Special Supplemental Nutrition Program For Women, Infants, and Children

Colorado WIC Formula Guide

And

WIC-Eligible Medical Foods Product Guide

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Colorado Department of Public Health and Environment

October 2013

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INTRODUCTION

COLORADO WIC-APPROVED INFANT FORMULAS & MEDICAL FOODS

Each WIC State agency can evaluate if a formula meets USDA WIC regulations as well as FDA regulations. Even when a particular formula conforms to these regulations, Colorado WIC is not obligated to choose it as a Colorado WIC-approved formula. USDA encourages states to be selective in the formulas they choose and to use the following criteria: purpose and function for the intended user, participant acceptance, product availability, price, and program management costs.

Classifications of Colorado WIC-Approved Infant Formulas and Medical Foods

The Colorado WIC Program uses USDA's classification of formulas and medical-nutritional products. Here are the definitions of Colorado WIC Program's classifications of infant formulas and medical foods:

INFANT FORMULA:
Any iron-fortified infant formula designed for normal, healthy infants without special medical conditions that is not an exempt infant formula. The term "infant formula" means 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 [US Food and Drug Administration Act 21 U.S.C. 321 (z)].

Regulations require infant formula to:

- Be nutritionally complete, not requiring the addition of any ingredients, other than water, prior to being served in a liquid state;
- Contain at least 10 milligrams of iron per liter at standard dilution, and;
- Supply 67 kilocalories per 100 milliliters (i.e., approximately 20 kilocalories per fluid ounce) of infant formula at standard dilution.

Examples of *infant formulas* include Enfamil Premium Infant, Enfamil AR, Enfamil Gentlease, Enfamil ProSobee, Gerber Good Start Gentle, Gerber Good Start Soy, Similac Advance, Similac Soy Isomil, and Similac Sensitive.

PRIMARY CONTRACT BRAND INFANT FORMULA:
Any infant formula (excluding exempt infant formulas) made by the company with whom Colorado WIC has a formula rebate contract (See MPSF: WC-00-25-P). Effective January 1, 2008, the Colorado WIC Program has a contract with Mead Johnson Nutritionals to provide Primary Contract Brand Infant Formulas. The rebates received from using these formulas allow the Colorado WIC Program to provide benefits to more participants. Approximately one-third of Colorado WIC's food dollars come from this rebate program. Federal regulations require the use of Primary Contract Brand Infant Formulas except when contraindicated by a specific medical condition. Therefore, all WIC infants participating in the Colorado WIC Program, receiving a non-specialized (standard) formula, must receive a Primary Contract Brand Infant Formula. A physician's prescription is not required for WIC issuance of these four infant formulas.

CONTRACT BRAND INFANT FORMULAS for the Colorado WIC Program are Enfamil Premium Infant, Enfamil AR, Enfamil Gentlease, and Enfamil Prosobee.

NON-CONTRACT BRAND INFANT FORMULA*:*
Includes all other Colorado WIC-approved infant formulas or exempt infant formulas that are not a contract brand infant formula and, therefore, not subject to rebate (See MPSF: WC-00-25-P). As of January 1, 2008, Colorado WIC no longer provides non-contract brand infant formula.

EXEMPT INFANT FORMULA:
Exempt infant formula means an infant formula that meets the requirements for an exempt infant formula under section 412(h) of the Federal Food, Drug, and Cosmetic Act (21U.S.C. 350a(h)) and the regulations at 21 CFR parts 106 and 107.

Exempt infant formulas are any infant formula designed for infants with special conditions such as prematurity, low birth weight, or medical conditions that require a modified infant formula. These formulas are authorized when a physician determines and documents that the participant has a medical condition that restricts the use of a conventional formula or foods and requires a special formula. A prescription from a licensed health care professional authorized to write medical prescriptions under State law is required and is maintained in the participant's WIC record.

Examples of *exempt infant formulas* include Enfamil EnfaCare, Neocate Infant, Nutramigen with Enflora LGG, Pregestimil, Similac Expert Care Alimentum, and Similac Expert Care NeoSure.

WIC-ELIGIBLE MEDICAL FOODS:
Enteral products specifically formulated to provide nutritional support for children over 1 year of age, teens, and adults with a diagnosed medical condition when use of conventional foods is precluded, restricted, or inadequate (See MPSF: WC-00-25-P). Such WIC-eligible medical foods may be nutritionally complete or incomplete; however, they must serve the purpose of a food, provide a source of calories and one or more nutrients, and be designed for enteral digestion via oral or tube feeding. Issuance of a WIC-eligible medical food must be approved by the WIC RD/RN and supported with a medical prescription (or *Physician Authorization Form*) that includes documentation of a medical condition, such as metabolic disorders, inborn errors of amino acid metabolism, gastrointestinal disorders, malabsorption syndromes, and food allergies.

Examples of *WIC-eligible medical foods* are EleCare Junior, Neocate Junior, PediaSure, Tolerex, and Vivonex Pediatric.

COMPLIMENTARY FOODS:
Effective June 1, 2009, Colorado WIC has the ability to issue complementary foods along with formula when supported by medical documentation from an authorized care provider. Soy beverage and tofu are authorized products for women and for children. No prescription is required to issue soy beverage to women. A prescription with a medical diagnosis of milk allergy, severe lactose maldigestion, or adherence to a vegan diet is required in order to issue any amount of soy beverage or tofu to children, or more than 4 pounds of tofu to women (6 pounds for exclusively breastfeeding women). Specifically, 3 quarts of milk may be substituted for a pound of cheese and 1 quart of milk may be substituted for 1 pound of tofu. No more than a total of 4 quarts of milk (6 quarts for exclusively breastfeeding women) may be substituted for tofu or cheese.

FORMULAS & MEDICAL FOODS NOT AUTHORIZED BY WIC

The following products are not WIC-eligible formulas/medical foods and cannot be issued to WIC participants:

- Drugs and medicines
- Parenteral or intravenous hyperalimentation nutrition products
- Vitamin or mineral supplements (e.g., pills, gel caps, liquids or drops)
- Enzymes
- Flavoring agents
- Oral rehydration fluids or electrolyte solutions
- Sports or breakfast drinks
- Over-the-counter weight control/loss beverages
- Rice or nut-based beverages or drinks
- All conventionally-marketed foods mainly marketed to and intended for consumption by healthy individuals
- Feeding utensils, apparatus, or devices (e.g., feeding tubes, bags, and pumps, including to administer a WIC-eligible formula)

PRODUCT LIST INTRODUCTION

The following Product List contains only those infant formulas and medical-nutritional products that are Colorado WIC-approved. It is constructed from information provided by product manufacturers at the time of this publication (March 2013).

Although considerable effort has been made to ensure the accuracy of information presented in this Product List, manufacturers frequently change product composition. Ingredient lists in this Formula Guide may not include specific ingredients that could be relevant in cases of severe allergy or food intolerances. Refer to product labels, the manufacturers' web sites, or contact company representatives for the most current product ingredient information. Contact information for each manufacturer is listed in *Contact Information* of the guide**.**

The information is presented for general guidance and is not intended to be recommendations for specific products. Questions about products, especially when the selection of a particular product is critical to the health of a WIC participant, should be directed to the product manufacturer, a Registered Dietitian or other health professional with expertise regarding the product being considered, or to a Colorado WIC nutrition consultant.

The Product List contains the following information:

Product / Description:
Name of formula/product (Manufacturer)
Description of product
Nutritional content, including:
- Sources and percentages of calories from each macronutrient
- Micronutrient information, when pertinent

Osmolality (when available)
Similarity (nutritionally) to another product by a different manufacturer

Indication:
- Recommended uses
- WIC issuance information
- Approval /approval with a prescription (*Physician Authorization Form*)
- Cautions

Packaging:
Federal regulations stipulate issuance of powder or concentrate liquid formula to formula-fed infants. Only the forms and sizes that are Colorado WIC-approved are listed:
- ***Powder*** **= powder**
  - ✓ Participant can choose between powder and concentrate forms of infant formula.
  - ✓ Recommended for breastfed infants being supplemented with formula.
  - ✓ May be unsterile and is not recommended for fragile infants whose immune system may be compromised.
- ***Concentrate*** **= concentrate**
  - ✓ Participant can choose between powder and concentrate forms of infant formula.

- ***RTF* = ready-to-feed**

  RTF can only be issued under one of the following circumstances:
  - ✓ The family's water supply is contaminated and unsafe for consumption.
  - ✓ The caregiver has difficulty correctly diluting concentrate or powder formula.
  - ✓ For a medically fragile infant (i.e. premature) whose immune system may be compromised with issuance of a product in powder form.
  - ✓ The formula only comes in RTF form.

Maximum Monthly Amount:

- Total amount issued in monthly food package, for infant, child, and/or women**.**
- Infants may be further classified as 0-3 months, 4-5 months, and 6-11 months to note issuance changes by age. Note: the maximum amount of formula for partially-breastfed infants is approximately half the amount for fully formula fed infants.
- Women may be further classified as P (pregnant), B (partial "in range" breastfeeding), N (postpartum or "novel," "out of range" breastfeeding), E (exclusively breastfeeding) and/or E-M (exclusively breastfeeding multiple infants) when issuance amount changes by category.
- Amount may not exceed USDA's maximum allowance (see below).

USDA Maximum Monthly Formula Allowance

Formula Type	**Infant 0-3 months**	**Infant 4-5 months**	**Infants 6-11 months***	**Child /Woman*****
Ready to Feed (RTF)	832 fluid oz	896 fluid oz	640 fluid oz	910 fluid oz
Powder	870 fluid oz reconstituted	960 fluid oz reconstituted	696 fluid oz reconstituted	910 fluid oz reconstituted
Concentrate	806 fluid oz reconstituted	884 fluid oz reconstituted	624 fluid oz reconstituted	910 fluid oz reconstituted

USDA Maximum Monthly Formula Allowance – Partially Breastfed Infants

Formula Type	**Infant 1-3 months****	**Infant 4-5 months**	**Infants 6-11 months***
Ready to Feed (RTF)	384 fluid oz	448 fluid oz	320 fluid oz
Powder	435 fluid oz reconstituted	522 fluid oz reconstituted	384 fluid oz reconstituted
Concentrate	364 fluid oz reconstituted	442 fluid oz reconstituted	312 fluid oz reconstituted

*****By prescription, infants 6-11 months who are unable to eat supplemental foods because of medical reasons may be issued the same amount of formula as 4-5 month old infants.

****** Breastfed infants are not provided formula in the first month of life

******* Women exclusively breastfeeding multiple infants may receive 1 ½ times the amount of formula, which equals 1365 reconstituted ounces.

Maximum monthly amount of formula authorized by Colorado WIC

Formula	Form	Size	Yield	Age of participant				
				0-3 months	4-5 months	6-11 months	12 months +	Women
				Number of cans				
Boost High Protein	RTF	32 oz						4 cases (108 cartons)
Boost Kid Essentials 1.5 cal (with or without fiber)	RTF	8 oz					4 cases (108 cartons)	
Bright Beginnings Soy Pediatric Drink	RTF	8 oz					108	
Compleat Pediatric	RTF	8.45 oz					107	
E028 Splash	RTF	8 oz					4 cases (108 boxes)	
Elecare Infant	Powder	14.1 oz	95 oz	9	10	7	9	
Elecare Junior	Powder	14.1 oz	62 oz				14	
Enfagrow Toddler Transitions Soy	Powder	21 oz	141 oz				6	
Enfamil AR	Powder	12.9 oz	91 oz	9	10	7	10	
Enfamil AR	RTF	32 oz		26	28	20	28	
Enfamil EnfaCare	Powder	12.8 oz	82 oz	10	11	8	11	
Enfamil EnfaCare	RTF	32 oz		26	28	20	28	
Enfamil Gentlease	Powder	12.4 oz	90 oz	9	10	7	10	
Enfamil Gentlease	RTF	32 oz		26	28	20	28	
Enfamil Premium Infant	Powder	12.5 oz	90 oz	9	10	7	10	
Enfamil Premium Infant	Conc.	13 oz		31	34	24	35	
Enfamil Premium Infant	RTF	32 oz		26	28	20	28	
Enfamil ProSobee	Powder	12.9 oz	93 oz	9	10	7	9	9
Enfamil ProSobee	Conc.	13 oz		31	34	24	35	35
Enfamil ProSobee	RTF	32 oz		26	28	20	28	28
Enfaport	RTF	8 oz		104	112	80	113	
Ensure / Ensure Plus	RTF	8 oz						108
Gerber Good Start Nourish	Powder	12.6 oz	83 oz	10	11	8	10	
Neocate Infant with DHA & ARA	Powder	14.1 oz	97 oz	8	9	7	9	

Formula	Form	Size	Yield	Age of participant				
				0-3 months	4-5 months	6-11 months	12 months +	Women
				Number of cans				
Neocate Junior / with Prebiotics	Powder	14 oz	59-64 oz				14	
Nutramigen	Conc.	13 oz		31	34	24	35	
Nutramigen	RTF	32 oz		26	28	20	28	
Nutramigen with Enflora LGG	Powder	12.6 oz	87 oz	10	11	8	10	
Nutren 1.0	RTF	8.45 oz						107
Nutren 1.0 with fiber	RTF	8.45 oz						107
Nutren 1.5	RTF	8.45 oz						107
Nutren 2.0	RTF	8.45 oz						107
Nutren Jr. / with fiber	RTF	8.45 oz					107	
Osmolite 1 cal	RTF	8 oz						113
PediaSure / with fiber / enteral	RTF	8 oz					108	
PediaSure 1.5 cal / with fiber	RTF	8 oz					108	
Peptamen	RTF	8 .45 oz						107
Peptamen Jr. / with fiber	RTF	8.45 oz					107	
Portagen	Powder	16 oz	70 oz				13	13
Pregestimil	Powder	16 oz	112 oz	7	8	6	8	
PurAmino (formerly Nutramigen AA)	Powder	14.1 oz	98 oz	8	9	7	9	
Similac Expert Care Alimentum	Powder	16 oz	115 oz	7	8	6	7	
Similac Expert Care Alimentum	RTF	32 oz		26	28	20	28	
Similac Expert Care NeoSure	Powder	13.1 oz	87 oz	10	11	8	10	
Similac Expert Care NeoSure	RTF	32 oz		26	28	20		
Similac PM 60/40	Powder	14.1 oz	102 oz	8	9	6	8	
Tolerex	Powder	2.82 oz pkts	300 ml = 10.144 oz					14 cartons of 6 pkts/carton
Vivonex Pediatric	Powder	1.7-oz pkts	250 ml (8.45 oz)				17 cartons of 6 (1.7-oz) pkts	
Vivonex T.E.N.	Powder	2.84 oz pkts	300 ml = 10.144 oz					8 cartons of 10 pkts/carton

