foods into small pieces or thin slices that can easily be chewed.
- Cut round foods, like cooked carrots, into short strips rather than round pieces. Do not feed raw whole grapes, cherries, berries, melon balls, and grape or cherry tomatoes to your

infant; these fruits and vegetables should be cut into quarters, with pits removed, before feeding. Large pieces of food can become lodged in the throat and cause choking.

- Remove all bones from poultry and meat, and especially from fish, before cooking. Remove hard pits and seeds from vegetables and fruit.
- Substitute foods that may cause choking with a safe substitute, such as meat chopped up or mashed ground beef instead of hot dogs or pieces of tough meat.
- Do not feed whole grain kernels of wheat, barley, rice, etc. to your infant. These grains must be cooked and finely ground or mashed before being fed to an infant.
- Do not feed whole nuts or seeds or nut/seed butters to infants. Whole nuts and seeds can lodge in the throat or get caught in the windpipe and nut/seed butters can get stuck to the roof of the mouth.
- Make sure that biscuits, toast, and crackers are eaten only when infant is in an upright position. An infant who eats these foods while lying down could choke on crumbs.
- In summary, do not feed infants any:
 - Tough or large chunks of meat;
 - Hot dogs, meat sticks, or sausages;
 - Fish with bones;
 - Large chunks of cheese, especially string cheese;
 - Peanuts or other nuts and seeds;
 - Peanut and other nut/seed butters;
 - Whole beans;
 - Cooked or raw whole-kernel corn;
 - Whole uncut cherry or grape tomatoes;
 - Raw vegetable pieces (e.g., carrots, green peas, string beans, celery, etc.) or hard pieces of partially cooked vegetables;
 - Whole uncut grapes, berries, cherries, or melon balls or hard pieces of raw fruit;
 - Whole pieces of canned fruit (cut them up instead);
 - Fruit pieces with pits or seeds;
 - Uncooked raisins and other dried fruit;
 - Plain wheat germ;
 - Whole grain kernels;
 - Popcorn;
 - Potato/corn chips and similar snack foods;
 - Pretzels;

- Hard candy, jelly beans, caramels or gum drops/gummy candies;
 - Chewing gum; or
 - Marshmallows.
- If your health care provider prescribes teething pain relief medicine, avoid giving it to your infant before mealtime because it may interfere with chewing.

Oral Health

Cleaning the Mouth and Teeth

To keep your infant's teeth and gums clean and thus prevent tooth decay:

- Before teeth appear: Clean your infant's mouth beginning from the first day of life. Wipe out the mouth gently and massage the gums with a clean damp gauze pad or washcloth after feedings or at least twice a day, including before bedtime. More frequent cleaning than twice a day may be recommended by a health care provider.
- Once teeth appear:
 - Begin cleaning your infant's teeth as soon as they appear through the gums. Clean the teeth well after each feeding or at least twice a day, including before bedtime. More frequent cleaning than twice a day may be recommended by a health care provider, especially if your infant starts to develop tooth decay.
 - To clean the teeth, a very small, child-size toothbrush with soft, rounded end bristles may be used with extreme care. Use water only, not toothpaste since an infant will swallow it. Continue using a clean damp gauze pad or washcloth to clean those areas in the mouth without teeth.

Teething Tips

- During teething, your infant's gums may be red and puffy and you may feel or see the new tooth coming out.
- To soothe your infant's gums during teething, chill a clean favorite rattle, teething ring, pacifier, or a spoon in the refrigerator and offer it to chew on. You can also try cleaning the infant's mouth 2 to 3 times per day with a clean damp gauze pad or washcloth.
- Do not offer your infant ice chips or raw, hard vegetables like carrots, or rub alcohol on the infant's gums, to soothe your teething infant.

General Prevention of Tooth Decay

To prevent tooth decay:

- Bottles should be used for feeding only infant formula, expressed breast milk, or a small amount of water (see guidelines on pages 28–29 on feeding water).
- Feed 100 percent pasteurized fruit juice only in a cup. Drinking from a cup will be messy at first. Be patient and allow your infant to learn this skill.
- Do not feed sweetened beverages to infants either in a bottle or a cup. These beverages include water sweetened with honey, sugar, or corn syrup; soda pop; sweetened iced tea; fruit drinks, punches, or ades; sweetened gelatin; or other sweetened drinks. The infant should instead be fed more nutritious beverages that will help him or her grow, such as breast milk or infant formula (water and fruit juice can be fed, but in small amounts). If your infant is having diarrhea, contact your health care provider for advice on what to feed him or her to drink and eat.
- Do not leave a bottle in the infant's crib or playpen.
- Do not allow your infant to walk around or sit alone with a bottle or spill-proof cup for long periods.
- Offer the bottle only at feeding time, not when going to bed to sleep or for a nap. If your infant falls asleep during a feeding, move the infant around slightly to stimulate swallowing before putting him or her down to sleep.
- If you are having trouble getting your infant to stop taking a bedtime bottle, try showing your infant love in different ways besides the bedtime bottle; for example, give a security blanket or teddy bear, sing or play music, hold or rock your infant, or read a story to your infant.
- Never give your infant a pacifier dipped in honey, syrup, or sugar.

- Avoid giving your infant any concentrated sweet foods such as lollipops, sweet candies, candy bars, sweet cookies or cakes, or sweetened cereals, or adding sweeteners to his or her food.
- Gradually introduce your infant to infant formula/ breast milk from a cup between ages 6 and 12 months. Try to wean your infant off the bottle entirely by about 12 months old.
- Follow the advice of your medical or dental health care provider regarding your infant's fluoride needs.
- To discover and prevent tooth decay, take your infant to your health care provider or a pediatric dentist for a dental check by 12 months of age. If your infant seems to have dental problems or decay before that age, take him or her to a health care provider as soon as possible.
- A mother with tooth decay may increase her infant's chances of getting tooth decay. Thus, try to:
 - Avoid sharing eating utensils or toothbrushes with your infant;
 - Do not chew food and then feed it to your infant;
 - Take care of your mouth with regular toothbrushing, flossing, and dental care; and
 - Obtain treatment for any tooth decay you have.

Preventing Obesity

The following factors may play a part in the development of childhood obesity:

- Breastfeeding may be linked to lower rates of childhood obesity but research is still ongoing;
- Late weaning from a bottle has been linked to higher rates of obesity;
- Rapid weight gain in infancy has been linked to higher rates of obesity;
- A high degree of caregiver control over the infant or child's intake has been linked to higher rates of obesity; and
- Diets that are overly restrictive have been linked to higher rates of obesity.

Promoting Physical Activity

- Physical activity is important for infant development and to establish healthy skills and behaviors for later childhood. Caregivers should:
 - Nurture their infant's motor skill development and encourage physical activity;
 - Participate in parent-infant play groups;
 - Provide toys and activities that encourage infants to move and do things for themselves in a safe environment;
 - Gently move their infant to encourage muscle development and connections between the brain and muscles;
 - Avoid rough activities and pay attention to whether their infant is distressed and cries when played with too vigorously;
 - Avoid extended periods of inactivity, such as in an infant seat or swing; and,
 - Assist the infant's development of head and neck control.
- **Infant walkers are dangerous and should never be used.** Use of other infant equipment, such as swings, highchairs, bouncers, and infant seats should be kept to a minimum to encourage physical development.
- Place your infant on his or her back to sleep or rest (whether after feeding or at bedtime) to minimize the risk of Sudden Infant Death Syndrome (SIDS).
- When your infant is developmentally ready, place him/her on his stomach for some time each day during play to encourage development of head and neck control and enhance motor skill development.
- Structured infant exercise programs are not necessary to encourage healthy physical development and may place an infant at risk for injury.
- Infants should not be allowed to view television or other entertainment media. Instead, they should interact with caregivers in activities that stimulate brain development, such as talking, singing, playing, and reading.



