

Infant Feeding: Formula and mix feeding

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Feeding Recommendations (Considerations)

- Growth in infancy
- Physiology of infancy
 - GI
 - Renal
- Infant Development
- Nutrient requirements
- Programming
- Health and prevention
- Coordinated sucking and swallowing
- Gastric emptying
- Intestinal motility
- Secretions: salivary, gastric, pancreatic, hepatobiliary
- Enterocyte function in terms of enzyme synthesis, absorption, mucosal protection
- Metabolism of products of digestion and absorption
- Expulsion of undigested waste products

Breast milk is the “must”

- *“Human milk is species-specific, and all substitute feeding preparations differ markedly from it, making human milk uniquely superior from infant feeding.*
- *Exclusive breastfeeding is the reference or normative model against which all alternative feeding methods must be measured with regard to growth, health, development, and all short and – and long terms outcomes.*
- *Human milk-fed preterm infants receive significant benefits with respect to protection and improved development outcomes compared with formula fed preterm infants”*

Feeding the Infant (Choices):

- Human Milk
- Standard Infant Formula (based on Cow or Soy protein)
- Special formulas
 - Hypoallergenic (hydrolysates vs amino acid based)
 - Lactose-free formula
 - Preterm
 - Post discharge formulas for preterm infants

Infant Feeding: Historical Perspective

- Breast feeding
- Wet nursing
- Human Milk Substitutes
- Science, Medicine and Industry

Breastfeeding

- Exclusive breastfeeding is ideal for the first 6 months
- Breastfeeding should continue for at least 24 months

- Supplements (water, glucose, juice, formula) should be avoided
- Pacifiers should be avoided

What happened?

- We started talking about breastfeeding as a '*choice*'
- Women figured out there was a '*right*' choice and a '*wrong*' choice
- Breastfeeding a '*moral minefield*'

The 1800's and Earlier – The Age of the Wet Nurse

- A common practice before the introduction of the feeding bottle and formula
- Wet nursing began as early as 2000 BC and extended until the 20th century
- **If a wet nurse could not be procured, a child was subject to starvation and malnutrition being fed animal's milk through "dry nursing"**
- **Lack of human milk literally meant life or death to infants up to the early 1800's**

Wet nursing vs Bottle feeding

- In the 19th century, artificial feeding became a feasible substitute for wet nursing
- Advancement in the feeding bottle and the availability of animal's milk began to slowly, but steadily, affect the use of wet nurses
- By 1900, the once highly organized wet-nursing profession was extinct

1845 to 1846 – The Invention of the Rubber Nipple and Baby Bottle

- Artificial bottles and nipples were used since ancient times, made from crude devices trying to simulate a mother nipple
- Vessels of all shapes and sizes have been found, dating back thousands of years BC
- Elijah Pratt invented and patented the truly functional India-rubber nipple in 1845
- Attention quickly shifted to the problem of finding a food, or "dry nursing" that didn't result in so many deaths

Artificial feeding traditions

e.g. Southern Germany, 15th century onwards

- In some areas breastfeeding was considered "swinish" and "filthy"
- Babies fed 'meal pap' (flour plus water/milk)
- About 50% of the babies died
- 1989 certain areas of Southern Germany still had infant mortality rates of 400 per 1,000

e.g. Dublin Foundling Hospital, 1775-1796

- 10,272 Infants were dry-nursed
- Only 45 survived (a mortality rate of 99.6%)

e.g. Punjab, 20th century

- Indian infants fed with animal milks
- Infant mortality rates of 950 per 1,000

Human Milk Substitutes

- Other mammalian milk (cow, goat, donkey, camel)
- Pablum: bread/flour, mixed with water
 - "bread, water, flour, sugar and castille soap to aid digestion"

Infant Formula

- 1890 to 1907 – Homemade Baby Formulas Are Introduced
 - 1891 – First milk laboratory opened

- Despite the claims of being “virtually identical to mothers milk”, many infants still died from undernourishment, scurvy, rickets and bacterial infections
- 1908 to 1950 – Evaporated Milk Formula’s Take America By Storm
- 1951 to 1970 – Commercial Formula’s Begin Aggressive Advertising Campaigns
 - By the early 1970s, over 75% of American babies were fed on formulas, almost entirely commercially produced

CONTRAINDICATIONS TO BREASTFEEDING

- Infant Conditions
 - Classic galactosemia (galactose 1-phosphate uridylyltransferase deficiency)
 - Maple syrup urine disease
 - Phenylketonuria
- Maternal Conditions
 - HIV
 - Active tuberculosis
 - Herpes simplex virus infection on a breast (until the lesions on the breast are cleared)
 - Medications (those of concern)
 - Street drugs

Conditions That Are Not Contraindications to Breastfeeding

- Mothers with hepatitis B or C
- Mothers with cytomegalovirus (CMV)
- Maternal tobacco smoking
- Women who have acute mastitis

Lactation failure (hypogalactia)

- Primary (1-3%)
 - Preglandular (hormonal issues)
 - Glandular (previous breast surgery, hypoplasia)
- Secondary
 - Postglandular (poor breastfeeding management: scheduled feeds, extended separation of mother and baby)

Degrees of hypogalactia

Ist degree – deficiency of the human milk is less than 25 % of the daily requirements;

IInd degree – deficiency of the human milk is between 25 and 50 % of the daily requirements;

IIIrd degree – deficiency of the human milk is between 50 and 75 % of the daily requirements;

IVth degree – deficiency of the human milk is more than 75 % of the daily requirements.