Revised 10.28.13

Maximum monthly amount of metabolic formula authorized by Colorado WIC

Formula	Form	Size	Yield	Age of participant				
		grams		0-3 months	4-5 months	6-11 months	12 months +	Women
				Number of cans				
Calcio - XD	pwd	375	96	9	10	7		
Cyclinex 1	pwd	400	102	8	9	6	8	
Cyclinex 2	pwd	400	88				10	10
Glutarex 1	pwd	400	96	9	10	7	9	
Glutarex 2	pwd	400	82				11	11
Hominex 1	pwd	400	96	9	10	7	9	
Hominex 2	pwd	400	82				11	11
I Valex 1	pwd	400	96	9	10	7	9	
I Valex 2	pwd	400	82				11	11
Ketonex 1	pwd	400	96	9	10	7	9	
Ketonex 2	pwd	400	82				11	11
Periflex Infant	pwd	400	84	10	11	8		
Periflex Junior – unflavored	pwd	454	89				10	
Periflex Junior – flavored	pwd	454	85				10	
Phenex 1	pwd	400	96	9	10	7	9	
Phenex 2	pwd	400	82				11	11
Phenyl Free 1	pwd	454	114	7	8	6	7	
Phenyl Free 2	pwd	454	93				9	9
Phenyl Free 2 HP	pwd	454	89				10	10
Phenylade Drink Mix	pwd	454	91				10	10
Pro-Phree	pwd	400	102	8	9	6	8	8
ProViMin	pwd	150	166	5	5	4	5	5
Propimex-1	pwd	400	96	9	10	7	9	
Propimex- 2		400	82				11	11
RCF	conc	13 oz 384 ml	26	31	34	24	35	35
Tyrex 1	pwd	400	96	9	10	7	9	

Formula	Form	Size	Yield	Age of participant				
		grams		0-3 months	4-5 months	6-11 months	12 months +	Women
				Number of cans				
Tyrex 2	pwd	400	82				11	11
TYROS 1	pwd	454	114	7	8	6	7	
TYROS 2	pwd	454	93				9	9
MSUD Analog	pwd	400	90	9	10	7		
XLeu Analog	pwd	400	90	9	10	7		
XMet Analog	pwd	400	90	9	10	7		
XLys XTrp Analog	pwd	400	90	9	10	7		
XMTVI Analog	pwd	400	90	9	10	7		
XPhe XTyr Analog	pwd	400	90	9	10	7		
XPTM Analog	pwd	400	90	9	10	7		
MSUD Maxamaid	pwd	454	74				12	
XLeu Maxamaid	pwd	454	74				12	
XLys XTrp Maxamaid	pwd	454	74				12	
XMet Maxamaid	pwd	454	74				12	
XMTVI Maxamaid	pwd	454	74				12	
XPhe Maxamaid	pwd	454	74				12	
XPhe XTyr Maxamaid	pwd	454	74				12	
MSUD Maxamum	pwd	454	46					19
XLeu Maxamum	pwd	454	46					19
XLys XTrp Maxamum	pwd	454	46					19
XMet Maxamum	pwd	454	46					19
XMTVI Maxamum	pwd	454	46					19
XPhe Maxamum	pwd	454	46					19

Revised 12.12.11

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

Product / Description	Indication	Packaging	Monthly Maximum Amount:		
			Infant	Child	Women
ACIDOPHILUS COW'S MILK ♦ Kcal / fl oz - 16.25 kcal / fl oz (2% milk) ♦ Pro: - Casein ♦ Fat: - Milk fat ♦ CHO: - Contains somewhat less lactose than unfermented milk. ♦ Pasteurized and enriched with vitamins A and D. 2% Milk: ♦ Pro: 8 gm / 8 fl oz ♦ Fat: 5 gm / 8 fl oz ♦ CHO: 13 gm / 8 fl oz ♦ Calories: 130 kcal / 8 fl oz	Fermented milk that contains somewhat less lactose than unfermented milk. Considered to have therapeutic benefits in the gastrointestinal tract. For children and adults who do not have an allergy to cow's milk protein. May be helpful for lactose intolerance. WIC provides whole milk for children until the age of 2 years to ensure sufficient energy and to provide linoleic acid, and essential fatty acids needed for growth and development of body tissues. Reduced fat (2%, 1%, fat free) milk is provided for women and all children 2 years of age and older. Can be purchased with WIC checks that specify "whole milk" or "2%, 1% or fat-free milk." A prescription is not needed. **CAUTION:** ♦ WIC does not recommend reduced fat milk for children under 2 years of age. ♦ Not approved for infants less than 1 year of age.	Ready to use: ♦ Gallon ♦ Half-gallon ♦ Quart		16 quarts	P – 22 qts B – 22 qts N – 16 qts E – 24 qts E-M – 36 qts

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

Product / Description	Indication	Packaging	Monthly Maximum Amount:		
			Infant	Child	Women
BOOST HIGH PROTEIN (Nestlé) High protein, nutritionally complete oral supplement. ♦ 30 kcal / oz (240 kcal / 8 fl oz) ♦ Pro: - 24% of total kcal - Milk protein concentrate, soy protein isolate, calcium caseinate, sodium caseinate - High protein - 15 gm high quality protein / 8 oz - Gluten-free ♦ Fat: - 22% of total kcal - 6 gm / 8 oz - Canola, high oleic sunflower oil and corn oil ♦ CHO: - 54% of total kcal - 33 gm / 8 oz - Sugar, corn syrup solids - Lactose-free - Low-residue, fiber-free ♦ Iron: - 4.5 mg / 8 fl oz - 1.875 mg / 100 kcal ♦ Osmolality: - 650 mOsm/kg (van & straw) - 690 mOsm/kg (chocolate) ♦ Provides at least 100% of RDI/DV for most essential vitamins and minerals in 32 fl oz Similar to Ensure High Protein (Abbott), which is not Colorado WIC-approved.	An oral feeding that meets the supplemental or total nutritional needs for adults. Low residue, lactose-free, gluten-free and Kosher. Often used for preoperative and postoperative nutrition support, wound prevention/treatment, protein-calorie malnutrition and inadequate oral intake due to difficulty chewing or swallowing. Approved with prescription for adults. Prescription valid up to 6 months. **CAUTION:** ♦ Not appropriate for children. (PediaSure or Nutren Jr. are appropriate for children 1-10 years of age.) ♦ Not usually recommended for tube feeding because of high osmolality. ♦ Not for individuals with galactosemia	*RTF*: 8 fl oz Tetra Brik cartons 27 cartons/ case (institutional packaging) *Flavors:* - vanilla - chocolate - strawberry Order by the case from Ward Road Pharmacy			4 cases (108 cartons)

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

Product / Description	Indication	Packaging	Monthly Maximum Amount:		
			Infant	Child	Women
BOOST KID ESSENTIALS 1.5 **BOOST KID ESSENTIALS 1.5 with fiber** **(Nestlé HealthCare Nutrition)** High calorie, high protein nutritional supplement. ♦ 45 kcal / fl oz (360 kcal / 8 fl oz) ♦ Pro: - 11% of total kcal - 10 gm / 8 fl oz - Sodium and calcium caseinates (milk), whey protein concentrate. ♦ Fat: - 45% of total kcal - 18 gm / 8 fl oz - Soybean oil, high oleic sunflower oil, MCT oil (from coconut and/or palm kernel oil) ♦ CHO: - 44% of total kcal - 39 gm / 8 fl oz - 2 gm fiber / 8 fl oz (only in formulation with fiber) - Maltodextrin, sugar - Lactose-free ♦ Iron: - 3.3 mg / 8 fl oz ♦ Fiber: - 8g / liter - 1.6 g.soluble fiber, 2.1 g insoluble fiber ♦ Osmolality: - 390 mOsm/kg water (without fiber) - 405 mOsm/kg water (with fiber) Similar to PediaSure 1.5 cal and 1.5 cal with fiber (Abbott).	A high-calorie, high-protein complete nutritional milk-based formula designed for oral or tube feeding of children ages 1-13. Lactose-free, gluten-free, Kosher. Available with or without fiber. The fiber formulation contains Benefiber, a soluble fiber and prebiotic, to support beneficial bacteria and normal bowel function. Appropriate for GI disorders, gluten intolerance, cardiac conditions, cystic fibrosis, fluid-restricted patients, and cerebral palsy. Approved with prescription for children. Prescription valid up to 6 months. **CAUTION:** ♦ Not recommended for use as an infant formula. ♦ Not for patients with galactosemia.	*RTF*: 8-oz (237 ml) Tetra Brik cartons 27 cartons / case *Flavor*: Without fiber: - vanilla - chocolate - strawberry With fiber: - vanilla Order by the case from Ward Road Pharmacy		4 cases (27-pack per case) -or- 108 cartons	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

Product / Description	Indication	Packaging	Monthly Maximum Amount:		
			Infant	Child	Women
BRIGHT BEGINNINGS SOY PEDIATRIC DRINK (PBM Products) Nutritionally complete oral or enteral formula for children ages 1-10 years. ♦ 30 kcal / oz (237kcal / 8 fl oz) ♦ Pro: - 12% of total calories - Soy protein isolate - 7.1 gm protein / 8 oz - Gluten-free ♦ Fat: - 44% of total kcal - 11.8 gm / 8 oz - High-oleic; safflower or sunflower oil - 32 mg of DHA Omega 3 ♦ CHO: - 44% of total kcal - 26 gm / 8 oz - Sucrose, maltodextrin - Lactose-free ♦ Iron: - 3.3 mg / 8 fl oz ♦ Fiber: - 3 g / 8 fl oz Provides 100% or more National Academy of Sciences (NAS) - National Research Council (NRC) Recommended Daily Allowances (RDAs) for protein, vitamins & minerals in ~34 fluid ounces for ages 1-6 and in ~44 in fluid ounces for ages 7-10.	Bright Beginnings Soy Pediatric Drink is a soy-based supplement that is specially formulated to meet the nutritional needs of children ages 1-10. It is nutritionally complete, Lactose-free, gluten-free, cholesterol free, Kosher and Vegetarian. Contains 32 mg of DHA Omega 3 to support growth and development. Contains scFos prebiotics for improved immune function. The Pediatric Drink may also be used as total nutritional support under the guidance of a physician. Approved with prescription for children ages 1-13. Prescription valid up to 6 months. Prescription valid only for diagnoses of FTT and milk-protein intolerance. **CAUTION:** ♦ Not for parenteral use. ♦ Not recommended for use as an infant formula. ♦ Not for individuals with galactosemia.	*RTF*: 8 fl oz (237 ml) cans; 6-pack 24 cans / case *Flavor*: - vanilla Order by the case from Ward Road Pharmacy		(18) 6 packs or 108 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

Product / Description	Indication	Packaging	Monthly Maximum Amount:		
			Infant	Child	Women
COMPLEAT PEDIATRIC (Nestlé HealthCare Nutrition) Nutritionally complete enteral formula for children ages 1-10 years. ♦ 30 kcal / oz (250 kcal / 8.45 fl oz) ♦ Pro: - 15% of total kcal - Chicken, sodium caseinate (milk) pea puree - 9.5 gm protein / 8.45 oz - Gluten-free ♦ Fat: - 34% of total kcal - 9.7 gm / 8.45 oz - Canola oil, MCT oil (from coconut and/or palm kernel oil) ♦ CHO: - 51% of total kcal - 33 gm / 8.45 oz - Corn syrup solids, peach puree, cranberry juice - Lactose-free ♦ Iron: - 3.5 mg / 8.45 fl oz ♦ Fiber - 6.8 g / L ♦ Osmolality: - 380 mOsm/kg water ♦ Meets or exceeds 100%DRIs for protein and 25 key vitamins and minerals for children consuming these amounts: - 1-8 year olds: 1000 ml - 9-13 year olds: 1500 ml Similar to PediaSure Enteral with Fiber and scFos (Abbott), and Nutren Jr. with Fiber (Nestlé HealthCare Nutrition)	Compleat Pediatric formula is the only blenderized tube feeding formula containing traditional food such as chicken, fruit, vegetables and cranberry juice. Gluten-free and lactose-free. Designed to improve tube-feeding tolerance for children with GI intolerance to semi-synthetic formulas, failure to thrive, developmental disabilities and HIV/AIDS. Contains NutriSource Fiber soluble fiber to help support digestive health and normal bowel function. Contains CalciLock™ blend of essential nutrients including calcium, phosphorus, magnesium, zinc and vitamins D, C and K to help support healthy bone development. Approved with prescription for children. Prescription valid up to 6 months. **CAUTION:** ♦ Not for parenteral use. ♦ Not recommended for oral consumption. ♦ Not for individuals with galactosemia.	*RTF*: 8.45 fl oz (250 ml) Tetra Brik cartons 24 cartons / case *Flavor;* -Unflavored Order by the case from Ward Road Pharmacy		107 cartons	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

COW'S MILK, PASTEURIZED ♦ Kcal / oz - 18.75 kcal / fl oz (whole milk) - 15 kcal / fl oz (2% milk) - 12.5 kcal / fl oz (1% milk) - 10 kcal / fl oz (fat-free milk) ♦ Pro: - Casein ♦ Fat: - Milk fat ♦ CHO: - Lactose Whole milk ♦ Pro: 8 gm / 8 fl oz ♦ Fat: 8 gm / 8 fl oz ♦ CHO: 11 gm / 8 fl oz ♦ Calories 150 kcal / 8 fl oz 2% Milk: ♦ Pro: 8 gm / 8 fl oz ♦ Fat: 5 gm / 8 fl oz ♦ CHO: 12 gm / 8 fl oz ♦ Calories 120 kcal / 8 fl oz 1% Milk: ♦ Pro: 8 gm / 8 fl oz ♦ Fat: 2.5 gm / 8 fl oz ♦ CHO: 12 gm / 8 fl oz ♦ Calories: 100 kcal / 8 fl oz Fat-free Milk: ♦ Pro: 9 gm / 8 fl oz ♦ Fat: 0 gm / 8 fl oz ♦ CHO: 12 gm / 8 fl oz ♦ Calories: 80 kcal / 8 fl oz	WIC approved for children over 1 year of age and adults who do not have an allergy to cow's milk protein. WIC provides whole milk for children until the age of 2 years to ensure sufficient energy and to provide linoleic acid, and essential fatty acids needed for growth and development of body tissues. Reduced fat (2%, 1%, fat free) milk is provided for women and all children 2 years of age and older. **CAUTION:** Cow's milk is not recommended for infants because: ♦ It can cause gastrointestinal blood loss, ♦ The solute load is too heavy for the infant's renal system to handle, ♦ It is low in vitamin C and iron, ♦ The early introduction of cow's milk may increase the incidence of cow's milk allergy, ♦ A specific form of eczema has been observed in infants deficient in linoleic acid. - WIC does not recommend the use of unpasteurized milk. Ingestion of unpasteurized dairy products is associated with illness caused by bacterial contamination.	*Gallon*: whole, 2%, 1%, fat-free, acidophilus *Half gallon*: whole, 2%, 1%, fat-free, buttermilk, acidophilus *Quart:* whole, 2%, 1%, fat-free, buttermilk, acidophilus *Powdered:* 3 or 8 quart boxes *Evaporated*: 12 oz cans		16 quarts 21 cans	P – 22 qts B – 22 qts N – 16 qts E – 24 qts E-M – 36 qts P – 29 cans B – 29 cans N – 21 cans E – 32 cans E-M – 48 cans