APPENDIX

Note:

*These resources are for staff use only.
Materials are not intended to be used as
handouts for participants.*

Appendix A: Table 1
Food and Nutrition Board, National Academy of Sciences, National Research Council
Dietary Reference Intakes for Macronutrients and Fat Soluble Vitamins

Age		Carbohydrate (grams/day)	Fat (grams/day)	n-6 PUFA (grams/day)	n-3 PUFA (grams/day)	Protein (grams/day)	Vitamin A (µg RAE)	Vitamin D (µg[IU])	Vitamin E (α-tocopherol) (mg)	Vitamin K (µg)
0-6 months	AI	60	31	4.4	0.50	9.1 (1.52/kg)	400	5.0 (200)	4	2
	EAR									
	RDA									
	UL						600 µg preformed	25 (1,000)	ND	ND
7-12 months	AI	95	30	4.6	0.50		500	5.0 (200)	5	2.5
	EAR					9.9 (1.1/kg)				
	RDA					1.5 g/kg				
	UL						600 µg preformed	50 (2,000)	200	ND
1-3 years	AI	19 g/day of total fiber	ND	ND	0.7 g/day α-linolenic acid			5.0 (200)		30
	EAR	100					210		5	
	RDA	130				13 (1.10/kg)	300		6	
	UL						600 µg preformed	50 (2,000)	200	ND

Appendix A: Table 2
Food and Nutrition Board, National Academy of Sciences, National Research Council
Dietary Reference Intakes for Water Soluble Vitamins

Age	Vitamin C (mg)	Thiamin (mg)	Riboflavin (mg)	Niacin (NE)	Vitamin B6 (mg)	Folate (µg)	Vitamin B12 (µg)	Pantothenic Acid (mg)	Biotin (µg)
0-6 months	AI	0.2	0.3	2	0.1	65	0.4	1.7	5
	EAR								
	RDA								
	UL	ND	ND	ND	ND	ND	ND	ND	ND
7-12 months	AI	0.3	0.4	4	0.3	80	0.5	1.8	6
	EAR								
	RDA				1.5 g/kg				
	UL	ND	ND	ND	ND	ND	ND	ND	ND
1-3 years	AI								
	EAR	13	0.4	5	0.4	120	0.7	2	
	RDA	15	0.5	6	0.5	150	0.9		
	UL	400	ND	10	30 mg as pyroxidine	300	ND	ND	ND

**Appendix A: Table 3
Food and Nutrition Board, National Academy of Sciences, National Research Council
Dietary Reference Intakes for Minerals**

Age	Calcium	Chromium (µg)	Copper (µg)	Fluoride (mg)	Iodine (µg)	Iron (mg)	Magnesium (mg)	Manganese (mg)	Phosphorous (mg)	Selenium (µg)	Zinc (mg)
0-6 months	AI	0.2	200	0.01	110	0.27	30	0.003	100	15	2.0
	EAR										
	RDA										
	UL	ND	ND	0.7	ND	40	ND	ND	ND	45	4
7-12 months	AI	5.5	220	0.5	130		75	0.6	275	20	
	EAR					6.9					2.5
	RDA					11					3
	UL	ND	ND	0.9	ND	40	ND	ND	ND	60	5
1-3 years	AI	11		0.7				1.2			
	EAR		260		65	3.0	65		380	17	2.5
	RDA		340	6	90	7	80		460	20	3
	UL	400	1,000	1.3	200	40	65 mg supplementary	2	3.0g	90	7

APPENDIX B:

CDC NATIONAL CENTER FOR HEALTH STATISTICS (NCHS)

WIC GROWTH CHARTS

Use and Interpretation of the CDC Growth Charts

Purpose

This guide instructs health care providers on how to use and interpret the CDC Growth Charts to assess physical growth in children and adolescents. Using these charts, health care providers can compare growth in infants, children, and adolescents with a nationally representative reference based on children of all ages and racial or ethnic groups. Comparing body measurements with the appropriate age- and gender-specific growth chart enables health care providers to monitor growth and identify potential health- or nutrition-related problems.

During routine screening, health care providers assess physical growth using the child's weight, stature, length, and head circumference. Although one measurement plotted on a growth chart can be used to screen children for nutritional risk, it does not provide adequate information to determine the child's growth pattern. When plotted correctly, a series of accurate weights and measurements of stature or length offer important information about a child's growth pattern, which may be influenced by such factors as gestational age, birth weight, and parental stature. Parental stature, for example, is considered before assuming there is a health or nutrition concern. Other factors, such as the presence of a chronic illness or special health care need, must be considered, and further evaluation may be necessary.

Obtain accurate weights and measures

When weighing and measuring children, follow procedures that yield accurate measurements and use equipment that is well maintained.

Select the appropriate growth chart

Select the growth chart to use based on the age and gender of the child being weighed and measured.

Enter the child's name and the record number, if appropriate.

Record data After selecting the appropriate chart and entering the patient's name and record number, if appropriate, complete the data entry table.

- First, record information about factors obtained at the initial visit that influence growth.
 - Enter mother's and father's stature as reported.
 - Enter the gestational age in weeks.
- The next line is reserved for recording the child's birth data.
 - Enter the date of birth.
 - Enter birth weight, length, and head circumference.
 - Add notable comments (e.g., breastfeeding).
- Record information obtained during the current visit.
 - Enter today's date.
- Determine age to the nearest month for infants and $\frac{1}{4}$ year for children 2 to 20 years.
 - Enter the child's age.

Example of how to calculate the child's

age: To calculate Sam's age, subtract his birth date from the date of the visit or measurement. To subtract, it will be necessary to convert months to days and years to months if either the month or day

in the birth data is larger than in the date of measurements. When converting one month to days, subtract 1 from the number of months in the date of measurement, then add 28, 30, or 31, as appropriate, to the number of days. When converting one year to months, subtract 1 from the number of years in the date of measurement, then add 12 to the number of months.

	Year	Month	Day
Date of Measurement	1998	4	4
<i>Convert one month to days</i>		(-1)	(+30)
<i>Convert one year to months</i>	1998 (-1)	3 (+12)	34
	1997	15	34
Birth Date	1994	9	15
Childs age	3	6	19

Sam is aged 3 years, 6 months and 19 days.

Days	Month	Months	Year
0-15	0	0-1	0
16-31	1	2-4	1/4
		5-7	1/2
		8-10	3/4
		11-12	1

Using the guide above, 3 years, 6 months, and 19 days is rounded to 3 years and 7 months. Because age for children over 2 is rounded to the nearest ¼ year. Sam's age is rounded to 3½ years.

- Enter weight, stature, and head circumference (if appropriate) immediately after taking the measurement.
- Add any notable comments (e.g., was not cooperative).

Plot measurements On the appropriate growth chart, plot the measurements recorded in the data entry table for the current visit.

- Find the child's age on the horizontal axis. When plotting weight-for-length, find the

length on the horizontal axis. Use a straight edge or right-angle ruler to draw a vertical line up from that point.

- Find the appropriate measurement (weight, length, stature, head circumference, or BMI) on the vertical axis. Use a straight edge or right-angle ruler to draw a horizontal line across from that point until it intersects the vertical line.
- Make a small dot where the two lines intersect.

Interpret the plotted measurements The curved lines on the growth chart show selected percentiles that indicate the rank of the child's measurement. Interpret the plotted measurements based on the percentile ranking and the percentile cutoff. If the percentile rank indicates a nutrition-related health concern, additional monitoring and assessment are recommended.

- Determine the percentile rank.
- Determine if the percentile rank suggests that the anthropometric index is indicative of nutritional risk based on the percentile cutoff value.
- Compare today's percentile rank with the rank from previous visits to identify any major shifts in the child's growth pattern and the need for further assessment.