Human Milk Substitutes (Formula)

Key points

- Given the significant health benefits to both infant and mother, health workers have a responsibility to promote breastfeeding first but, if infant formula is needed, to educate and support parents about formula feeding
- A mother’s informed decision not to breastfeed should be respected and support from a health worker
- When infants are not breastfed, infant formula is the only suitable and safe alternative to meeting their primary nutritional needs
- Infant formula requires accurate reconstitution and hygienic preparation to ensure its safety, so it is important that health workers know how to demonstrate the preparation of infant formula and how to feed an infant with a bottle

- Cow's milk-based formula is suitable for the first 12 months of life unless the infant cannot take cow's milk-based products for specific medical in which case special formulas may be used under medical supervision.

Classification of milk formulas

- Degree of adaptation:
 - nonadapted ("Classic")
 - partially adapted
 - adapted
- The age, in which they are indicated
 - For the start (0-6 mo)
 - ✓ for prematures
 - ✓ for term new-borns
 - For follow up (6-12 mo)
- The source of protein
 - cow milk
 - soya ("vegetal milk")
- Special needs
 - Lactose-free or low lactose
 - Gluten-free
 - Low fat or fat free
 - Enriched with lipids
 - Enriched with proteins

Risks of formula feeding

- Common respiratory and GIT infections
- Malnutrition or overweight
- Rickets, anemia
- Risk of allergies and milk intolerance
- Risk of chronic diseases
- Lower scores on IQ test
- High risk of sudden death syndrome

Good bottle-feeding practice

- always checking the temperature of the formula before feeding by shaking a little milk from the teat onto the inside of the wrist – it should feel warm, not hot
- holding, cuddling and talking to (if it is not too distracting) the infant while feeding and responding to infant cues – parent-infant contact is extremely important
- not leaving an infant to feed on their own (i.e. with the bottle propped) – the milk may flow too quickly and cause the infant to splutter or choke
- not putting an infant to sleep while drinking from a bottle – as well as the risk of choking this increases the risk of ear infection

Cow's Milk Based Formula

- Commercial formula designed to approximate nutrients provided in human milk
- Cow's milk based formula is recommended for the first 12 months if breast milk is not available
- Some nutrients added at higher levels due to less complete digestion and absorption

Soy Formulas (Characteristics compared to Milk Based)

- Higher protein (lower quality)
- Higher sodium, calcium, and phosphorus

- Carbohydrate: Corn syrup solids, sucrose, and/or maltodextrin; lactose free
- Fats: Long chain
- Meet needs of healthy infants
 - NOT indicated in preterm infants due to increased risk of inadequate bone mineralization

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

- Infants with galactosemia or hereditary lactase deficiency
- Infants whose parents are seeking a vegetarian diet for their full-term infant
- 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

- 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

- Infant formulas manufactured and labeled for infants with allergies vary in the degree to which the allergy-causing protein has been modified:
 - partially hydrolyzed protein
 - extensively hydrolyzed protein
 - free amino acids
- Extensively hydrolyzed and free amino acid-based infant formulas have been demonstrated to be tolerated by at least 90% of infants with documented allergies.
- Currently available partially hydrolyzed infant formulas are not hypoallergenic and should NOT be used to treat infants with documented allergies.

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.
- 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
- 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.

Mix-feeding

- **Mix-feeding** – the feeding of the babies of first 5-6 mo with human milk and formula in which the volume of formula is more than 1/5 of daily volume (or the daily volume of the human milk is less than 4/5)

Methods of mix-feeding

- Classic (complimentary) method
- Alternative method

Calculation of infant needs

- For newborns up to 7 days of life
 - Finkelstein formula

$$L = (N-1) \times 70 \text{ or } 80,$$

(L- daily quantity of milk, N- number of life days)

The coefficient

70 is for NB weight under 3250 g

80 is for NB weight over 3250 g

- For children 7-14 days of life
 - Apert formula

$$V = 1/10 \text{ from infant's weight} + 200$$

- Infants older than 14 days old
 - volumetric method
 - ✓ 2-8 weeks: $V = 1/5$ from infant's weight
 - ✓ 8 weeks - 4 mo: $V = 1/6$ from body weight
 - ✓ 4-6 months: $V = 1/7$ from body weight
 - Energetic method
 - ✓ Ist trimester – 120 kcal/ kg/day
 - ✓ IInd trimester – 115 kcal/ kg/day
 - ✓ IIIrd trimester – 110 kcal/ kg/day
 - ✓ IVth trimester – 100 kcal/kg/day

Diversification (solid food)

- From around 6 months, infants should be offered a range of foods of an appropriate texture and consistency for their developmental stage.
- First foods should be iron-rich and an increasing range and quantity of foods should be introduced so that by 12 months the infant is consuming a wide variety of family foods.
- Breast milk or infant formula should be continued while introducing solids, with other drinks.
- appetite and nutritional requirements are no longer satisfied by breast milk or infant formula alone
- stores of several nutrients – for example, iron and zinc – are often falling in exclusively milk-fed infants (both breast and formula),
- feeding behaviour has progressed from sucking to biting (most infants are chewing by 7-9 months and can manage finger foods at 8 months)
- the tongue-extrusion reflex has disappeared and the infant's increasing ability to sit without support allows greater manipulation of food before swallowing, so that thicker foods can be managed
- the digestive system has matured and the infant is able to digest starches
- most infants have developed an interest in their environment, which prompts a willingness to accept new textures and flavours – it is useful to exploit this exploratory phase by gradually introducing new food tastes and textures.