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

DAIRY EASE (Land O Lakes) Lactose free milk ♦ Kcal / fl oz - 20 kcal / fl oz (whole milk) - 16.25 kcal / fl oz (2 % milk) - 11.25 kcal / fl oz (fat-free milk) ♦ Pro: - Casein ♦ Fat: - Milk fat ♦ CHO: - Hydrolyzed lactose (glucose & galactose) - Lactose free Whole: ♦ Pro: 8 gm / 8 fl oz ♦ Fat: 9 gm / 8 fl oz ♦ CHO: 11 gm / 8 fl oz ♦ Calories: 160 kcal / 8 fl oz Reduced fat (2%): ♦ Pro: 9 gm / 8 fl oz ♦ Fat: 5 gm / 8 fl oz ♦ CHO: 12 gm / 8 fl oz ♦ Calories: 130 kcal / 8 fl oz Fat free: ♦ Pro: 8 gm / 8 fl oz ♦ Fat: 0 gm / 8 fl oz ♦ CHO: 12 gm / 8 fl oz ♦ Calories: 90 kcal / 8 fl oz Similar to Lactaid® (McNeil).	Cow's milk that has been treated with lactase to break down the lactose into two simple sugars, causing it to taste slightly sweeter and making it easier to digest. Dairy Ease is 100% lactose free. For children and adults with intolerance to lactose. WIC provides only whole milk for children until the age of 2 years. This ensures sufficient energy intake and provides linoleic acid, an essential fatty acid needed for growth and development of body tissues. After two years of age, lower fat milks (2%, 1%, fat- free) are provided for all women and children. Can be purchased with WIC checks that specify "Lactaid/Dairy Ease milk." A prescription is not needed. **CAUTION:** ♦ WIC does not recommend low fat or fat-free milk for children under 2 years of age ♦ Not approved for infants less than 1 year of age. ♦ Soy formula or lactose-free formula may be more appropriate for infants and 1 year olds with lactose intolerance. Soy beverage may also be issued to children with a prescription and medical diagnosis of milk allergy, severe lactose maldigestion, or adherence to a vegan diet.	Ready to use: ♦ Half-gallon *(whole, 2% and fat-free)* ♦ Quart *(2% and fat-free only)*		16 quarts	P – 22 qts B – 22 qts N – 16 qts E – 24 qts E-M – 36 qts

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

E028 SPLASH (Nutricia – North America) Nutritionally complete amino acid-based medical food for children. ♦ 30 kcal / fl oz; 237 per 8 oz carton ♦ Pro: - 10% of total kcal - 2.5 gm / 100 kcal - Contains 100% free amino acids - Contains carnitine, taurine and free glutamine. - Soy, gluten and milk protein (whey and casein)-free ♦ Fat: - 32% of total kcal - 3.5 gm / 100 kcal - Fractionated coconut oil, canola oil, high oleic sunflower oil, palm kernel oil (65% LCT, 35% MCT oil) ♦ CHO: - 58% of total kcal - 14.6 gm / 100 kcal - Maltodextrin, sugar - Lactose-free ♦ Iron: - 0.77 mg / 100 kcal ♦ Osmolality: 820 mOsm/kg Similar to EleCare Junior (Abbott), Neocate Junior (Nutricia – North America), and Vivonex Pediatric (Novartis).	A nutritionally complete, elemental formula for children ages 1 to 10 years of age with intact protein sensitivity and/or compromised gastrointestinal function. It contains 100% synthetic free amino acids. Soy, gluten and milk-protein (casein and whey)-free, lactose-free. Contains the same nutrient profile as Neocate Junior, but cannot be labeled as hypoallergenic because of the added artificial flavor and citric acid. Can be used orally or for tube feeding. Not for parenteral use. Intake to be determined by a medical professional and is dependent on the child's age, body weight, and medical condition. Approved with prescription for children. Prescription valid up to 6 months. **CAUTION:** ♦ Use only under strict medical supervision. The WIC nutritionist or nurse should work closely with the physician and/or clinical dietitian working with the participant on issuance and transitional feeding. ♦ High osmolality for very young children. ♦ Not intended for use in children under one year of age. ♦ Not for parenteral use.	*RTF*: 8 fl oz ready-to-use boxes. 27 boxes / case *Flavors:* -orange-pineapple -tropical fruit -grape Order by the case from Ward Road Pharmacy		4 cases _-or- 108 boxes	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

ELECARE INFANT (Abbott) Nutritionally complete amino acid-based medical food. ♦ 20 kcal/fl oz ♦ Pro: - 15% of total kcal - 3.1 gm / 100 kcal - 100% free L-amino acids - Milk protein-free - Soy protein-free - Gluten-free ♦ Fat: - 43% of total kcal - 4.8 gm / 100 kcal - High oleic safflower, MCT & soy oils. (0.15% DHA, 0.40%ARA) ♦ CHO: - 42% of total kcal - 10.7 gm / 100 kcal - 100% corn syrup solids - Lactose-free, fructose-free, galactose-free ♦ Iron: 1.8 mg / 100 kcal ♦ Osmolality: - 350 m Osm/kg water Similar to Neocate Infant (Nutricia – North America) and PurAmino (Mead Johnson).	Nutritionally complete 100% free amino acid-based formula for infants who cannot tolerate intact proteins. EleCare Infant is indicated for the dietary management of protein maldigestion, malabsorption, severe food allergies, short-bowel syndrome, eosinophilic GI disorders, GI-tract impairment, or other conditions in which an amino acid-based diet is required. Can be fed orally or by tube. Not for parenteral use. Contains DHA and ARA. Does not contain milk protein, soy protein, fructose, galactose, lactose or gluten. Halal Approved with prescription for infants and children. Prescription valid up to 6 months. Verify physician's dilution instructions. **CAUTION:** ♦ Do not heat EleCare mixture. ♦ Not for parenteral use.	*Powder:* 14.1 oz can (Reconstitutes to 95 fl oz) 6 cans / case *Flavors:* - unflavored	0-3: 9 cans 4-5: 10 cans 6-11: 7 cans	9 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

ELECARE JUNIOR (Abbott) Nutritionally complete amino acid-based medical food for children over 1 year of age. ♦ 30 kcal / fl oz ♦ Pro: - 15% of total kcal - 3.1 gm / 100 kcal - 100% free L-amino acids - Milk protein-free - Soy protein-free - Gluten-free ♦ Fat: - 43% of total kcal - 4.8 gm / 100 kcal - High oleic safflower, MCT & soy oils. ♦ CHO: - 42% of total kcal - 10.5 gm / 100 kcal - 100% corn syrup solids - Lactose-free, fructose-free, galactose-free ♦ Iron: 1.8 mg / 100 kcal ♦ Osmolality: - 590 m Osm/kg water Similar to Neocate Junior (Nutricia – North America).	Nutritionally complete 100% free amino acid-based formula for children who cannot tolerate intact proteins. EleCare Junior is indicated for the dietary management of protein maldigestion, malabsorption, severe food allergies, short-bowel syndrome, eosinophilic GI disorders, GI-tract impairment, or other conditions in which an amino acid-based diet is required. Can be fed orally or by tube. Not for parenteral use. Does not contain milk protein, soy protein, fructose, galactose, lactose or gluten. Halal Approved with prescription for children. Prescription valid up to 6 months. Verify physician's dilution instructions. **CAUTION:** ♦ Do not heat EleCare mixture. ♦ Not for parenteral use.	*Powder:* 14.1 oz can (reconstitutes to 62 fl oz) 6 cans / case *Flavors:* - unflavored - vanilla		14 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods

PRODUCT LIST

Product / Description	Indication	Packaging	Monthly Maximum Amount:		
			Infant	Child	Women
ENFAGROW TODDLER TRANSITIONS SOY (Mead Johnson) Soy-based formula for children ♦ 20 kcal / fl oz standard dilution ♦ Pro: - 13% of total kcal - 3.3 gm / 100 kcal - Soy protein isolate & L-Methionine ♦ Fat: - 40% of total kcal - 4.4 gm / 100 kcal - 44% palm olein, 19% soy oil, 19% coconut oil, 15% high oleic sunflower oil, 3% single-cell oil blend rich in DHA and ARA ♦ CHO: - 47% of total kcal - 11.8 gm / 100 kcal - Corn syrup solids ♦ Iron: 2 mg / 100 kcal ♦ Calcium: 195 mg / 100 kcal ♦ Osmolality: 230 mOsm/kg water Similar to Similac Go & Grow Soy Based Formula (Abbott) and Gerber Good Start 2 Soy (Nestlé Infant Nutrition), neither of which are Colorado WIC-approved.	Iron fortified, milk-free, lactose-free, sucrose-free soy formula designed to help meet the nutritional needs of milk protein-sensitive toddlers. Approved with prescription with a qualifying medical diagnosis (i.e.: sensitivity to cow's milk protein) for children ages 12 months of age and older. Prescription valid up to 6 months. Lactose-free, milk-free, sucrose-free, gluten-free, galactose-free **CAUTION:** ♦ Avoid use by anyone with an allergy to soy protein	*Powder*: 21 oz can (Reconstitutes to 141 fl oz) 4 cans / case Order by the can from Ward Road Pharmacy		6 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

ENFAMIL A.R. (Mead Johnson) Milk-based infant formula that thickens after ingestion. ♦ 20 kcal / fl oz ♦ Pro: - 10% of total kcal - 2.5 gm / 100 kcal - Nonfat milk (Whey to casein ratio: 18:82) ♦ Fat: - 46% of total kcal - 5.1 gm / 100 kcal - Contains 43.5% palm olein oil, 19.5% soy oil, 19.5% coconut oil, 14.5% high oleic sunflower oil, and 3% single-cell oil blend rich in DHA and ARA ♦ CHO: - 44% of total kcal - 11.3 gm / 100 kcal - Powder: 59% lactose, 29% rice starch, 12% maltodextrin - RTF: 66% lactose, 20% pregelatinized rice starch, 14% maltodextrin ♦ Iron: - 1.8 mg / 100 kcal ♦ Osmolality: - Powder: 230 mOsm/kg water - RTF: 240 m Osm/kg water ♦ Designed to flow through standard nipple Similar to Similac Sensitive for Spit Up (Abbott), which is not Colorado WIC-approved.	Nutritionally balanced, milk-based, iron fortified infant formula with **A**dded **R**ice starch, causing it to thicken as it comes in contact with stomach acid. The nutrient profile is similar to standard infant formula. Gluten-free. May be useful for infants or children with uncomplicated gastro-esophageal reflux. For term infants who do not have special nutritional requirements. **A Colorado WIC Contract Brand Infant Formula**. Prescription is not required for infants. Prescription is required for children and must be renewed every 6 months. **CAUTION:** ♦ Not recommended for use in pre-term infants as they may be at risk of developing gastrointestinal complications. ♦ Contains soy and milk.	*Powder:* 12.9 oz can (Reconstitutes to 91 fl oz.) 6 cans/case *RTF*: 32 fl oz can; 6 cans / case	0-3: 9 cans 4-5: 10 cans 6-11: 7 cans 0-3: 26 cans 4-5: 28 cans 6-11: 20 cans	10 cans 28 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

ENFAMIL ENFACARE (Mead Johnson) Milk-based 22-calorie infant formula ♦ 22 kcal / fl oz standard dilution ♦ Pro: - 11% of total kcal - 2.8 gm / 100 kcal - Whey protein concentrate and nonfat milk (Whey to casein ratio: 60:40) ♦ Fat: - 47% of total kcal - 5.3 gm / 100 kcal - Contains 34% high oleic vegetable oil, 29% soy oil, 20% MCT oil, 14% coconut oil, and 3% single-cell oil blend rich in DHA and ARA. ♦ CHO: - 42% of total kcal - 10.4 gm / 100 kcal - Powder: 70% lactose, 30% corn syrup solids - RTF: 60% maltodextrin, 40% lactose ♦ Iron: - 1.8 mg / 100 kcal ♦ Protein and many vitamin and mineral levels are higher than in Enfamil Premium Infant. ♦ Osmolality: - Powder: 310 mOsm/kg water - RTF: 250 mOsm/kg water Similar to Similac Expert Care NeoSure (Abbott) and Gerber Good Start Nourish (Nestlé Infant Nutrition).	A milk-based discharge formula for premature or low birth weight infants. Gluten-free. Nutritionally complete 22-calorie milk-based formula containing higher levels of protein, vitamins and minerals than Enfamil Premium Infant. Specially designed for premature infants who have reached a weight of 1800 grams. Is typically used until 3-4 months corrected age, but can be used through the first year of life. Contains DHA and ARA, two long-chain polyunsaturated fatty acids found in breast milk. Research suggests that DHA and ARA may enhance cognitive development and visual acuity in infants, particularly premature infants. Full term infants have adequate stores; however, premature infants are often born with low DHA and ARA levels. Nutrient levels in Enfamil EnfaCare (22 cal/oz) are between those of Enfamil Premature (24 cal/oz) and Enfamil Premium Infant (20 cal/oz) Approved with prescription for infants and children. Prescription valid up to 6 months. **CAUTION:** ♦ There must be a physician's order for any dilution different from that stated on the label.	*Powder:* 12.8 oz can (Reconstitutes to 82 fl oz) 6 cans/case *RTF*: 32 fl oz can; 6 cans / case	0-3: 10 cans 4-5: 11 cans 6-11: 8 cans 0-3: 26 cans 4-5: 28 cans 6-11: 20 cans	11 cans 28 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