* *See Policy Memorandum 98–99: WIC Nutrition Risk Criteria*

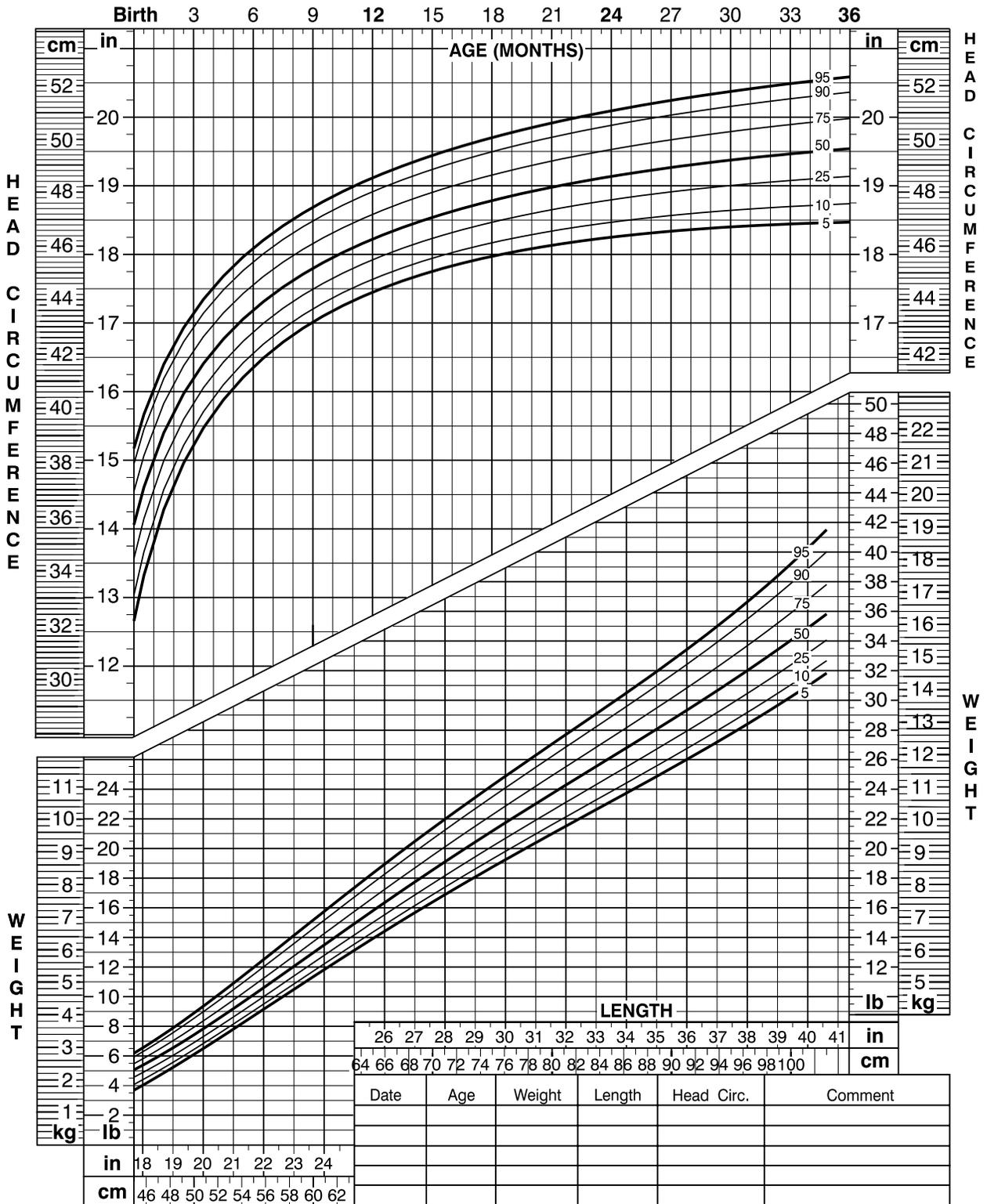
References

1. World Health Organization. Physical Status: The Use and Interpretation of Anthropometry. Geneva: World Health Organization, 1995. WHO Technical Report Series 854.
2. American Academy of Pediatrics. Pediatric Nutrition Handbook. 4th ed. Elk Grove Village, IL: American Academy of Pediatrics. 1998;4:168–169.
3. Kuczmarski RJ, Ogden C, Grummer-Strawn LM, et al. CDC Growth Charts: United States. Hyattsville, MD: U.S. Department of Health and Human Services, 2000. NCHS Advance Data Report No. 314.
4. Himes JH, Dietz WH. Guidelines for overweight in adolescent preventive services: Recommendations from an expert committee. American Journal of Clinical Nutrition 1994;59:307–316.
5. Barlow SE, Dietz WH. Obesity evaluation and treatment: Expert committee recommendations. Pediatrics 1998;102(3):E29.
6. Nelhaus G. Head circumference from birth to eighteen years: Practical composite international and interracial graphs. Pediatrics 1968;41:106–114.
7. WIC CDC Growth Charts may be viewed, downloaded, and printed in Adobe Acrobat from the WIC Works Resource System (WIC Works).
8. *Adapted from* <http://www.cdc.gov/nccdphp/dnpa/growthcharts/00binaries/growthchart.pdf>

Birth to 36 months: Boys
Head circumference-for-age and
Weight-for-length percentiles

NAME _____

RECORD # _____



Available at <http://www.nal.usda.gov/wicworks>

SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2002). <http://www.cdc.gov/growthcharts>



WIC Makes A Difference

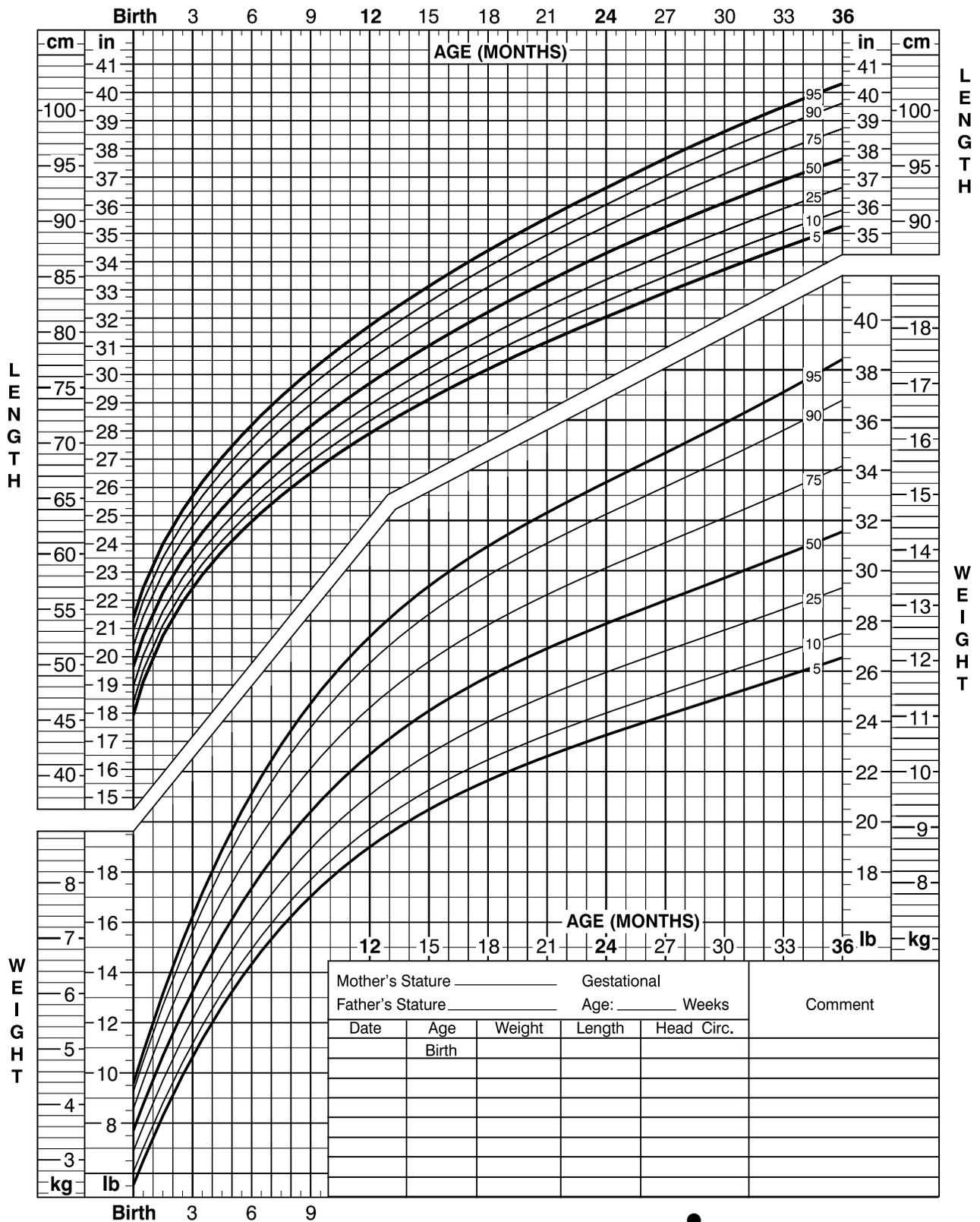


SAFER • HEALTHIER • PEOPLE™

Birth to 36 months: Boys
Length-for-age and Weight-for-age percentiles

NAME _____

RECORD # _____



Mother's Stature _____		Gestational Age: _____ Weeks		Comment
Father's Stature _____				
Date	Age at Birth	Weight	Length	