ENFAMIL GENTLEASE (Mead Johnson) Milk based, partially-hydrolyzed, reduced-lactose infant formula ♦ 20 kcal / fl oz standard dilution ♦ Pro: - 9% of total kcal - 2.3 gm / 100 kcal - Nonfat milk and whey protein concentrate (whey to casein ratio: 60:40) - Proteins are partially hydrolyzed ♦ Fat: - 48% of total kcal - 5.3 gm / 100 kcal - Contains 44% palm olein, 19.5% soy oil, 19.5% coconut oil, 14.5% high oleic sunflower oil, 2.5% single-cell oil blend rich in DHA (Omega-3) and ARA. ♦ CHO: - 43% of total kcal - 10.8 gm / 100 kcal - 80% Corn syrup solids and 20% lactose from non-fat milk - Contains about 1/5 the lactose of standard milk-based formulas ♦ Iron: - 1.8 mg / 100 kcal ♦ Osmolality: - Powder: 230 mOsm/kg water - RTF: 220 mOsm/kg water Similar to Similac Sensitive (Abbott), which is not Colorado WIC-approved	A nutritionally balanced milk-based infant formula. The protein is partially hydrolyzed making it easier to digest. It also contains reduced lactose – about 1/5th the amount in standard full-lactose, milk-based formulas. Gluten-free. Designed for infants with fussiness or gas. **A Colorado WIC Contract Brand Infant Formula**. Prescription is not required for infants. Prescription is required for children and must be renewed every 6 months. **CAUTION:** ♦ Not intended for infants or children with galactosemia. ♦ Contains milk and soy	*Powder:* 12.4 oz can (available Aug 2011) (Reconstitutes to 90 fluid oz) 6 cans/case *RTF*: 32 fl oz can; 6 cans / case	0-3: 9 cans 4-5: 10 cans 6-11: 7 cans 0-3: 26 cans 4-5: 28 cans 6-11: 20 cans	10 cans 28 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

ENFAMIL PREMIUM INFANT (Mead Johnson) Milk based infant formula ♦ 20 kcal/fl oz standard dilution ♦ Pro: - 8.5% of total kcal - 2.1 gm / 100 kcal - Whey and nonfat milk (Whey to casein ratio: 60:40) ♦ Fat: - 48% of total kcal - 5.3 gm / 100 kcal - Contains 44% palm olein, 19.5% soy oil, 19.5% coconut oil, 14.5% high oleic sunflower oil, 2.5% single-cell oil blend rich in DHA and ARA ♦ CHO: - 43.5% of total kcal - 11.2 gm / 100 kcal - Lactose from nonfat milk ♦ Iron: - 1.8 mg / 100 kcal ♦ Osmolality: - 300 mOsm/kg water Similar to Similac Advance (Abbott), Gerber Good Start Gentle, and Gerber Good Start Protect (Nestlé Infant Nutrition), none of which are Colorado WIC-approved.	For the routine feeding of full term, healthy infants and for sick infants who do not have special nutritional requirements. Gluten-free. Contains Natural Defense Dual Prebiotic Blend; 2 g/L GOS and 2 g/l polydextrose. **A Colorado WIC Contract Brand Infant Formula**. Prescription is not required for infants. Prescription is required for children and must be renewed every 6 months.	*Powder*: 12.5 oz can (Reconstitutes to 90 fl oz) 6 cans/case *Concentrate:* 13 fl oz can *RTF*: 32 fl oz can	0-3: 9 cans 4-5: 10 cans 6-11: 7 cans 0-3: 31 cans 4-5: 34 cans 6-11: 24 cans 0-3: 26 cans 4-5: 28 cans 6-11: 20 cans	10 cans 35 cans 28 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

ENFAMIL PROSOBEE (Mead Johnson) Soy-based infant formula ♦ 20 kcal per fl oz ♦ Pro: - 10% of total kcal - 2.5 gm / 100 kcal - Soy protein isolate supplemented with L-methionine - Low renal solute load ♦ Fat: - 48% of total kcal - 5.3 gm / 100 kcal - 44% palm olein oil, 19.5% soy oil, 19.5% coconut oil, 14.5% high oleic sunflower oil, 2.5% single-cell oil blend rich in DHA and ARA ♦ CHO: - 42% of total kcal - 10.6 gm / 100 kcal - Sucrose- and lactose-free - Contains 100% glucose polymers (corn syrup solids) ♦ Iron: - 1.8 mg / 100 kcal ♦ Osmolality: - Powder: 180 mOsm/kg water - Conc: 170 mOsm/kg water - RTF: 200 mOsm/kg water Similar to Similac Soy Isomil (Abbott) and Gerber Good Start Soy (Nestlé Infant Nutrition), neither of which are Colorado WIC-approved.	Milk-free, lactose-free, sucrose-free, gluten-free, soy-based infant formula. Infant formula for infants and children with an allergy or sensitivity to cow's milk or disorders for which lactose should be avoided: lactase deficiency, lactose intolerance, and galactosemia. The glucose polymers are compatible with the digestive capacity of the infant recovering from gastrointestinal illness. Can be used for vegetarian diets when animal protein formula is not desired. When used as a milk substitute for children ≥ 1 year of age, the total calcium content of the diet should be assessed. **A Colorado WIC Contract Brand Infant Formula**. Prescription is not required for infants. Prescription is required for children and must be renewed every 6 months. **CAUTION:** ♦ Avoid use by anyone with an allergy to soy protein. ♦ Not recommended for very-low-birth-weight infants whose birth weight is <1,8000 grams (4 pounds).	*Powder*: 12.9 oz can (Reconstitutes to 92 fl. oz) 6 cans / case *Concentrate*: 13 fl oz can *RTF*: 32 fl oz can	0-3: 9 cans 4-5: 10 cans 6-11: 7 cans 0-3: 31 cans 4-5: 34 cans 6-11: 24 cans 0-3: 26 cans 4-5: 28 cans 6-11: 20 cans	9 cans 35 cans 28 cans	9 cans 35 cans 28 cans

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

ENFAPORT LIPIL (Mead Johnson) Milk based infant formula with 84% of fat as MCT oil ♦ 30 kcal/fl oz ready-to-feed ♦ Pro: - 14% of total kcal - 3.5 gm / 100 kcal - Cow's milk sources: calcium caseinate and sodium caseinate. ♦ Fat: - 45% of total kcal - 5.4 gm / 100 kcal - 84% fat as MCT oil, 13% soy oil, 3% single-cell oil blend - 34 mg ARA/100 calories - 17 mg DHA/100 calories ♦ CHO: - 41% of total kcal - 10.2 gm / 100 kcal - 100% corn syrup solids ♦ Iron: - 1.8 mg / 100 kcal ♦ Osmolality: - 280 mOsm/kg water	Enfaport is designed to meet the unique nutritional needs of infants with Chylothorax or LCHAD deficiency. Enfaport balances high levels of MCT oil for easier absorption, along with DHA and ARA, important fatty acids for infant development. Lactose free, sucrose-free, and gluten-free. Approved with prescription for infants and children. Prescription valid up to 6 months. **CAUTION:** ♦ Use only under strict medical supervision. The WIC nutritionist or nurse should work closely with the physician and/or clinical dietitian working with the participant on issuance and transitional feeding. ♦ Not for parenteral use	*RTF*: 8 fl oz can 24 can/case Order by the case from Ward Road Pharmacy	0-3: 104 cans 4-5: 112 cans 6-11: 80 cans	113 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

ENSURE (Abbott) A nutritionally complete, lactose-free, low-residue formula. Contains milk and soy ingredients. ♦ 31 kcal / fl oz (250 kcal / 8 fl oz) ♦ Pro: - 14% of total kcal - 9 gm / 8 fl oz - Gluten-free ♦ Fat: - 22% of total kcal - 6 gm / 8 fl oz - Low in saturated fat and cholesterol - No trans fats ♦ CHO: - 64% of total kcal - 40 gm / 8 fl oz - Lactose-free ♦ Iron: - 4.5 mg / 8 fl oz ♦ An 8 fl oz serving provides at least 25% of the DVs for 24 essential vitamins and minerals ♦ Osmolality - 620 mOsm/kg water (vanilla, strawberry, coffee latte, butter pecan) - 640 mOsm/kg water (milk chocolate, dark chocolate) Similar to Boost (Nestlé HealthCare Nutrition), which is not Colorado WIC-approved.	For supplemental use with or between meals or as a sole source of nutrition for adults. Useful whenever the patient's medical, surgical, or psychological state causes inadequate dietary intake. Ensure is intended for oral use but may be used for tube feeding on a short-term, interim basis. Kosher,halal, lactose- and gluten-free, low-residue. Approved with prescription for adults. Prescription valid up to 6 months. **CAUTION:** ♦ Not for parenteral use. ♦ Not to be used for children under 10 years of age. (PediaSure or Nutren Jr. are appropriate for children 1-10 years of age.)	*RTF:* Retail: 8 fl oz reclosable bottles – 6-pack Institutional: 8 fl oz can – 24 cans / case *Flavors:* <u>Retail:</u> - vanilla - chocolate - coffee latte <u>Institutional:</u> - vanilla - milk chocolate - dark chocolate - strawberry - butter pecan			(18) 6-packs or (108) 8 oz cans

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

ENSURE PLUS (Abbott) A nutritionally complete, lactose-free, low-residue, high calorie and high protein formula. Contains milk and soy ingredients. ♦ 44 kcal / fl oz (350 kcal / 8 fl oz) ♦ Pro: - 15% of total kcal - 13 gm / 8 fl oz - Gluten-free - Milk, soy and whey protein concentrate ♦ Fat: - 28% of total kcal - 11gm / 8 fl oz - Low in saturated fat and cholesterol ♦ CHO: - 57% of total kcal - 50 gm / 8 fl oz - Combination of corn maltodextrin and sucrose. - Lactose-free ♦ Iron: - 4.5 mg / 8 fl oz ♦ An 8 fl oz serving provides at least 25% of the DVs for 24 essential vitamins and minerals ♦ Fiber – 3gm / 8 fl oz. ♦ Osmolality - 680 mOsm/kg water Similar to Boost Plus (Nestlé HealthCare Nutrition), which is not Colorado WIC approved.	A high-calorie liquid food for adults who may not be able to tolerate large-volume intakes. Can be used as a dietary supplement or for interim sole-source nutrition. Useful for nutritionally depleted patients whose medical, surgical or psychological state causes inadequate dietary intake. Good source of fiber to help maintain regularity. Ensure Plus is intended for oral use but may be used for tube feeding on a short-term, interim basis. Kosher, halal, lactose- and gluten-free, low-residue. Approved with prescription for adults. Prescription valid up to 6 months. **CAUTION:** ♦ Not appropriate for children less than 10 years of age. (Boost Kid Essentials 1.5 cal, Boost Kid Essentials 1.5 cal with fiber, or PediaSure 1.5 cal or PediaSure 1.5 cal with fiber appropriate for children 1-10 years of age.) ♦ Not for parenteral use	*RTF:* Retail: 8 fl oz reclosable bottles – 6-pack Institutional: 8 fl oz can – 24 cans / case *Flavors*: <u>Retail:</u> - vanilla - milk chocolate - dark chocolate - strawberry - butter pecan <u>Institutional:</u> - vanilla - milk chocolate - strawberry - butter pecan Order by the case from Ward Road Pharmacy			(18) 6 packs or (108) 8 oz cans

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

GERBER GOOD START NOURISH (Nestlé Infant Nutrition) Milk-based 22-calorie infant formula ♦ 22 kcal / fl oz standard dilution ♦ Pro: - 11% of total kcal - 2.8 gm / 100 kcal - Hydrolyzed whey protein isolate ♦ Fat: - 47% of total kcal - 5.2 gm / 100 kcal - Contains 60% high oleic vegetable oil (safflower or sunflower), 20% MCT oil, 18% soy oil, and 2% single-cell oil blend rich in DHA and ARA. ♦ CHO: - 42% of total kcal - 10.5 gm / 100 kcal - 60% lactose, 40% maltodextrin ♦ Iron: - 1.8 mg / 100 kcal ♦ Protein and many vitamin and mineral levels are higher than in standard infant formulas. ♦ Osmolality: - 275 mOsm/kg water Similar to Enfamil EnfaCare (Mead Johnson) and Similac Expert Care NeoSure (Abbott).	A milk-based 100% whey protein partially hydrolyzed discharge formula for premature or low birth weight infants. Gluten-free. Nutritionally complete 22-calorie milk-based formula containing higher levels of nutrients known to be important to support growth in premature infants after discharge from the NICU. Appropriate for use through one year corrected age. . Contains DHA and ARA, two long-chain polyunsaturated fatty acids found in breast milk. Research suggests that DHA and ARA may enhance cognitive development and visual acuity in infants, particularly premature infants. Full term infants have adequate stores; however, premature infants are often born with low DHA and ARA levels. Approved with prescription for infants and children. Prescription valid up to 6 months. **CAUTION:** ♦ There must be a physician's order for any dilution different from that stated on the label.	*Powder:* 12.6 oz can (Reconstitutes to 83 fl oz) 6 cans/case Order by the can from Ward Road Pharmacy	0-3: 10 cans 4-5: 11 cans 6-11: 8 cans	10 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

GOAT'S MILK (Meyenberg) ♦ Kcal / fl oz - 17.75 kcal / fl oz (whole milk) - 11.13 kcal / fl oz (1% milk) ♦ Pro: - Goat milk protein, casein, whey - Contains only trace amounts of the major protein in cow milk - Does not contain soy proteins ♦ Fat: - Milk fat (higher in short- and medium- chain fatty acids than cow's milk and may be easier to digest and absorb.) ♦ CHO: - Lactose ♦ Contains 13% more calcium, 25% more vitamin B6, 47% more vitamin A, 134% more potassium and 350% more niacin when compared to cow milk. Whole fresh goat milk: ♦ Pro: 8.45 gm / 8 fl oz (23% total kcal) ♦ Fat: 7.2 gm / 8 fl oz (48% total kcal) ♦ CHO: 10.75 gm / 8 fl oz (29% total kcal) ♦ Calories: 142 kcal / 8 fl oz ♦ Calcium: 307 mg / 8 fl oz Whole evaporated goat milk (reconstituted): ♦ Pro: 8.18 gm / 8 fl oz (23% total kcal) ♦ Fat: 7.8 gm / 8 fl oz (48% total kcal) ♦ CHO: 10.42 gm / 8 fl oz (29% total kcal) ♦ Calories: 144.6 kcal / 8 fl oz ♦ Calcium: 298 mg / 8 fl oz Low fat (1%) fresh goat milk: ♦ Pro: 7.39 gm / 8 fl oz (33% total kcal) ♦ Fat: 2.4 gm / 8 fl oz (24% total kcal) ♦ CHO: 9.4 gm / 8 fl oz (42% total kcal) ♦ Calories: 89 kcal / 8 fl oz ♦ Calcium: 268 mg / 8 fl oz	Can be used by women and children. May be helpful when there is a cow's milk sensitivity and/or intolerance or adverse reaction to soymilk. The casein in goat milk, plus the evaporation process (in evaporated milk), renders the milk more digestible and less allergenic. The fat has a high proportion of short- and medium-chain fatty acids. It may be more readily digested and absorbed than cow's milk. Evaporated goat's milk is fortified with folate and vitamin D. Fresh goat's milk is fortified with vitamins A and D. Certified Kosher. Whole goat's milk may only be issued to children under two years of age; low fat goat's milk may only be issued to women and children two years of age and older. No prescription needed for adults and children. **CAUTION:** ♦ Not WIC-approved for infants under one year of age because of the high protein, potassium and chloride content, and inadequate amounts of vitamin C, D, B12, niacin, folic acid and iron.	*Fresh milk* – Quart (32 fl oz carton) Whole, low fat (1%) *Evaporated* (whole)- 12 fl oz can *Powdered* (whole) - 12 oz can (Reconstitutes to 3 quarts or 96 ounces)		16 quarts 21 cans 5 cans	P – 22 qts B – 22 qts N – 16 qts E – 24 qts E-M – 36 qt

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

LACTAID (McNeil) Lactose free milk ♦ Kcal / fl oz: - 18.75 kcal / fl oz (whole) - 16.25 kcal / fl oz (2%) - 13.75 kcal / fl oz (1%) - 10 kcal / fl oz (fat-free) ♦ Pro: - 1gm/fl oz in all 4 types ♦ Fat: Milk fat ♦ CHO: - Hydrolyzed lactose (glucose & galactose) - Lactose free ♦ Pasteurized, with vitamins A and D enriched. Whole: ♦ Pro: 8 gm / 8 fl oz ♦ Fat: 8 gm / 8 fl oz ♦ CHO: 12 gm / 8 fl oz ♦ Calories: 150 kcal / 8 fl oz Reduced fat (2%): ♦ Pro: 8 gm / 8 fl oz ♦ Fat: 5 gm / 8 fl oz ♦ CHO: 13 gm / 8 fl oz ♦ Calories: 130 kcal / 8 fl oz Low fat (1%) ♦ Pro: 8 gm / 8 fl oz ♦ Fat: 2.5 gm / 8 fl oz ♦ CHO: 13 gm / 8 fl oz ♦ Calories: 110 kcal / 8 fl oz Fat free: ♦ Pro: 8 gm / 8 fl oz ♦ Fat: 0 gm / 8 fl oz ♦ CHO: 13 gm / 8 fl oz ♦ Calories: 80 kcal / 8 fl oz Similar to Dairy Ease (Land O' Lakes).	Cow's milk that has been treated with lactase enzyme to break down the lactose into two simple sugars, causing it to taste slightly sweeter and making it easier to digest. Lactaid is 100% lactose free. For children and adults with intolerance to lactose. Can be purchased with WIC checks that specify "Lactaid/Dairy Ease milk." A prescription is not needed. WIC provides whole milk for children until the age of 2 years to ensure sufficient energy and to provide linoleic acid, an essential fatty acid needed for growth and development of body tissues After two years of age, lower fat milks (2%, 1%, fat- free) are provided for all children and women. **CAUTION:** ♦ WIC does not provide low fat or fat-free milk for children less than 2 years of age. ♦ Not approved for infants less than 1 year of age. ♦ Soy formula or lactose-free formula may be more appropriate for infants and 1 year olds with lactose intolerance. Soy beverage may also be issued to children with a prescription and medical diagnosis of milk allergy, severe lactose maldigestion, or adherence to a vegan diet.	*Quart* *Half-gallon* ♦ Fat-Free ♦ Low fat (1%) ♦ Reduced Fat (2%) ♦ Whole		16 quarts	P – 22 qts B – 22 qts N – 16 qts E – 24 qts E-M – 36 qts

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

NEOCATE INFANT with DHA and ARA (Nutricia – North America) Nutritionally complete hypoallergenic amino-acid based infant formula ♦ 20 kcal/ fl oz ♦ Pro: - 12% of total kcal - 3.1 gm / 100 kcal - 100% free amino acids including taurine and carnitine - No peptides - Whey, soy, gluten and milk- protein free. ♦ Fat: - 41% of total kcal - 4.5 gm / 100 kcal - 33% of fat is MCT oil - Refined vegetable oil (MCT); Palm kernel and/or coconut oil 7%); High oleic sunflower oil 7%); Soy oil 6%) - Contains M. Alpina oil (source of ARA and C. Cohnii oil (source of DHA) ♦ CHO: - 47% of total kcal - 11.7 gm / 100 kcal - Corn syrup solids - Lactose-free, sucrose-free ♦ Iron: 1.85 mg / 100 kcal ♦ Osmolality: 375 mOsm /kg water Similar to EleCare Infant (Abbott) and Puramino (Mead Johnson).	A nutritionally complete elemental formula for infants with severe cow's milk or soymilk allergy and multiple food protein intolerance. Some medical conditions may necessitate issuing to children. Hypoallergenic, contains 100% synthetic free amino acids and is proven safe for use in infants who cannot tolerate soy formulas (e.g. Enfamil ProSobee) or protein hydrolysates (e.g. Nutramigen, Pregestimil and Similac Expert Care Alimentum.) Whey, soy, gluten and milk-protein free, lactose-free, sucrose-free. Can be used orally or as a tube feeding. Not for parenteral use. Approved with prescription for infants and children. Prescription valid up to 6 months. **CAUTION:** ♦ The WIC nutritionist or nurse should work closely with the physician and/or clinical dietitian working with the participant on issuance and transitional feeding. ♦ Dosage should be determined by a physician and is dependent on the age, body weight and medical condition. ♦ Special directions for preparation and use are on label and on web site. ♦ Not for parenteral use.	*Powder*: 14 oz (400 gm) can. (Reconstitutes to 85 fl oz standard dilution) 4 cans / case Order by the can from Ward Road Pharmacy	0-3: 10 cans 4-5: 11 cans 6-11: 8 cans	10 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

NEOCATE JUNIOR (Nutricia – North America) Nutritionally complete amino acid-based medical food for children. ♦ 30 kcal / fl oz ♦ Pro: - 13% of total kcal – unflavored - 14% of total kcal – tropical fruit & choc - 3.3 gm / 100 kcal – unflavored - 3.5 gm / 100 kcal – tropical fruit & choc - 100% free amino acids - Whey, soy, gluten and milk- protein free. ♦ Fat: - 45% of total kcal – unflavored - 42% of total kcal – tropical fruit & choc - 5 gm / 100 kcal – unflavored - 4.7 gm / 100 kcal – tropical fruit & choc - Fractionated coconut oil, canola oil, high oleic safflower oil (65% LCT, 35% MCT oil) ♦ CHO: - 42% of total kcal – unflavored - 44% of total kcal – tropical fruit & choc - 10.4 gm / 100 kcal – unflavored - 11 gm / 100 kcal – tropical fruit & choc - Corn syrup solids - Lactose-free, sucrose-free ♦ Iron: - 1.5 mg / 100 kcal – unflavored - 1.6 mg / 100 kcal – tropical fruit & choc ♦ Osmolality: - 590 mOsm / kg water– unflavored - 680 mOsm / kg water– tropical fruit - 700 mOsm / kg water– chocolate Similar to EleCare Junior (Abbott) and E028 Splash (Nutricia – North America).	A nutritionally complete elemental medical food for children aged 1 to 10 years who cannot tolerate protein hydrolysates, who have gastrointestinal impairment due to milk protein sensitivity, cow milk protein intolerance, or malabsorption or other medical conditions that affecting the GI tract. Whey, soy, gluten, and milk-protein free, lactose-free, sucrose-free. Can be used orally or as a tube feeding. Not for parental use. Approved with prescription for children. Prescription valid up to 6 months. **CAUTION:** ♦ Use only under medical supervision. The WIC nutritionist or nurse should work closely with the physician and/or clinical dietitian working with the participant on issuance and transitional feeding. ♦ Dosage should be determined by a physician and is dependent on the age, body weight and medical condition. ♦ Special directions for preparation and use are on label and on web site. ♦ Not for parenteral use.	*Powder*: 14 oz (400 gm) can (At standard dilution reconstitutes to approximately: 62 fl oz (unflavored) 59 fl oz (tropical fruit & chocolate) 4 cans / case *Flavors:* - unflavored - tropical fruit - chocolate Flavor packets (not included) available for unflavored Neocate Junior: - grapefruit - lemon-lime - cherry-vanilla. Order by the can from Ward Road Pharmacy		14 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

NEOCATE JUNIOR WITH PREBIOTICS (Nutricia – North America) Nutritionally complete amino acid-based medical food for children. ♦ 30 kcal / fl oz ♦ Pro: - 13% of total kcal - 3.3 gm / 100 kcal - 100% free amino acids - Whey, soy, gluten and milk- protein free. ♦ Fat: - 45% of total kcal - 5 gm / 100 kcal - Fractionated coconut oil, canola oil, high oleic safflower oil (65% LCT, 35% MCT oil) ♦ CHO: - 42% of total kcal - 10.4 gm / 100 kcal - Dietary fiber: 0.96 gm / 8 fl oz (0.4 gm/100 kcal) - Corn syrup solids - Lactose-free, sucrose-free ♦ Iron: - 1.5 mg / 100 kcal ♦ Osmolality: - 570 mOsm / kg water Similar to Elecare Junior (Abbott) and E028 Splash (Nutricia – North America Except that Neocate Junior with Prebiotics also contains dietary fiber.	A nutritionally complete elemental medical food for children aged 1 to 10 years who cannot tolerate protein hydrolysates, who have gastrointestinal impairment due to milk protein sensitivity, cow milk protein intolerance, or malabsorption or other medical conditions that affecting the GI tract. Whey, soy, gluten, and milk-protein free, lactose-free, sucrose-free. Prebiotic fibers are proven to stimulate the growth of good bacteria and decrease the incidence of diarrhea, constipation, vomiting and gas. Can be used orally or as a tube feeding. Not for parental use. Approved with prescription for children. Prescription valid up to 6 months. **CAUTION:** ♦ Use only under medical supervision. The WIC nutritionist or nurse should work closely with the physician and/or clinical dietitian working with the participant on issuance and transitional feeding. ♦ Dosage should be determined by a physician and is dependent on the age, body weight and medical condition. ♦ Not for parenteral use.	*Powder*: 14 oz (400 gm) can (Reconstitutes to 62 fl oz.) 4 cans / case *Flavors:* - unflavored - vanilla Flavor packets (not included) available for unflavored Neocate Junior with Prebiotics: - grapefruit - lemon-lime - cherry-vanilla. Order by the can from Ward Road Pharmacy		14 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

NUTRAMIGEN (Mead Johnson) Hypoallergenic protein hydrolysate formula ♦ 20 kcal / fl oz ♦ Pro: - 11% of total kcal - 2.8 gm / 100 kcal - Casein hydrolysate, amino acids - Contains a high percentage of free amino acids and a lower percentage of small peptides. - Gluten-free ♦ Fat: - 48% of total kcal - 5.3gm / 100 kcal - 44% palm olein, 19.5% soy oil, 19.5% coconut oil, 14.5% high oleic sunflower oil, 2.5% single-cell blend rich in DHA and ARA ♦ CHO: - 41% of total kcal - 10.3 gm / 100 kcal - 75% corn syrup solids and 25% modified corn starch. - Lactose-free; sucrose-free ♦ Iron: - 1.8 mg / 100 kcal ♦ Osmolality: - Conc: 260 mOsm/kg water - RTF: 270 mOsm/kg water Similar to Similac Expert Care Alimentum (Abbott).	Hypoallergenic formula supplying protein in hydrolyzed form for: ♦ Infants and children sensitive to intact proteins of milk and of other foods ♦ Infants with severe or multiple food allergies ♦ Infants with sensitivity to soy protein ♦ Infants with persistent diarrhea or other gastrointestinal disturbances due to milk protein allergy ♦ Infants with galactosemia Nutramigen is not intended for those with problems relating to fat absorption. (Pregestimil is designed for infants with fat malabsorption.) Approved with prescription for infants and children. Prescription valid up to 6 months. **CAUTION:** ♦ Can be unpalatable to some infants and can cause looser stools. ♦ Not recommended for routine use in highly stressed, low birth weight infants as these infants may be at increased risk of developing gastrointestinal complications. ♦ A pork-derived enzyme is used to hydrolyze the protein, which may make product unacceptable to participants who observe certain religious dietary laws.	*Concentrate*: 13 fl oz can 12 cans / case *RTF*: 32 fl oz can 6 cans / case	0-3: 31 cans 4-5: 34 cans 6-11: 24 cans 0-3: 26 cans 4-5: 28 cans 6-11: 20 cans	35 cans 28 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

NUTRAMIGEN WITH ENFLORA LGG (Mead Johnson) Hypoallergenic protein hydrolysate formula ♦ 20 kcal / fl oz ♦ Pro: - 11% of total kcal - 2.8 gm / 100 kcal - Casein hydrolysate, amino acids - Contains a high percentage of free amino acids and a lower percentage of small peptides. - Gluten-free ♦ Fat: - 48% of total kcal - 5.3gm / 100 kcal - 44% palm olein, 19.5% soy oil, 19.5% coconut oil, 14.5% high oleic sunflower oil, 2.5% single-cell blend rich in DHA and ARA ♦ CHO: - 41% of total kcal - 10.3 gm / 100 kcal - 86% corn syrup solids and 14% modified corn starch - Lactose-free; galactose-free ♦ Iron: - 1.8 mg / 100 kcal ♦ Osmolality: - Powder: 300 mOsm/kg water Similar to Nutramigen (Mead Johnson) and Similac Expert Care Alimentum (Abbott).	Hypoallergenic formula supplying protein in hydrolyzed form for: ♦ Infants and children sensitive to intact proteins of milk and of other foods ♦ Infants with severe or multiple food allergies ♦ Infants with sensitivity to soy protein ♦ Infants with persistent diarrhea or other gastrointestinal disturbances due to milk protein allergy ♦ Infants with galactosemia ♦ Contains the probiotic bacterium *Lactobacillus rhamnosus* GG (LGG) to help support the strength of the intestinal barrier and support digestive health. Nutramigen with Enflora LGG is not intended for those with problems relating to fat absorption. (Pregestimil is designed for infants with fat malabsorption.) Approved with prescription for infants and children. Prescription valid up to 6 months. **CAUTION:** ♦ Not recommended for routine use in highly stressed, low birth weight infants as these infants may be at increased risk of developing gastrointestinal complications. ♦ A pork-derived enzyme is used to hydrolyze the protein, which may make product unacceptable to participants who observe certain religious dietary laws.	*Powder:* 12.6 oz can (357 g) (Reconstitutes to 87 fl oz) 6 cans / case	0-3: 10 cans 4-5: 11 cans 6-11: 8 cans	10 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