Available at <http://www.nal.usda.gov/wicworks>

SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2002). <http://www.cdc.gov/growthcharts>



WIC Makes A Difference

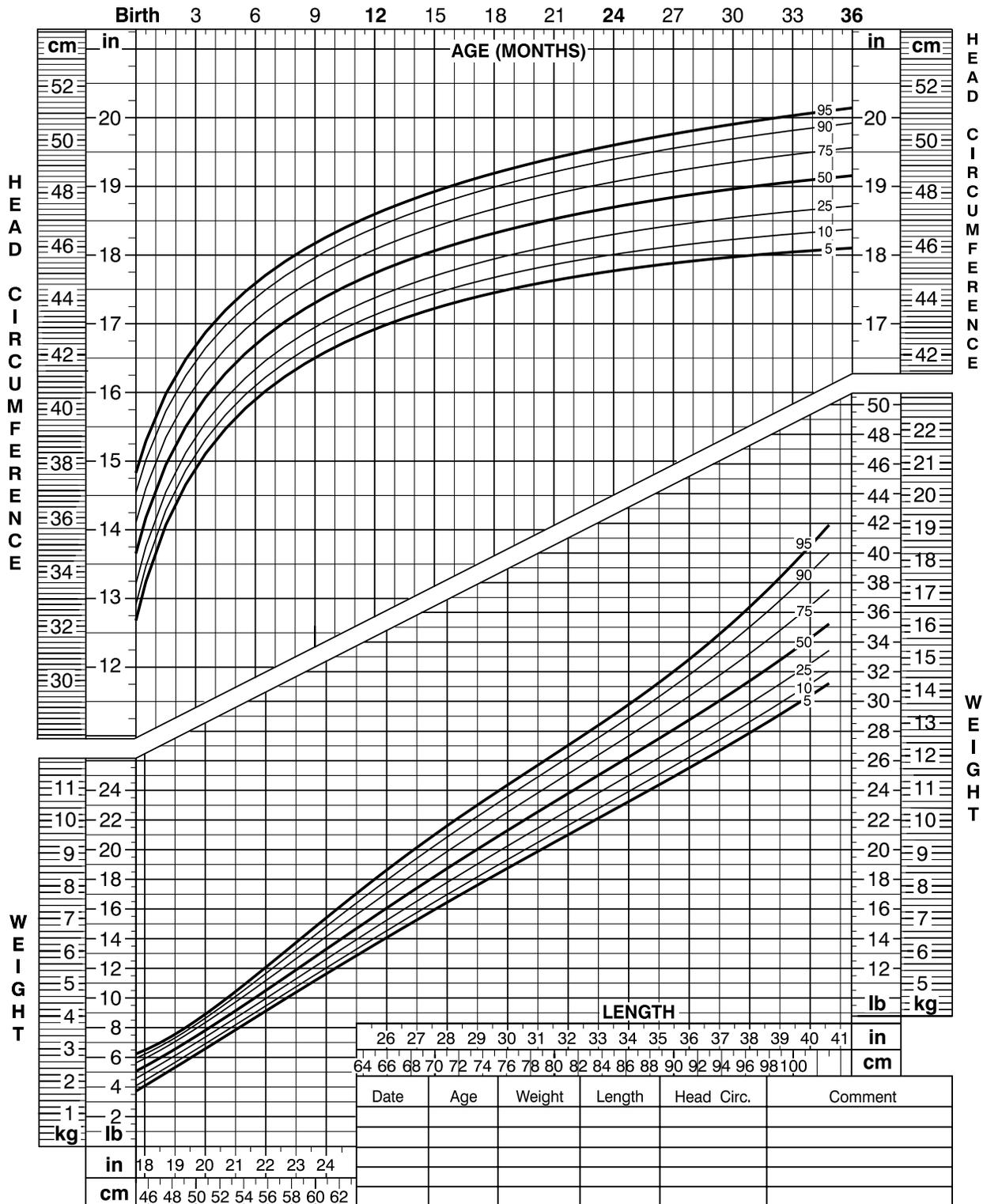


SAFER • HEALTHIER • PEOPLE™

Birth to 36 months: Girls
Head circumference-for-age and
Weight-for-length percentiles

NAME _____

RECORD # _____



Available at <http://www.nal.usda.gov/wicworks>

SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2002). <http://www.cdc.gov/growthcharts>



WIC Makes A Difference



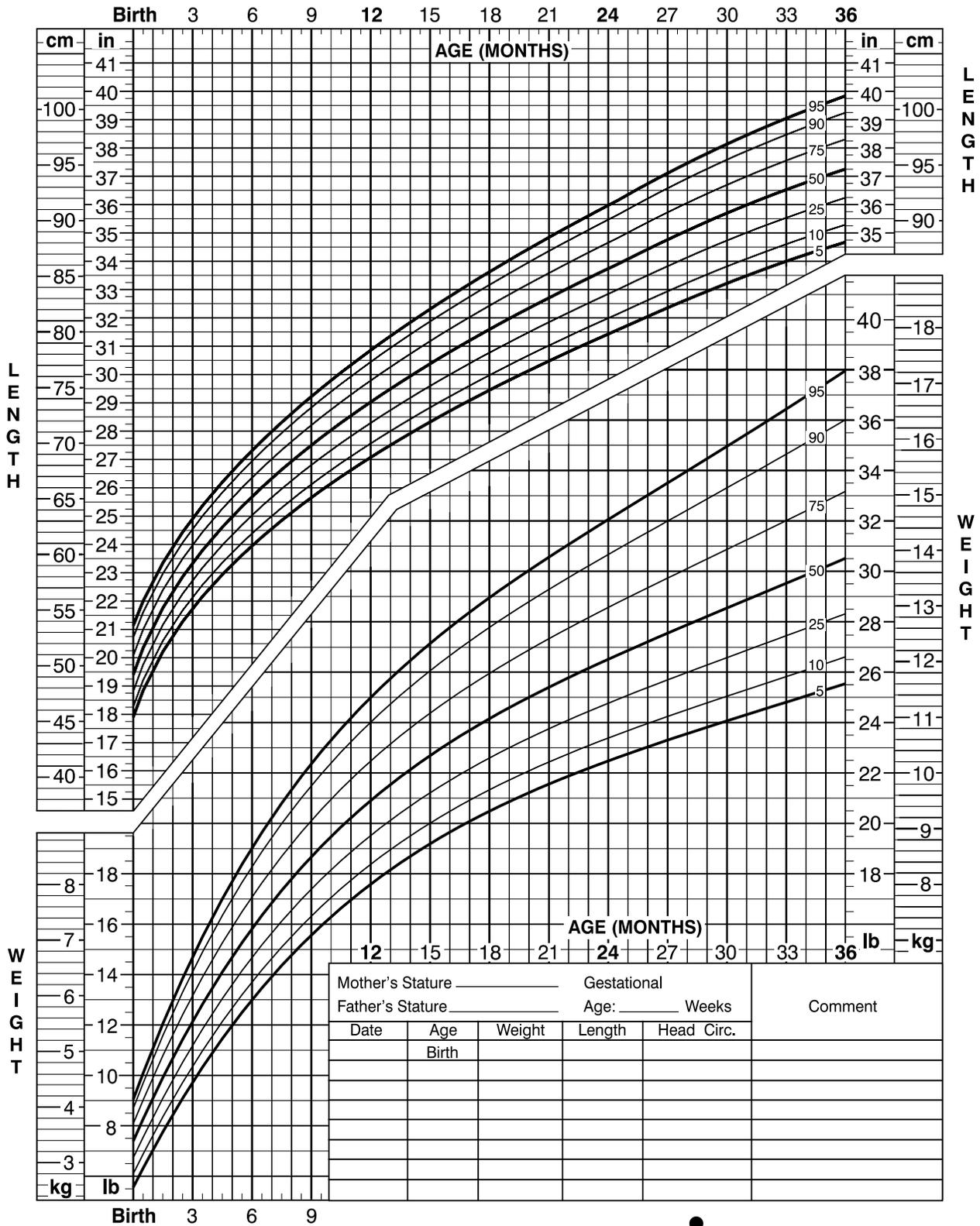
SAFER • HEALTHIER • PEOPLE™

Birth to 36 months: Girls

Length-for-age and Weight-for-age percentiles

NAME _____

RECORD # _____



Available at <http://www.nal.usda.gov/wicworks>

SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2002). <http://www.cdc.gov/growthcharts>