NUTREN JUNIOR & NUTREN JUNIOR WITH FIBER (Nestlé) Nutritionally complete oral supplement or tube feeding for children. ♦ 30 kcal / fl oz ♦ Pro: - 12% of total kcal - 7.5 gm / 250 mL - Contains milk protein concentrate, whey protein concentrate (50% whey, 50% casein) - Gluten-free ♦ Fat: - 44% of total kcal - 12.4 gm / 250 mL - Soybean oil, canola oil, MCT (21%) (soy lecithin - Nutren Jr. only) ♦ CHO: - 44% of total kcal - 27.5 gm / 250 mL - Maltodextrin, sugar - Lactose-free and low residue - Fiber blend (Nutren with Fiber) pea fiber, FOS, inulin supplies 2.2 g soluble and 3.8 g insoluble fiber / L (1000 kcal) ♦ Iron: 3.5 mg / 250 ml ♦ Osmolality: 350 mOsm/kg water ♦ Contains taurine, carnitine, and ultra-trace elements for long-term tube feedings. Meets or exceeds 100% DRIs for protein and 25 key vitamins and minerals for children consuming these amounts: 1-8 years: 1000 ml 9-13 years: 1500 ml Similar to PediaSure and PediaSure with Fiber (Abbott) and Compleat Pediatric (Nestlé HealthCare Nutrition).	Is indicated as complete liquid nutrition or as a nutritional supplement for children ages 1-10. Contains intact proteins and is intended for children with a stable functioning gastrointestinal tract. Isotonic, lactose-free, gluten-free, low-residue, Kosher. Use for chronic illness, injury or trauma, or failure to thrive. For use as oral or tube feeding. Available with or without fiber. Nutren Junior with Fiber includes 2.2 g/L PREBIO soluble fiber to help promote the growth of beneficial bacteria and 3.3 g/L insoluble fiber to help support normal bowel function. Contains CalciLock™ blend of essential nutrients including calcium, phosphorus, magnesium, zinc and vitamins D, C and K to help support healthy bone development. Approved with prescription for children. Prescription valid up to 6 months. **CAUTION:** ♦ Not for parenteral use. ♦ Not for individuals with galactosemia.	*RTF*: 8.45 fl oz (250ml) Tetra Brik cartons 24 cartons / case *Flavor:* - vanilla Order by the case from Ward Road Pharmacy		107 cartons	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

NUTREN 1.0 & NUTREN 1.0 WITH FIBER (Nestlé) Complete liquid nutrition for adults and children 10 years or older. ♦ 30 kcal / fl oz (1 kcal / mL) ♦ Pro: - 16% of total kcal - 10 gm / 250 mL - Calcium-potassium caseinate - Gluten-free ♦ Fat: - 34% of total kcal - 9.5 gm / 250 mL - Canola oil, MCT, corn oil, soy lecithin (25% MCT) - n6:n3 ratio: 4.1:1 ♦ CHO: - 50% of total kcal - 32 gm / 250 mL - Maltodextrin and sugar) - Lactose-free and low-residue - Fiber blend (Nutren 1.0 with Fiber): supplies 14 g / L from pea fiber, FOS and inulin. Contains 5.2 g prebiotic soluble fiber blend and 8.8 g insoluble fiber / L (1000 kcal) ♦ Iron: 3 mg / 250 ml ♦ Meets 100% of the RDI for 20 vitamins and minerals in 1500 mL (1500 kcal) ♦ Contains taurine, carnitine and ultra-trace minerals for long-term feeding ♦ Osmolality: - 370 mOsm/kg water (no fiber) - 410 mOsm/kg water (with fiber) Similar to Osmolite 1 Cal (Abbott).	A nutritionally complete, isotonic, balanced formula used for complete or supplemental nutrition support. Ideal for short/long term tube or oral feeding for adults with normal protein and calorie requirements. Nutren1.0 with Fiber contains Prebio blend to help promote a healthy gut microbiota. Lactose-free, gluten-free, low-residue, Kosher. Approved with prescription for adults. Prescription valid up to 6 months. **CAUTION:** ♦ Not recommended for infants and children under 10 years of age. ♦ Not for parenteral use. ♦ Not for individuals with galactosemia. ♦ Use as directed by a medical professional.	*RTF*: 8.45 fl oz (or 250 mL) Tetra Brik cartons 24 cartons / case *Flavor:* - vanilla Order by the case from Ward Road Pharmacy			107 cartons

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

NUTREN 1.5 (Nestlé) Complete high-calorie liquid nutrition for adults and children 10 years or older. ♦ 45 kcal / fl oz (1.5 kcal / mL) ♦ Pro: - 16% of total kcal - 15 gm / 250 mL - Calcium-potassium caseinate - Gluten-free ♦ Fat: - 40% of total kcal - 17 gm / 250 mL - MCT oil, canola oil, corn oil, soy lecithin (50% MCT) - n6:n3 ratio: 4.3:1 ♦ CHO: - 44% of total kcal - 42 gm / 250 mL - Maltodextrin - Lactose-free and low-residue ♦ Iron: 4.5 mg / 250 ml ♦ Meets 100% of the RDI for 20 key vitamins and minerals in 1000 mL (1500 kcal) ♦ Contains taurine, carnitine and ultra-trace minerals for long-term feeding requirements ♦ Osmolality: - 510 mOsm/kg water (vanilla)	A nutritionally complete, high-calorie, balanced formula especially designed for oral or tube feeding of children (over 10 years) and adults with a fluid restriction or high-calorie needs. May be used as the sole source of nutrition or as a supplement. Lactose-free, gluten-free, low-residue, Kosher. Approved with prescription for adults. Prescription valid up to 6 months. **CAUTION:** ♦ Not recommended for infants and children under 10 years or age. ♦ Not for parenteral use. ♦ Not for individuals with galactosemia. ♦ Use as directed by a medical professional.	*RTF*: 8.45 fl oz (or 250 mL) Tetra Brik cartons 24 cartons / case *Flavor:* - vanilla Order by the case from Ward Road Pharmacy			107 cartons

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

NUTREN 2.0 (Nestlé HealthCare Nutrition) Complete very high-calorie liquid nutrition for adults and children 10 years or older. ♦ 60 kcal / fl oz (2.0 kcal / mL) ♦ Pro: - 16% of total kcal - 20 gm / 250 mL - Calcium-potassium caseinate - Gluten-free ♦ Fat: - 45% of total kcal - 26 gm / 250 mL - MCT oil, canola oil, soy lecithin, corn oil (75% MCT) - n6:n3 ratio: 4.6:1 ♦ CHO: - 39% of total kcal - 49 gm / 250 mL - Corn syrup solids, maltodextrin, and sugar ♦ Iron: 6 mg / 250 ml ♦ Contains taurine, carnitine and ultra-trace minerals for long-term feeding requirements. ♦ Meets or exceeds 100% RDI for 21 key vitamins and minerals in 750 mL (1500 kcal). ♦ Lactose-free, low-residue. ♦ Osmolality: 745 mOsm/kg water	A nutritionally complete, very high-calorie, balanced formula especially designed for oral or tube feeding for older children and adults needing concentrated caloric, high quality nutrition in a limited volume. May be used as the sole source of nutrition or as a supplement. Lactose-free, gluten-free, low-residue, Kosher. Approved with prescription for adults. Prescription valid up to 6 months. **CAUTION:** ♦ Not recommended for infants and children under 10 years of age unless specified by a physician. ♦ Not for parenteral use. ♦ Not for individuals with galactosemia.	*RTF*: 8.45 fl oz (or 250 mL) Tetra Brik cartons 24 cartons / case *Flavor:* - vanilla Order by the case from Ward Road Pharmacy			107 cartons

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

OSMOLITE 1 CAL (Abbott) Isotonic, low-residue tube-feeding formula. ♦ 31 kcal / fl oz (1.06 kcal / mL) 250 kcal / 8 fl oz ♦ Pro: - 16.7% of total kcal - 10.5 gm / 8 fl oz - Sodium & calcium caseinates and soy protein isolate - Gluten-free ♦ Fat: - 29 % of total kcal - 8.2 gm / 8 fl oz - Canola, MCT, corn oil, soy lecithin ♦ CHO: - 54.3% of total kcal - 33.9 gm / 8 fl oz - Corn maltodextrin, corn syrup solids - Lactose-free ♦ Iron: 3.3 mg / 8 fl oz ♦ 100% of the RDIs for 24 essential vitamins and minerals in 1400 kcal ♦ Osmolality: 300 mOsm/kg water Similar to Nutren1.0 (Nestlé HealthCare Nutrition).	♦ An isotonic, low-residue formula providing complete, balanced nutrition for long-term tube feeding. Designed for patients with calorie requirements of less than 2000 kcal/day or for those with increased protein requirements. Lactose-free, gluten-free, halal, Kosher. ♦ Uses: - For tube feeding patients intolerant to hyperosmolar feedings. - As an oral feeding for patients experiencing altered taste perception. - For supplemental or sole-source nutrition. Approved with prescription for adults. Prescription valid up to 6 months. **CAUTION:** ♦ Not for parenteral use. ♦ Use under medical supervision.	*RTF*: 8 fl oz can 24 cans / case *Flavor:* - unflavored Order by the case from Ward Road Pharmacy			113 cans

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

PEDIASURE (Abbott) Nutritionally balanced oral supplement for children ♦ 30 kcal / fl oz (240 kcal / 8 fl oz) ♦ Pro: - 12% of total kcal - 7 gm / 8 fl oz - Milk protein concentrate, whey protein concentrate, soy protein isolate - Gluten-free ♦ Fat: - 34% of total kcal - 9 gm / 8 fl oz - High-oleic safflower oil, canola oil, tuna oil, soy lecithin - DHA omega -3 FA ♦ CHO: - 54% of total kcal - 33 gm / 8 fl oz - Sugar and corn maltodextrin - Fiber 1 g/8 fl oz - Lactose-free ♦ Iron: 2.7 mg / 8 fl oz ♦ Meets or exceeds 100% of the DRIs for protein plus 25 vitamins and minerals for children 1-8 years of age / 1000 mL. ♦ Osmolality - 480 mOsm/kg water (vanilla, strawberry, banana) - 540 mOsm/kg water (chocolate) Similar to Nutren Junior (Nestlé HealthCare Nutrition) and Compleat Pediatric (Nestlé HealthCare Nutrition).	PediaSure is a source of complete, balanced nutrition especially designed for oral feeding of children 1 to 13 years of age. Lactose-free, gluten-free, halal, Kosher. May be used as the sole source of nutrition or as a supplement for oral or tube feeding. Contains prebiotics for digestive system health, antioxidants to support the immune system, and DHA omega-3 for brain and eye health. Approved with prescription for children over 1 year of age with a qualifying medical condition. PediaSure may not be issued solely for the purpose of enhancing nutrient intake or managing body weight with no qualifying medical condition. Prescription valid up to 6 months. Note: PediaSure Enteral Formula is specially designed for tube feedings. It contains less sucrose and is lower in osmolality than PediaSure or PediaSure with Fiber. It is Colorado WIC approved. **CAUTION:** ♦ Not recommended for infants under 1 year of age unless specified by a physician. ♦ Not for children with galactosemia. ♦ Not for parenteral use. ♦ Use under medical supervision	*RTF*: Retail: 8 fl oz reclosable bottles – 6-pack Institutional: 8 fl oz can – 24 cans / case *Flavors:* Retail: - vanilla - chocolate - strawberry - banana - berry Institutional - vanilla - chocolate - strawberry		(18) 6 packs or 108 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

PEDIASURE WITH FIBER (Abbott) Nutritionally balanced oral supplement for children Vanilla: ♦ 30 kcal / fl oz (240 kcal / 8 fl oz) ♦ Pro: - 12% of total kcal - 7 gm / 8 fl oz - Milk protein concentrate, soy protein isolate - Gluten-free ♦ Fat: - 34% of total kcal - 9 gm / 8 fl oz - High-oleic safflower oil, canola oil, tuna oil, soy lecithin - DHA omega-3 FA ♦ CHO: - 54% of total kcal - 33 gm / 8 fl oz - Sugar, corn maltodextrin, scFOS - Dietary fiber: 3 g / 8 fl oz - Lactose-free ♦ Iron: 2.7 mg / 8 fl oz ♦ Meets or exceeds 100% of the DRIs for protein plus 25 vitamins and minerals for children 1-8 years of age / 1000 mL. ♦ Osmolality: 480 mOsm/kg water Similar to Nutren Junior with Fiber (Nestlé HealthCare Nutrition) and Compleat Pediatric (Nestlé HealthCare Nutrition).	PediaSure with Fiber is a source of complete, balanced nutrition especially designed for oral feeding of children 1 to 13 years of age. It contains fiber which helps normalize bowel function. Lactose-free, gluten-free, Kosher. Contains prebiotics for digestive system health, antioxidants to support the immune system, and DHA omega-3 for brain and eye health. Approved with prescription for children over 1 year of age. PediaSure with Fiber may not be issued solely for the purpose of enhancing nutrient intake or managing body weight with no qualifying medical condition. Prescription valid up to 6 months. Note: PediaSure Enteral Formula with Fiber is specially designed for tube feedings. It contains less sucrose and is lower in osmolality than PediaSure or PediaSure with Fiber. It is Colorado WIC approved. **CAUTION:** ♦ Not recommended for infants under 1 year of age unless specified by a physician. ♦ Not for children with galactosemia. ♦ Not for parenteral use.	*RTF*: Retail: 8 fl oz reclosable bottles – 6-pack Institutional: 8 fl oz can – 24 cans / case *Flavors:* Retail: - vanilla - strawberry Institutional - vanilla		(18) 6 packs or 108 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

PEDIASURE ENTERAL FORMULA (Abbott) Nutritionally balanced, complete formula designed for tube feeding children. ♦ 30 kcal / fl oz (240 kcal / 8 fl oz) ♦ Pro: - 12% of total kcal - 7 gm / 8 fl oz - Milk protein concentrate - Gluten-free ♦ Fat: - 34% of total kcal - 9 gm / 8 fl oz - High-oleic safflower oil, soy oil, soy lecithin - DHA omega-3 FA ♦ CHO: - 54% of total kcal - 33 gm / 8 fl oz - Corn maltodextrin, sugar - Lactose-free ♦ Iron: 2.7 mg / 8 fl oz ♦ Meets or exceeds 100% of the DRIs for protein plus 25 vitamins and minerals for children 1-8 years of age / 1000 mL. ♦ Osmolality: 335 mOsm/kg water Similar to Nutren Junior (Nestlé HealthCare Nutrition) and Compleat Pediatric ((Nestlé HealthCare Nutrition).	A nutritionally complete, milk-based, enteral formula specially designed for tube feeding of children 1 to 13 years of age. Contains less sucrose and is lower in osmolality than other forms of PediaSure. May be used as the sole source of nutrition or as a supplement. Lactose-free, gluten-free, halal, Kosher. Approved with prescription for children over 1 year of age. Prescription valid up to 6 months. **CAUTION:** ♦ Not recommended for infants under 1 year of age unless specified by a physician. ♦ Not for children with galactosemia. ♦ Not for parenteral use. ♦ Use under medical supervision.	*RTF*: 8 fl oz cans 24 cans / case Available institutional packaging only *Flavor*: - vanilla Order by the can from Ward Road Pharmacy.		(18) 6 packs or 108 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

PEDIASURE ENTERAL FORMULA WITH FIBER (Abbott) Nutritionally balanced, complete formula designed for tube feeding children. ♦ 30 kcal / fl oz (240 kcal / 8 fl oz) ♦ Pro: - 12% of total kcal - 7 gm / 8 fl oz - Milk protein concentrate - Gluten-free ♦ Fat: - 34 of total kcal - 9 gm / 8 fl oz - High-oleic safflower oil, soy oil, soy lecithin ♦ CHO: - 54% of total kcal - 34 gm / 8 fl oz - Corn maltodextrin, sugar - Dietary fiber: 3 g / 8 fl oz - ScFOS: 1.5 gm / 8 fl oz - Lactose-free ♦ Iron: 2.7 mg / 8 fl oz ♦ Meets or exceeds 100% of the DRIs for protein plus 25 vitamins and minerals for children 1-8 years of age / 1000 mL. ♦ Osmolality: 350 mOsm/kg water Similar to Nutren Junior with Fiber (Nestlé HealthCare Nutrition) and Compleat Pediatric (Nestlé HealthCare Nutrition).	A nutritionally complete, milk-based, enteral formula specially designed for tube feeding of children 1 to 13 years of age. Contains a blend of soluble and insoluble fibers and fructooligosaccharides to help normalize bowel functions. Contains less sucrose and is lower in osmolality than other forms of PediaSure. May be used as the sole source of nutrition or as a supplement. Lactose-free, gluten-free, halal, Kosher. Order from Ward Road Pharmacy with assistance from a State Nutrition Consultant. Approved with prescription for children over 1 year of age. Prescription valid up to 6 months. **CAUTION:** ♦ Not recommended for infants under 1 year of age unless specified by a physician. ♦ Not for children with galactosemia. ♦ Not for parenteral use. ♦ Use under medical supervision.	*RTF*: 8 fl oz cans 24 cans / case Available institutional packaging only *Flavor*: - vanilla Order by the can from Ward Road Pharmacy.		(18) 6 packs or 108 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

PEDIASURE 1.5 Cal (Abbott) High calorie high protein nutritional supplement for children ♦ 44 kcal / fl oz (350 kcal / 8 fl oz) ♦ Pro: - 16% of total kcal - 14 gm / 8 fl oz - Milk protein concentrate - Gluten-free ♦ Fat: - 41% of total kcal - 16 gm / 8 fl oz - High-oleic safflower oil, MCT, C. Cohnii oil ♦ CHO: - 43% of total kcal - 38 gm / 8 fl oz - Corn maltodextrin - Lactose-free ♦ Iron: 2.7 mg / 8 fl oz ♦ Meets or exceeds 100% of the DRIs for protein plus 25 vitamins and minerals for children 1-8 years of age / 1000 mL. ♦ Osmolality - 370 mOsm/kg water Similar to Boost Kid Essentials 1.5 (Nestlé HealthCare Nutrition).	PediaSure1.5 Cal is a higher caloric density product designed to meet the energy requirements of pediatric patients who are at risk for malnutrition, require a higher caloric density, or have fluid restrictions. PediaSure 1.5 Cal provides a source of complete, balanced nutrition for children 1 to 13 years of age. Lactose-free, gluten-free, halal, Kosher. May be used as the sole source of nutrition or as a supplement for oral or tube feeding. Approved with prescription for children over 1 year of age with a qualifying medical condition. PediaSure 1.5 Cal may not be issued solely for the purpose of enhancing nutrient intake or managing body weight with no qualifying medical condition. Prescription valid up to 6 months. **CAUTION:** ♦ Not recommended for infants under 1 year of age. ♦ Not for children with galactosemia. ♦ Not for parenteral use. ♦ Use under medical supervision	*RTF*: 8 fl oz cans 24 cans / case Available institutional packaging only *Flavor*: - vanilla Order by the can from Ward Road Pharmacy.		108 cans (4 ½ cases)	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

PEDIASURE 1.5 Cal with Fiber (Abbott) High calorie high protein nutritional supplement for children ♦ 44 kcal / fl oz (350 kcal / 8 fl oz) ♦ Pro: - 16% of total kcal - 14 gm / 8 fl oz - Milk protein concentrate - Gluten-free ♦ Fat: - 41% of total kcal - 16 gm / 8 fl oz - High-oleic safflower oil, soy oil, MCT, C. Cohnii oil ♦ CHO: - 43% of total kcal - 39 gm / 8 fl oz - Corn maltodextrin - Dietary fiber: 3 g / 8 fl oz - ScFOS: 1.6 gm / 8 fl oz - Lactose-free ♦ Iron: 2.7 mg / 8 fl oz ♦ Meets or exceeds 100% of the DRIs for protein plus 25 vitamins and minerals for children 1-8 years of age / 1000 mL. ♦ Osmolality - 390 mOsm/kg water Similar to Boost Kid Essentials 1.5 with fiber (Nestlé HealthCare Nutrition).	PediaSure1.5 Cal with Fiber is a higher caloric density product designed to meet the energy requirements of pediatric patients who are at risk for malnutrition, require a higher caloric density, or have fluid restrictions. PediaSure 1.5 Cal with Fiber provides a source of complete, balanced nutrition for children 1 to 13 years of age. Contains a good source of dietary fiber to help regulate bowel function. Lactose-free, gluten-free, halal, Kosher. May be used as the sole source of nutrition or as a supplement for oral or tube feeding. Approved with prescription for children over 1 year of age with a qualifying medical condition. PediaSure 1.5 Cal with Fiber may not be issued solely for the purpose of enhancing nutrient intake or managing body weight with no qualifying medical condition. Prescription valid up to 6 months. **CAUTION:** ♦ Not recommended for infants under 1 year of age. ♦ Not for children with galactosemia. ♦ Not for parenteral use. ♦ Use under medical supervision	*RTF*: 8 fl oz cans 24 cans / case Available institutional packaging only *Flavor*: - vanilla Order by the can from Ward Road Pharmacy.		108 cans (4 ½ cases)	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

PEPTAMEN (Nestlé) Nutritionally complete, isotonic, elemental formula for adults. ♦ 30 kcal / fl oz ♦ Pro: - 16% of total kcal - 10 gm / 250 kcal - Enzymatically hydrolyzed 100% whey - Peptide-based for better absorption - Gluten-free ♦ Fat: - 33% of total kcal - 9.8 gm / 250 kcal - MCT (70%), soybean oil, soy lecithin) - n6:n3 ratio: 7.4:1 ♦ CHO: - 51% of total kcal - 32 gm / 250 kcal - Maltodextrin, corn starch (unflavored) - Lactose-free ♦ Iron: - 4.5 mg / 250 kcal ♦ Meets or exceeds 100% of the RDI for 22 key vitamins and minerals in 1500 mL (1500 kcal) ♦ Low-residue ♦ Osmolality: - 270 mOsm/kg water (unflavored) - 380 mOsm/kg water (vanilla) .	Nutritionally complete, isotonic, elemental formula for adults. Use for impaired GU functions such as malabsorption, pancreatitis, short bowel syndrome, chronic diarrhea, Crohn's Disease/inflammatory bowel disease, ulcerative colitis, Cystic Fibrosis, delayed gastric emptying, Cerebral Palsey, Malnutrition and HIV. Lactose-free, gluten-free and low residue. Peptamen (unflavored) should be used only for tube feeding. Peptamen (vanilla flavored) can be used orally. Approved with prescription for adults. Prescription valid up to 6 months. **CAUTION:** ♦ For use only under medical supervision. ♦ Not for parenteral use. ♦ Contains ingredients (cow's milk protein) that may not be appropriate for individuals with food allergies. ♦ Not for individuals with galactosemia.	*RTF*: 8.45 fl oz (250 ml) Tetra Brik cartons 24 cartons / case *Flavors*: - unflavored (tube feeding) - vanilla (oral) Order by the case from Ward Road Pharmacy			107 cartons

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

PEPTAMEN JUNIOR & PEPTAMEN JUNIOR WITH FIBER (Nestlé) Complete peptide-based elemental diet for children. ♦ 30 kcal / fl oz standard dilution ♦ Pro: - 12% of total calories - 7.5 gm / 250 kcal - Enzymatically hydrolyzed 100% whey - Peptide-based for better absorption - Gluten-free ♦ Fat: - 34% of total kcal - 9.6 gm / 250 kcal - MCT, soybean oil, canola oil, soy lecithin - 60% MCT, 40% LCT - n6:n3 ratio: 4.8:1 ♦ CHO: - 54% of total kcal - 34 gm / 250 kcal - Maltodextrin, corn starch, (sugar – oral flavors only) - Lactose-free - Low-residue - Fiber blend (Peptamen Junior with Fiber) from pea fiber, FOS and inulin supplies 3.6 g prebiotic soluble fiber and 3.8 g insoluble fiber / L (1000 kcal) ♦ Iron: - 3.5 mg / 250 kcal ♦ Osmolality: - 260 mOsm/kg water (unflavored) - 380 mOsm/kg water (vanilla & chocolate) - 390 mOsm/kg water (vanilla with fiber and prebio) - 400 mOsm/kg water (strawberry) Similar to Vital Jr. (Abbott), which is not Colorado-WIC approved.	Ready-to-use elemental diet for elevated caloric requirements. Nutritionally complete, elemental diet for children ages 1-10 with impaired gastrointestinal function. May be indicated for inflammatory bowel disease/Crohn's Disease, short bowel syndrome, cystic fibrosis, chronic diarrhea, cerebral palsy, delayed gastric emptying, gastric failure and malabsorption. Contains CalciLock™ blend of essential nutrients including calcium, phosphorus, magnesium, zinc and vitamins D, C and K to help support healthy bone development. Peptamen Junior with Fiber contains a prebiotic fiber blend (Prebio) that helps support a healthy gut microflora. Meets or exceeds 100%DRIs for protein and 25 key vitamins and minerals for children consuming these amounts: - 1-8 year olds: 1000 ml - 9-13 year olds: 1500 ml Approved with prescription for children. Prescription valid up to 6 months. **CAUTION:** ♦ Use only under strict medical supervision. ♦ Not for infants under 1 year of age. ♦ Not for parenteral use. ♦ Contains cow's milk protein that may not be appropriate for individuals with food allergies. ♦ Not for individuals with galactosemia.	*RTF:* 8.45 fl oz Tetra Brik cartons 24 cartons / case *Flavors*: <u>Peptamen Junior:</u> - unflavored (enteral feeding) - vanilla (oral use) - chocolate (oral use) - strawberry (oral use) <u>Peptamen Junior. with Fiber</u> - vanilla (enteral or oral use) Order by the case from Ward Road Pharmacy		107 cartons	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

PORTAGEN (Mead Johnson) Milk based formula with MCT oil for children and adults. Not nutritionally complete ♦ 30 kcal / fl oz ♦ Pro: - 14% of total kcal - 34 gm / quart - Sodium caseinate (milk-based protein) ♦ Fat: - 40% of total kcal - 46 gm / quart - 87% of fat from MCT oil, 13% corn oil; provides linoleic acid ♦ CHO: - 46% of total kcal - 110 gm / quart - 75% corn syrup solids, 25% sugar (sucrose) - Lactose-free ♦ Iron: - 18 mg / quart ♦ Osmolality: 350 mOsm/kg water	Used for oral feeding of children and adults when conventional dietary fats are poorly digested, absorbed, or used. Medium Chain Triglycerides (MCT) are better hydrolyzed and absorbed than long chain fatty acids in conventional food fat. Portagen is not nutritionally complete. Supplementation of essential fatty acids and ultra trace minerals should be considered if used long-term. Can be used as a portion of the diet or as a beverage to be consumed with each meal. Gluten-free, lactose-free, low-residue. Appropriate for conditions such as cystic fibrosis, intestinal resection, pancreatic insufficiency, bile acid deficiency, lymphatic anomalies, celiac disease, steatorrhea, and biliary atresia. Approved with prescription for children and women. Prescription valid up to 6 months. **CAUTION:** ♦ Not a nutritionally complete formula. ♦ For use only under medical supervision. ♦ Need to maintain normal water intake when used as a sole source of nutrition. ♦ Not recommended for use as an infant formula. ♦ Not for individuals with galactosemia. ♦ Contains milk protein. ♦ Do not store in plastic containers as oil may escape.	Powder: 16 oz can (Reconstitutes to 70 fl oz) 6 cans / case Order by the case from Ward Road Pharmacy; *not routinely stocked*		13 cans	13 cans

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

PREGESTIMIL (Mead Johnson) Hypoallergenic protein hydrolysate infant formula with MCT ♦ 20 kcal / fl oz standard dilution ♦ Pro: - 11% total kcal - 2.8 gm / 100 kcal - Hydrolyzed casein supplemented with 3 amino acids: L-cystine, L-tyrosine and L-tryptophan ♦ Fat: - 48% of total kcal - 5.6 gm / 100 kcal - Fat blend of 55% MCT, 25% soy oil, 2% corn oil, 7.5% high oleic vegetable oil, 2.5% single-cell oil blend rich in DHA and ARA ♦ CHO: - 41% of total kcal - 10.2 gm / 100 kcal - Contains carbohydrate blend of 65% corn syrup solids, and 7% modified cornstarch. - Sucrose- and lactose-free. ♦ Iron: - 1.8 mg / 100 kcal ♦ Increased levels of the fat-soluble vitamins A, D, E and K, as well as vitamin C and zinc to offset possible loss due to malabsorption. ♦ Osmolality: 320 mOsm/kg water ♦ Low renal solute load	For infants and children with severe malabsorption disorders including chronic diarrhea, short bowel syndrome, intestinal resection, cystic fibrosis, lactase and sucrase deficiency, steatorrhea, and food allergies. The protein source is hypoallergenic in comparison to the intact proteins used in other formulas. This is helpful in managing infants sensitive to intact protein, following severe and persistent diarrhea, and following intestinal illness or trauma. MCT oil is valuable in the nutritional management of malabsorption disorders. The carbohydrate source is non-antigenic and thus hypoallergenic and is helpful following intestinal disorders. Approved with prescription for infants and children. Prescription valid up to 6 months. **CAUTION:** ♦ For use only under medical supervision. ♦ Not recommended for routine use in very low birth weight infants as some may be at increased risk of developing gastrointestinal complications. ♦ A pork-derived enzyme is used to hydrolyze the protein, which may make product unacceptable to participants who observe certain religious dietary laws.	*Powder*: 16 oz can (Reconstitutes to 112 fl oz) 6 cans / case	0-3: 7 cans 4-5: 8 cans 6-11: 6 cans	8 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