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Appendix C: Nutrient Chart - Function, Deficiency and Toxicity Symptoms, and Major Food Sources

Nutrient	Function	Deficiency Symptoms	Toxicity Symptoms	Major Food Sources
Protein	Anabolism of tissue proteins; helps maintain fluid balance; energy source; formation of immunoglobulins; maintenance of acid-base balance; important part of enzymes and hormones	Kwashiorkor-edema; reddish pigmentation of hair and skin; fatty liver; retardation of growth in children; diarrhea; dermatosis; decreased T-cell lymphocytes with increased secondary infections; Ketosis	Azotemia; acidosis; hyperammonemia	Breast milk, infant formula, meat, fish, poultry, egg yolk, cheese, yogurt, legumes
Carbohydrate	Major energy source; protein sparing; necessary for normal fat metabolism; glucose is the sole source of energy for the brain; many sources also provide dietary fiber	Eczema; low growth rate in infants; lowered resistance in infection; hair loss		Breast milk; infant formula; whole-grain breads, cereals, and other fortified or enriched grain products; potatoes; corn; legumes; fruits; vegetables
Fat	Concentrated energy source; protein sparing; insulation for temperature maintenance; supplies essential fatty acids; carries fat-soluble vitamins A, D, E, K	Rickets (symptoms: costochondral beading, epiphyseal enlargement, cranial bossing, bowed legs, persistently open anterior fontanelle)	Abnormally high blood calcium (hypercalcemia), retarded growth, vomiting, nephrocalcinosis	Breast milk, infant formula, protein-rich foods (meats, dairy products, egg yolk, nuts), butter, margarine, cream, salad oils and dressings, cooking and meat fats
Vitamin D	Necessary for the formation of normal bone; promotes the absorption of calcium and phosphorus in the intestines	Night blindness, dry eyes, poor bone growth, impaired resistance to infection, papillary hyperkeratosis of the skin	Fatigue; night sweats; vertigo; headache; dry and fissured skin; lips; hyperpigmentation; retarded growth; bone pain; abdominal pain; vomiting; jaundice; hypercalcemia	Infant formula, egg yolk, liver, fatty fish, sunlight (activation of 7-dehydrocholesterol in the skin)
Vitamin A	Preserves integrity of epithelial cells; formation of rhodopsin for vision in dim light; necessary for wound healing, growth, and normal immune function	Hemolytic anemia in the premature and newborn; hyporeflexia, and spinocerebellar and retinal degeneration	May interfere with vitamin K activity leading to prolonged clotting and bleeding time; in anemia, suppresses the normal hematologic response to iron	Breast milk, infant formula, liver, egg yolk, dark green and deep yellow vegetables and fruits
Vitamin E	May function as an antioxidant in the tissues; may also have a role as a coenzyme; neuromuscular function			Breast milk; infant formula; vegetable oils; liver; egg yolk; butter; green leafy vegetables; whole-grain breads, cereals, and other fortified or enriched grain products; wheat germ

Nutrient	Function	Deficiency Symptoms	Toxicity Symptoms	Major Food Sources
Vitamin K	Catalyzes prothrombin synthesis; required in the synthesis of other blood clotting factors; synthesis by intestinal bacteria	Prolonged bleeding and prothrombin time; hemorrhagic manifestations (especially in newborns)	Possible hemolytic anemia; hyperbilirubinemia (jaundice)	Infant formula, vegetable oils, green leafy vegetables, pork, liver
Ascorbic Acid (Vitamin C)	Essential in the synthesis of collagen (thus, strengthens tissues and improves wound healing and resistance to infection); iron absorption and transport; water-soluble antioxidant; functions in folacin metabolism	Scurvy, pinpoint peripheral hemorrhages, bleeding gums, osmotic diarrhea	Nausea, abdominal cramps, diarrhea, possible formation of kidney stones	Breast milk, infant formula, fruits (especially citrus fruits, papaya, cantaloupe, strawberries), vegetables (potatoes, cabbage)
Vitamin B12 (Cobalamin, Cyanocobalamin)	Essential for biosynthesis of nucleic acids and nucleoproteins; red blood cell maturation; involved with folate metabolism; central nervous system metabolism	Pernicious anemia; neurologic deterioration		Infant formula, breast milk, meat, fish, poultry, cheese, egg yolk, liver
Folacin (Folate)	Essential in the biosynthesis of nucleic acids; necessary for the normal maturation of red blood cells	Poor growth; megaloblastic anemia (concurrent deficiency of vitamin B12 should be suspected); impaired cellular immunity	Masking of B12 deficiency symptoms in those with pernicious anemia not receiving cyanocobalamin	Breast milk; infant formula; liver; green leafy vegetables; legumes; whole-grain breads, cereals, and fortified or enriched grain products; legumes; oranges; cantaloupe; lean beef
Pyridoxine (Vitamin B6)	Aids in the synthesis and breakdown of amino acids and unsaturated fatty acids from essential fatty acids; essential for conversion of tryptophan to niacin; essential for normal growth	Microcytic anemia; convulsions; irritability	Sensory neuropathy with progressive ataxia; photosensitivity	Breast milk; infant formula; liver; meat; whole-grain breads, cereals, or other grain products; legumes; potatoes
Thiamin (Vitamin B1)	Combines with phosphorus to form thiamin pyrophosphate (TPP) necessary for metabolism of protein, carbohydrate, and fat; essential for growth, normal appetite, digestion, and healthy nerves	Beriberi, neuritis, edema, cardiac failure		Breast milk; infant formula; lean pork; wheat germ; whole-grain and enriched breads, cereals, and other grain products; legumes; potatoes

Nutrient	Function	Deficiency Symptoms	Toxicity Symptoms	Major Food Sources
Riboflavin (Vitamin B2)	Essential for growth; plays enzymatic role in tissue respiration and acts as a transporter of hydrogen ions; synthesis of FMN and FAD	Photophobia, cheilosis, glossitis, corneal vascularization, poor growth	Transient due to the vasodilating effects of niacin (does not occur with niacinamide)-flushing, tingling, dizziness, nausea; liver abnormalities; hyperuricemia; decreased LDL and increased HDL cholesterol	Breast milk; infant formula; meat; dairy products; egg yolk; legumes; green vegetables; whole-grain breads, cereals, and fortified or enriched grain products
Niacin	Part of the enzyme system for oxidation, energy release; necessary for synthesis of glycogen and the synthesis and breakdown of fatty acids	Pellegra: dermatitis, diarrhea, dementia	Excessive calcification of bone; calcification of soft tissue; hypercalcemia; vomiting; lethargy	Breast milk; infant formula; meat; poultry; fish; whole-grain breads, cereals, and fortified or enriched grain products; egg yolk
Calcium	Builds and maintains bones and teeth; essential in clotting of blood; influences transmission of ions across cell membranes; required in nerve transmission	Rickets – abnormal development of bones.	Hemochromatosis; hemosiderosis.	Breast milk, infant formula, yogurt, cheese, fortified or enriched grain products, some green leafy vegetables (such as collards, kale mustard greens, and turnip greens), tofu (if made with calcium sulfate), sardines, salmon
Iron	Essential for the formation of hemoglobin and oxygen transport; increases resistance to infection; functions as part of enzymes involved in tissue respiration. Component of many enzyme systems and insulin	Hypochromic microcytic anemia; malabsorption; irritability; anorexia; pallor, lethargy	Acute gastrointestinal upset; vomiting; sweating; dizziness; copper deficiency	Breast milk; infant formula; meat; liver; legumes; whole-grain breads, cereals, or fortified or enriched grain products; and dark green vegetables
Zinc	Component of many enzyme systems and insulin	Decreased wound healing, hypogonadism, mild anemia, decreased taste acuity, hair loss, diarrhea, growth failure, skin changes	Mottled, discolored teeth; possible increase in bone density; calcified muscle insertions and exotosis	Breast milk; infant formula; meat; liver; egg yolk; oysters and other seafood; whole-grain breads, cereals, and other fortified or enriched grain products; legumes
Fluoride	Helps protect teeth against tooth decay; may minimize bone loss	Increased dental caries		Fluoridated water
Chloride	Helps regulate acid-base equilibrium and osmotic pressure of body fluids; component of gastric juices	Usually accompanied by sodium depletion; see Sodium		Breast milk, infant formula, sodium chloride (table salt)

Nutrient	Function	Deficiency Symptoms	Toxicity Symptoms	Major Food Sources
Chromium	Required for normal glucose metabolism; insulin cofactor	Glucose intolerance; impaired growth; peripheral neuropathy; negative nitrogen balance; decreased respiratory quotient		Meat; whole-grain breads, cereals, and other fortified or enriched grain products; brewer's yeast; corn oil
Copper	Facilitates the function of many enzymes and iron; may be an integral part of RNA, DNA molecules	Pallor, retarded growth, edema, anorexia	Wilson's disease – copper deposits in the cornea; cirrhosis of liver; deterioration of neurological processes	Liver; kidney; poultry; shellfish; legumes; whole-grain breads, cereals, and other grain products
Iodine	Helps regulate thyroid hormones; important in regulation of cellular oxidation and growth	Endemic goiter; depressed thyroid function; cretinism	Possible thyroid enlargement	Breast milk, infant formula, seafood, iodized salt
Magnesium	Required for many coenzyme oxidation-phosphorylation reactions, nerve impulse transmissions, and for muscle contraction	Muscle tremors; convulsions; irritability; tetany; hyper- or hypoflexia	Diarrhea; transient hypocalcemia	Breast milk; infant formula; whole-grain breads, cereals, and other grain products; tofu; legumes; green vegetables
Manganese	Essential part of several enzyme systems involved in protein and energy metabolism	Impaired growth; skeletal abnormalities; neonatal ataxia	In extremely high exposure from contamination: severe psychiatric and neurologic disorders	Whole-grain breads, cereals, and other grain products; legumes; fruits; vegetables (leafy)
Molybdenum	Part of the enzymes xanthine oxidase and aldehyde oxidase, possibly helps reduce incidence of dental caries		Goutlike syndrome	Organ meats; breads, cereals, and other grain products; dark green leafy vegetables; legumes
Phosphorus	Builds and maintains bones and teeth; component of nucleic acids, phospholipids; as coenzyme functions in energy metabolism; buffers intracellular fluid	Phosphate depletion unusual – effects renal, neuromuscular, skeletal systems as well as blood chemistries	Hypocalcemia (when parathyroid gland not fully functioning)	Breast milk; infant formula; cheese; egg yolk; meat; poultry; fish; whole-grain breads, cereals, and other grain products; legumes
Potassium	Helps regulate acid-base equilibrium and osmotic pressure of body fluids; influences muscle activity, especially cardiac muscle	Muscle weakness; decreased intestinal tone and distension; cardiac arrhythmias; respiratory failure		Breast milk; infant formula; fruits especially orange juice, bananas, and dried fruits; yogurt; potatoes; meat; fish; poultry; soy products; vegetables

Nutrient	Function	Deficiency Symptoms	Toxicity Symptoms	Major Food Sources
Selenium	May be essential to tissue respiration; associated with fat metabolism and vitamin E; acts as an antioxidant	Myalgia; muscle tenderness; cardiac myopathy; increased fragility of red blood cells; degeneration of pancreas		Whole-grain breads, cereals, and other fortified or enriched grain products; onions; meats; seafood; dependent on soil content – vegetables
Sodium	Helps regulate acid-base equilibrium and osmotic pressure of body fluids; plays a role in normal muscle irritability and contractility; influences cell permeability	Nausea; cramps; vomiting; dizziness; apathy; exhaustion; possible respiratory failure		Sodium chloride (table salt), abundant in most foods except fruit
Pantothenic Acid	Functions in the synthesis and breakdown of many vital body compounds; essential in the intermediary metabolism of carbohydrate, fat, and protein	Fatigue; sleep disturbances; nausea; muscle cramps; impaired coordination; loss of antibody production	Diarrhea; water retention	Breast milk; infant formula; meat; fish; poultry; liver; egg yolk; yeast; whole-grain breads, cereals, and other grain products; legumes; vegetables
Biotin	Essential component of enzymes; important in reactions involving the lengthening of carbon chains; coenzyme carrier of carbon dioxide; plays an important role in the metabolism of fatty acids and amino acids	Seborrheic dermatitis; glossitis; nausea; insomnia;		Breast milk, infant formula, liver, meat, egg yolk, yeast, bananas, most vegetables, strawberries, grapefruit, watermelon,

Chart revised from first edition using following references:
 Maher LK, Escott-Stump S. Krause's Food, Nutrition, and Diet Therapy. 11th ed. USA: Elsevier, 2004.
 Vitamins. In: Kleinman RE, editor. Pediatric Nutrition Handbook. 5th ed. Elk Grove Village, IL: American Academy of Pediatrics, 2004.

Appendix D: Guidelines for Feeding Healthy Infants, Birth to 1 Year Old

(Note: These are general guidelines for the healthy, full-term infant per day; serving sizes may vary with individual infants.)

Age	Breast Milk or Infant Formula	Grain Products	Juices	Vegetables	Fruits	Protein-Rich Foods
Birth–4 Months	Breast: 8–12+ feedings Iron-Fortified Infant Formula: 14–42 ounces (~108 kcal/kg body weight)	None				
4–6 Months	Breast: 5 or more feedings Iron-Fortified Infant Formula: 26–39 ounces (~108 kcal/kg body weight)	Iron-fortified infant cereals or enriched hot cereals (1–2 Tbsp)	None	Plain strained or pureed cooked vegetables (1–2 Tbsp)	Plain strained or pureed fresh or cooked fruits (1–2 Tbsp)	Plain strained or pureed protein-rich foods such as meats, egg yolk, and legumes may be introduced if an additional food source of iron is needed
The American Academy of Pediatrics (AAP) Section on Breastfeeding recommends exclusive breastfeeding for the first 6 months of life. The AAP Committee on Nutrition recommends that, in developed countries, complementary foods may be introduced between ages 4 and 6 months. This is a population-based recommendation, and the timing of introduction of complementary foods for an individual infant may differ from this recommendation.						
6–8 Months	Breast: 3–5 feedings Iron-Fortified Infant Formula: 24–32 ounces (~98 kcal/kg body weight)	Iron fortified infant cereals or enriched hot cereals (4–6 Tbsp) Dry toast, small pieces of crackers, or dry breakfast cereals and other grain products (4–6 Tbsp)	100 percent pasteurized fruit or vegetable juice (2–4 ounces) * Juice offers no nutritional benefit over whole fruits and vegetables. If offered, it should be in a cup.	Plain strained or pureed cooked vegetables (3–4 Tbsp)	Plain strained or pureed fresh or cooked fruits (3–4 Tbsp)	Plain strained or pureed protein-rich foods such as meats, egg yolk, and legumes (1–2 Tbsp)

Age	Breast Milk or Infant Formula	Grain Products	Juices	Vegetables	Fruits	Protein-Rich Foods
8-12 Months	Breast: 3-4 feedings Iron-Fortified Infant Formula: 24-32 ounces (~98 kcal/kg body weight)	Iron-fortified infant cereals or enriched hot cereals (4-6 Tbsp) Dry toast, small pieces of crackers, or dry breakfast cereals and other grain products (4-6 Tbsp)	100 percent pasteurized fruit or vegetable juice (2-4 ounces) * Juice offers no nutritional benefit over whole fruits and vegetables. If offered, it should be in a cup.	Plain pureed, mashed, or chopped cooked vegetables (3-4 Tbsp)	Plain pureed, mashed, or chopped cooked fruits (3-4 Tbsp)	Pureed or chopped lean meat, poultry, fish, egg yolk, cheese, yogurt, or mashed legumes (1-3 Tbsp)
Comments	<ul style="list-style-type: none"> By about 12 to 14 months, try to wean entirely off the bottle and onto a cup. An infant's health care provider may recommend feeding a small amount of sterile water (~4 to 8 ounces per day) in a cup when complementary foods are introduced. 	<ul style="list-style-type: none"> Examples of other grain products include zwieback, bread, noodles, mashed rice, corn grits, and soft tortilla pieces. Avoid wheat cereals until 8 months. Do not add sugar or syrups to cereal. Never add honey to cereal or any foods. Avoid foods that may cause choking. 	<ul style="list-style-type: none"> Avoid feeding soda, fruit punches, ades, and drinks, gelatin water, coffee, or tea. 	<ul style="list-style-type: none"> It is not necessary to add salt, sugar, oil, butter, other fats, or seasonings. Avoid foods that may cause choking. 	<ul style="list-style-type: none"> Do not add sugar or syrups to fruits. Never add honey to fruit or any foods. Remove seeds and pits from fruits. Avoid foods that may cause choking 	<ul style="list-style-type: none"> Avoid fried meats, gravies, sauces, processed meats (e.g., hot dogs, luncheon meats, bacon, and sausage). Check carefully for bones (especially in fish). Do not feed any shellfish, peanut butter, whole eggs, or egg whites before 1 year of age. Avoid foods that may cause choking.

Bibliography

- Nevin-Folino NL, editor. *Pediatric Manual of Clinical Dietetics*. 2nd ed. Chicago, IL: American Dietetic Association, 2003.
- Kleinman RE, editor. *Pediatric Nutrition Handbook*. 5th ed. Elk Grove Village, IL: American Academy of Pediatrics; 2004.
- Samour PQ, King K, editors. *Handbook of Pediatric Nutrition*. 3rd ed. Sudbury, MA: Jones and Bartlett Publishers, Inc., 2005.

Appendix E: Activities for Infants

Infants

Kick It! (Fig. 1)

Let your baby find out what her legs can do while she learns about cause and effect.

- Lay the baby on her back.
- Place a small pillow or a stuffed animal by the baby's feet.
- Encourage her to kick it!

Also:

- If the baby doesn't kick the object on her own, hold it just close enough to let her feel it with the bottom of her feet.
- Make sure she gets to kick with both right and left feet.
- Use language to encourage her and describe what she's doing. For example: "You're kicking the pillow!"



Fig. 1

Crossing the Midline (Fig. 2)

Have playtime activities that help your baby's right arm or leg cross over to the left and the left arm or leg cross over to the right. This crossing over is an important step in helping your baby learn.

- Place the baby in a comfortably seated position.
- Sit or kneel in front of him and hide a favorite toy behind your back.
- Make a game of handing him the toy so he has to reach *across* his body to get it.

Also:

- Repeat this, encouraging the use of both left and right hands, as long as the baby stays interested!



Fig. 2

Let It Pour (Fig. 3)

This outdoor summer activity promotes both eye-hand coordination and coordination in general.

- Place a plastic sheet or old tablecloth on the porch, patio or grass, and seat the baby on it, along with two large plastic cups – one empty and one filled with water or sand.
- Demonstrate pouring the water or sand from one cup to the other.
- Encourage the baby to try it!

Also:

- Later you can use two cups of different shapes that hold the same amount – for example, one 8-ounce cup that's short and squat and one 8-ounce cup that's tall and narrow.
- Fill one cup to the rim and demonstrate pouring the water or sand from one cup to the other.
- Encourage the baby to try it, too.



Fig. 3

Creepy/Crawly (Fig. 4)

Crawling and creeping not only help your baby get around but also use the right and left sides of the body at the same time. This helps later with reading and writing skills.

- Lay the baby on her tummy on a carpet or smooth, clean surface.
- Place a favorite toy in front of her, just out of her reach.
- Encourage her to go get it.

Also:

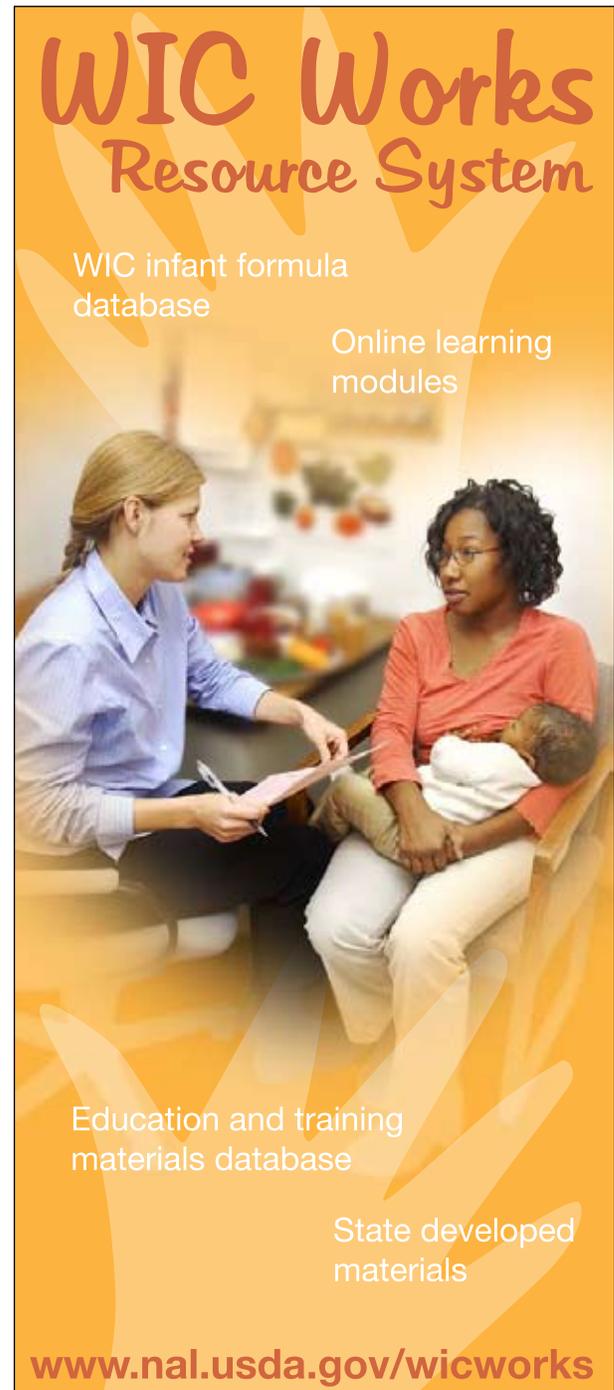
- Let the baby reach and retrieve the toy, but then make a game out of moving it out of reach again.
- Repeat as long as the baby stays interested.



Fig. 4

Using the WIC Works Resource System (WIC Works)

The WIC Works Resource System (WIC Works) is a joint project of the Food and Nutrition Service and the National Agriculture Library. It is an internet-based tool for WIC State and local agency health and nutrition professionals. Its purpose is to increase staff knowledge and skills by improving access to important nutrition resources and services. WIC Works contains two databases: 1) downloadable participant nutrition education materials; and 2) a searchable reference of WIC-eligible infant formulas, exempt infant formulas, and WIC-eligible medical foods. Additional links allow users to access State-developed training materials, tools, reports and studies, and other health-related information. An electronic discussion group offers the opportunity for WIC staff to share ideas and interact across the country. As part of this ongoing project, a series of on-line learning modules for WIC staff have been developed. These modules provide WIC agencies with a low-cost, user-friendly, time-efficient method of staff development and continuing education. Visit WIC Works at <http://www.nal.usda.gov/wicworks/>.

A graphic for the WIC Works Resource System. The background is a warm orange color with faint, stylized leaf patterns. In the center, a woman in a light blue shirt is sitting and talking to a woman in a red shirt who is holding a baby. The woman in blue is holding a pink folder and a pen. The text 'WIC Works Resource System' is at the top in a large, red, rounded font. Below it, on the left, is 'WIC infant formula database' and on the right is 'Online learning modules'. At the bottom, on the left, is 'Education and training materials database' and on the right is 'State developed materials'. At the very bottom, the website address 'www.nal.usda.gov/wicworks' is written in a red, sans-serif font.

**WIC Works
Resource System**

WIC infant formula
database

Online learning
modules

Education and training
materials database

State developed
materials

www.nal.usda.gov/wicworks

Resources on Infant Nutrition, Food Safety, and Related Topics

Agency/Organization and Address	Resources Available and Contact Information
<p>Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) Food and Nutrition Service, USDA 3101 Park Center Drive, Room 520 Alexandria, VA 22302</p>	<p>Administers USDA's Women, Infants, and Children (WIC) program at the national and regional levels. Phone: (703) 305-2590 Web site: http://www.fns.usda.gov</p>
<p>Food Safety and Inspection Service U.S. Department of Agriculture Washington, DC 20250</p>	<p>Protects consumers by ensuring that meat, poultry, and egg products are safe, wholesome, and accurately labeled. Provides resource materials on food safety. Operates the USDA Meat and Poultry Hotline (MPH). (MPH) Hotline Toll-free phone: 1-800-535-4555 TTY: 1-800-256-7072 Web site: http://www.fsis.usda.gov/</p>
<p>Centers for Disease Control and Prevention 1600 Clifton Rd. Atlanta, GA 30333</p>	<p>Develops and applies disease prevention and control, environmental health, and health promotion and education activities. The National Center for Chronic Disease Prevention and Health Promotion publishes pediatric growth charts as well as information on using and interpreting growth data. Toll-free phone: 1-800-311-3435 Web site: http://www.cdc.gov</p>
<p>Food and Drug Administration Center for Food Safety and Applied Nutrition 200 C Street, S.W. Washington, DC 20204</p>	<p>Promotes and protects the public's health by ensuring that the nation's food supply is safe, sanitary, wholesome, and honestly labeled, and that cosmetic products are safe and properly labeled. Toll-free phone: 1-888-SAFEFOOD Web sites: http://www.cfsan.fda.gov/list.html http://www.foodsafety.gov/ (this is a gateway web site that provides links to selected government food safety-related information)</p>
<p>National Agricultural Library (NAL) 10301 Baltimore Blvd., Room 304 Beltsville, MD 20705-2351</p>	<p>Provides resource materials on infant nutrition and food safety. NAL sponsors:</p> <ul style="list-style-type: none"> - Food and Nutrition Information Center (FNIC) (collects and disseminates information about food and nutrition). Phone: (301) 504-5414 Web site: http://www.nal.usda.gov/fnic - WIC Works Resource System (an internet-based tool for WIC State and local agency health and nutrition professionals providing information on infant nutrition and breastfeeding) Web site: http://www.nal.usda.gov/wicworks - Nutrition.gov (serves as a gateway to reliable information on nutrition, healthy eating, physical activity, and food safety for consumers from across the federal government) Web site: http://www.nutrition.gov/

Agency/Organization and Address	Resources Available and Contact Information
<p>Healthy People Office of Disease Prevention and Health Promotion U.S. Department of Health and Human Services 1101 Wootton Parkway Suite LL100 Rockville, MD 20852</p>	<p>National health objectives designed to identify the most significant preventable threats to health and to establish national goals to reduce these threats (including national targets for breastfeeding every five years). Publishes Dietary Guidelines for Americans. Web site: http://www.healthypeople.gov</p>
<p>U. S. Environmental Protection Agency (EPA) Ariel Rios Building 1200 Pennsylvania Avenue, N.W. Washington, DC 20460</p>	<p>Provides information on water safety and recommendations for consumption of foods susceptible to contamination with hazardous materials such as mercury or lead. Web site: http://www.epa.gov</p>
<p>U.S. Consumer Product Safety Commission (CPSC) 4330 East West Highway Bethesda, MD 20814</p>	<p>CPSC protects the public from unreasonable risks of injury or death from many types of consumer products including baby and children’s products. Toll-free phone hotline: 1-800-638-2772 TTY Hotline: 1-800-638-8270 Web site: http://www.cpsc.gov Free copies of CPSC’s “Sleep Safe/Play Safe” campaign brochures and posters, in English and Spanish, are available through the web site or by writing to CPSC, Washington, DC 20207.</p>
<p>United States Breastfeeding Committee 2025 M Street, NW, Suite 800 Washington, DC 20036</p>	<p>A collaborative partnership of organizations vvv mission is to promote, protect and support breastfeeding in the U.S. They publish issue papers and position statements related to breastfeeding. Phone: (202)-367-1132 Web site: http://www.usbreastfeeding.org</p>
<p>U.S. Government Bookstore 732 North Capitol Street, NW Washington, DC 20401</p>	<p>Offers for sale official Government books, periodicals, posters, pamphlets, forms, and subscription services in many subject categories, including nutrition, childhood, health care, and safety. Phone: 1-866-512-1800 Web site: http://bookstore.gpo.gov/</p>
<p>American Dietetic Association (ADA) 216 W. Jackson Blvd. Suite 800 Chicago, IL 60606</p>	<p>Source of materials and information on infant nutrition, food safety, and other nutrition topics. ADA’s National Center for Nutrition and Dietetics (NCND) Information Line offers the public direct access to objective, credible food and nutrition information from registered dietitians. Toll-free phone: 1-800-877-1600 Web site: http://www.eatright.org/</p>

Agency/Organization and Address	Resources Available and Contact Information
<p>The American Academy of Pediatrics 141 Northwest Point Boulevard Elk Grove Village, IL 60007-1098</p>	<p>Source of materials on infant nutrition, child safety, first aid and choking prevention. Publishes position papers on nutrition related topics including: vitamin D supplementation, breastfeeding and the use of human milk, iron fortification of infant formulas, use of soy formulas, hypoallergenic infant formulas, use and misuse of fruit juice, and others. Phone: (847) 434-4000 Web site: http://www.aap.org</p>
<p>American Academy of Pediatric Dentistry (AAPD) 211 East Chicago Avenue, Suite 700 Chicago, IL 60611</p>	<p>Source for oral health policies, clinical guidelines related to oral health for infants and children, and parent education brochures. Phone: (312) 337-2169 Web site: http://www.aapd.org</p>
<p>International Lactation Consultants Association (ILCA) 1500 Sunday Drive, Suite 102 Raleigh, NC 27607</p>	<p>Source of education, resources and materials on breastfeeding and lactation consultants. Phone: (919) 861-5577 Web site: http://www.ilca.org</p>
<p>La Leche League International (LLLI) 1400 N. Meacham Road Schaumburg, IL 60173</p>	<p>Provides resources for both breastfeeding mothers and professionals. Includes information on how to find local LLLI leaders or groups. Phone: (847) 519-7730 Toll-free phone: 1-800- LALECHE Web site: http://www.llli.org/</p>
<p>Institute of Medicine of the National Academies 500 Fifth Street, NW Washington, DC 20001</p>	<p>Serves as an independent adviser to the nation to improve health, providing advice that is unbiased, based on evidence, and grounded in science. Periodically updates and publishes the Dietary Reference Intakes. Phone: (202) 334-2052 Web site: http://www.iom.edu/</p>
<p>American Red Cross National Headquarters 2025 E Street, NW Washington, DC 20006</p>	<p>Provides health and safety training to the public and emergency social services to U.S. military members and their families. Your local chapter provides pamphlets, posters, and classes in emergency techniques for first aid, preventing choking, and cardiopulmonary resuscitation (CPR). Phone: (202)-303-4498 Web site: http://www.redcross.org/</p>
<p>Partnership for Food Safety Education 50 F Street, NW, 6th Floor Washington, DC 20001</p>	<p>Sponsors "Fight BAC!" Campaign; source of information on food safety. Phone: (202)-220-0651 Web site: http://www.fightbac.org</p>

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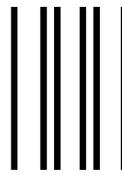
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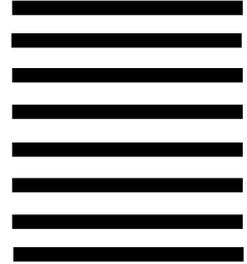
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