PURAMINO (formerly Nutramigen AA) (Mead Johnson) Hypoallergenic amino acid-based infant formula ♦ 20 kcal / fl oz ♦ Pro: - 11% of total kcal - 2.8 gm / 100 kcal - 100% free amino acids - Gluten-free ♦ Fat: - 48% of total kcal - 5.3gm / 100 kcal - 44% palm olein, 19.5% soy oil, 19.5% coconut oil, 14.5% high oleic sunflower oil, 2.5% single-cell blend rich in DHA and ARA ♦ CHO: - 41% of total kcal - 10.3 gm / 100 kcal - 95% corn syrup solids and 5% modified tapioca starch. - Lactose-free; galactose-free ♦ Iron: - 1.8 mg / 100 kcal ♦ Osmolality: - 350 mOsm/kg water Similar to Elecare Infant (Abbott) and Neocate Infant (Nutricia – North America).	PurAmino is a hypoallergenic, amino acid-based infant formula for the dietary management of infants and toddlers with severe cow's milk protein allergy, not effectively managed by an extensively hydrolyzed formula. Suitable for gut impairment conditions that require an elemental diet. PurAmino is also indicated for the dietary management of infants and toddlers with multiple food protein allergies. Nutritionally complete for infants up to 6 months and a major source of nutrition through 24 months. Approved with prescription for infants and children. Prescription valid up to 6 months. **CAUTION:** ♦ For use only under medical supervision. ♦ When PurAmino is used as a milk substitute, the total calcium content of the diet should be assessed.	*Powder:* 14.1 oz can (Reconstitutes to 98 fl oz) 4 cans / case Order by the can from Ward Road Pharmacy	0-3: 8 cans 4-5: 9 cans 6-11: 7 cans	9 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

SIMILAC EXPERT CARE ALIMENTUM (Abbott) Hypoallergenic protein hydrolysate formula ♦ 20 kcal / oz standard dilution ♦ Pro: - 11% of total kcal - 2.75 gm / 100 kcal - Fully hydrolyzed protein (casein hydrolysate) supplemented with free amino acids (L-Cystine, L-Tyrosine & L-Tryptophan) ♦ Fat: - 48% of total kcal - 5.54 gm / 100 kcal - Readily digested and absorbed fat blend. (High oleic safflower oil, medium chain triglycerides, and soy oil). - DHA and ARA added to all forms in this product line ♦ CHO: - 41% of total kcal - 10.2 gm / 100 kcal - Sugar and modified tapioca starch - Both powder and RTF are lactose-free ♦ Iron: - 1.8 mg / 100 kcal ♦ Osmolality: 320 mOsm/kg water ♦ Alimentum RTF is corn-free. Alimentum powder is <u>not</u> corn-free and has a different carbohydrate composition. Similar to Nutramigen and Nutramigen with Enflora LGG (Mead Johnson).	A nutritionally complete, hypoallergenic formula for infants and a supplemental beverage for children with severe food allergies, sensitivity to cow's milk protein, colic due to protein sensitivity, chronic intractable diarrhea, multiple food allergies, carbohydrate or fat malabsorption, galactosemia, or cystic fibrosis. Approved with prescription for infants and children. Prescription valid up to 6 months. **CAUTION:** ♦ Does not contain levels of protein, vitamins, and minerals needed by premature infants. ♦ A pork-derived enzyme is used to hydrolyze the protein, which may make the product unacceptable to participants who observe certain religious dietary laws.	*Powder:* 16 oz can (Reconstitutes to 115 fl oz) 6 cans / case *RTF*: 32 fl oz can 6 plastic bottles / case	0-3: 7 cans 4-5: 8 cans 6-11: 6 cans 0-3: 26 cans 4-5: 28 cans 6-11 20 cans	7 cans 28 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

SIMILAC EXPERT CARE NEOSURE (Abbott) Milk-based 22-calorie infant formula ♦ 22 kcal / fl oz standard dilution ♦ Powder mixable to various caloric concentrations: 20, 22, 24 and 27 kcal / fl oz ♦ Pro: - 11% of total kcal - 2.8 gm / 100 kcal - Source: nonfat milk and whey protein concentrate ♦ Fat: - 49% of total kcal - 5.50 gm / 100 kcal - Source: Soy, high oleic safflower oil, MCT and coconut oil - Contains DHA and ARA ♦ CHO: - 40% of total kcal - 10.1 gm / 100 kcal - Source: Corn syrup solids & lactose (50:50) ♦ Iron: 1.8 mg / 100 kcal ♦ Higher levels of protein, vitamins and minerals than term formula ♦ Osmolality: 250 mOsm/kg water Similar to Enfamil EnfaCare (Mead Johnson) and Gerber Good Start Nourish (Nestlé Infant Nutrition).	A preterm discharge formula for infants. For healthy premature infants weighting 1800 gm (approximately 4 pounds) or more. Designed to promote catch-up growth and support development. Used for transition feeding after hospital discharge (or after use of a premature formula) until a term formula is appropriate. Kosher and halal. Contains DHA and ARA, two long-chain polyunsaturated fatty acids found in breast milk. Research suggests that DHA and ARA may enhance cognitive development and visual acuity in infants, particularly premature infants. Full term infants have adequate stores; however, premature infants are often born with low DHA and ARA levels. Approved with prescription for infants and children. Prescription valid up to 6 months. **CAUTION:** ♦ There must be a physician's order for any dilution different from that stated on the label.	*Powder:* 13.1 oz can (Reconstitutes to 87 fl oz standard dilution) 6 cans / case *RTF*: 32 fl oz can	0-3: 10 cans 4-5: 11 cans 6-11: 8 cans 0-3: 26 cans 4-5: 28 cans 6-11: 20 cans	10 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

SIMILAC PM 60/40 (Abbott) Low mineral, low-iron infant formula ♦ 20 kcal / fl oz ♦ Pro: - 9 % of total kcal - 2.2 gm pro / 100 kcal - Whey protein concentrate & sodium caseinate (60:40) ♦ Fat: - 50% of total kcal - 5.6 gm / 100 kcal - High oleic safflower oil, soy oil, coconut oil (41:30:29) ♦ CHO: - 41% of total kcal - 10.2 gm / 100 kcal - 100% Lactose ♦ Iron: 0.7 mg / 100 kcal ♦ Calcium: 56 mg / 100 kcal ♦ Phosphorus: 28 mg / 100 kcal ♦ Potassium: 80 mg / 100 kcal ♦ Sodium: 24 mg / 100 kcal ♦ Osmolality: 280 mOsm/kg water	A low-iron formula for infants who are predisposed to hypocalcemia, or those with renal, digestive or cardiovascular impaired functions that would benefit from lowered mineral levels (such as calcium, phosphorus, potassium and sodium). The calcium-to-phosphorus ratio and content is designed to treat serum calcium disorders – such as Williams' syndrome. Guten-free, Kosher, Halal. Approved with prescription for infants and children. Renew prescription every 6 months. **CAUTION:** ♦ For use only under medical supervision. ♦ May be necessary to supply electrolytes and iron from other sources under medical supervision. ♦ Infants under 1500 grams may need additional nutrients.	*Powder* 14.1 oz can (Reconstitutes to 102 fl oz) 6 cans / case Order by the case from Ward Road Pharmacy; *not routinely stocked*	0-3: 8 cans 4-5: 9 cans 6-11: 6 cans	8 cans	

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

SOY BEVERAGE (8th Continent) Soy-based oral beverage. <u>Regular Original: 8 fl oz.</u> ♦ Calories – 80 ♦ Protein – 8 gm - Gluten-free ♦ Fat – 2.5 gm - Saturated fat – 0 gm - Trans fat – 0 gm - Cholesterol – 0 mg - 29% calories from fat ♦ Carbohydrate – 11 gm - Dietary fiber – 0 gm - Sugars – 7 gm - 100% Lactose-free ♦ Iron: 10% daily value in 8 oz. ♦ Calcium: 284 mg	Soymilk is made from natural soy beans and can be a substitute for individuals with intolerance to milk products. It also is a good source of protein for individuals that do not eat meat or do not consume adequate amounts of protein. Lactose-free, gluten-free, and certified vegetarian. Women can receive soymilk as a substitute for low fat milk without a prescription. A prescription is needed for children ages 1-5 and is valid for up to 6 months. Approved medical conditions for issuance of soymilk to children are milk allergy, severe lactose intolerance, vegan diet or religious preference (for individuals following a Kosher diet since soy beverage is pareve, which means it can be consumed with both meat and dairy dishes). **CAUTION:** ▪ Keep refrigerated after opening	Half gallon		8 half gallon	P – 11 half gal B – 11 half gal N – 8 half gal E – 12 half gal E-M – 18 half gal

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

SOY BEVERAGE (Pacific Natural Foods) Soy-based oral beverage. <u>Ultra Soy Plain: 8 fl oz.</u> ♦ Calories – 120 ♦ Protein – 10 gm - Gluten-free ♦ Fat – 4 gm - Saturated fat – 0.5 gm - Trans fat – 0 gm - Cholesterol – 0 mg - 29% calories from fat ♦ Carbohydrate – 11 gm - Dietary fiber – 1 gm - Sugars – 8 gm - 100% Lactose-free ♦ Iron: 10% daily value in 8 oz. ♦ Calcium: 284 mg <u>Ultra Soy Vanilla: 8 fl. oz.</u> ♦ Calories – 130 ♦ Protein – 10 gm ♦ Fat – 4 gm - Saturated fat – 0.5 gm - Trans fat – 0 gm - Cholesterol – 0 mg - 29% calories from fat ♦ Carbohydrate – 14 gm - Dietary fiber – 1 gm - Sugars – 10gm - 100% Lactose-free ♦ Iron: 10% daily value in 8 oz. ♦ Calcium: 284 mg	Soymilk is made from natural soy beans and can be a substitute for individuals with intolerance to milk products. It also is a good source of protein for individuals that do not eat meat or do not consume adequate amounts of protein. Kosher, lactose-free, gluten-free, vegan. Women can receive soymilk as a substitute for low fat milk without a prescription. A prescription is needed for children ages 1-5 and is valid for up to 6 months. Approved medical conditions for issuance of soymilk to children are milk allergy, severe lactose intolerance, vegan diet or religious preference (for individuals following a Kosher diet since soy beverage is pareve, which means it can be consumed with both meat and dairy dishes). **CAUTION:** ▪ Keep refrigerated after opening	1 quart shelf-stable containers *Flavors*: - vanilla - plain -		16 quarts	P – 22 qts B – 22 qts N – 16 qts E – 24 qts E-M – 36 qts

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

TOFU (Azumaya) Tofu food product made from soybeans. *Firm*: 3 *oz. serving* ♦ Calories: 70 / serving ♦ Pro: - 7 g / serving ♦ Fat: - 3.5 g / serving - No cholesterol ♦ CHO: - 2 g / serving - No sugar added - Less than 1 g fiber ♦ Sodium: 20 mg / serving ♦ Iron: 6% daily value / serving ♦ Calcium: 15% daily value / serving *Extra Firm: 3 oz*. serving ♦ Calories: 70 / serving ♦ Pro: - 8 g / serving ♦ Fat: - 4 g / serving; 3 oz - No cholesterol ♦ CHO: - 2g / serving - No sugar added - 1 g fiber ♦ Sodium: 20 mg / serving ♦ Iron: 8% daily value / serving ♦ Calcium: 15% daily value / serving	Tofu is made from natural soy beans and can be a substitute for individuals with intolerance to milk products. It also is a good source of protein for individuals who do not eat meat or do not consume adequate amounts of protein. Women may substitute up to 4 quarts of milk (6 quarts for exclusively breastfeeding women) for either cheese or tofu. One quart of milk substitutes for one pound of tofu. Three quarts of milk substitutes for one pound of cheese. A medical prescription is required to substitute more than 4 quarts of milk (6 quarts for exclusively breastfeeding women) for either cheese or tofu. A prescription is needed to issue any amount of tofu for children ages 1-5. Prescriptions are valid for up to 6 months. Approved medical conditions for issuance of tofu are milk allergy, severe lactose intolerance or vegan diet. **CAUTION:** ▪ Keep refrigerated ▪ Shelf life is 70 days from date of manufacture; can be kept in refrigerator 3-5 days after opening.	Azumaya: *14 oz. package – Firm* *14 oz package – Extra Firm*		With approved Rx, may be substituted for milk at a rate of 1 lb tofu for 1 qt milk up to the maximum 16 quarts of milk.	P – 4 lbs B – 4 lbs N – 4 lbs E - 6 lbs E-M – 9 lbs With approved Rx, additional tofu may be provided as a substitute for milk at the rate of 1 lb tofu for 1 qt milk up to the maximum allotment of milk.

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

TOLEREX (Nestlé HealthCare Nutrition) Complete elemental formula for adults ♦ 30 kcal / oz (300 kcal / 300 mL - 1 reconstituted packet) ♦ Protein: - 8 % of total kcal - 6.2 gm / packet (300 kcal) - 100% free amino acids - Gluten-free ♦ Fat: 2 % of total kcal - 0.6 gm / packet (300 kcal) - Safflower oil ♦ CHO: - 90 % of total kcal - 68 gm / packet (300 kcal) - Maltodextrin (from corn), modified corn starch - Lactose-free - Low residue ♦ Iron: 3 mg / packet (300 kcal) ♦ Osmolality: 550 mOsm/kg water	Nutritionally complete elemental (protein is predigested) tube feeding or beverage for adults with impaired digestion and absorption, such as severe protein and fat malabsorption or specialized nutrient needs such as food allergies. Approved with prescription for adults. Prescription valid up to 6 months. **CAUTION:** ♦ For use only under medical supervision. ♦ Not for parenteral use ♦ Not for individuals with galactosemia	*Powder:* 2.82-oz packets Dilution: Each 2.82-oz packet when reconstituted with 255 mL water provides 300 mL of formula. 6 packets/carton 10 cartons/case *Flavor:* - unflavored Order by the carton from Ward Road Pharmacy; *not routinely stocked*			14 cartons of 6 (2.82-oz) packets -or- 84 (2.82-oz) packets

Colorado WIC-Approved Infant Formulas and Medical Foods
PRODUCT LIST

VIVONEX PEDIATRIC (Nestlé HealthCare Nutrition) Nutritionally complete, elemental formula for children. ♦ 24 kcal / oz; 0.8 kcal / mL ♦ 200 kcal / 250 mL (1 reconstituted packet) ♦ Pro: - 12% of total kcal - 6 gm / packet (200 kcal) - 100% free Amino Acids - Gluten-free ♦ Fat: - 25% of total kcal - 5.8 gm / packet (200 kcal) - MCT oil (from coconut and/or palm kernel oil), soybean oil ♦ CHO: - 63% of total kcal - 31.5 gm / packet (200 kcal) - Maltodextrin, modified cornstarch - Lactose-free - Low residue ♦ Iron: 2.5 mg / packet (200 kcal) ♦ Osmolality: 360 mOsm/kg water ♦ Meets 100% of the NAS-NRC RDA for 18 key micronutrients for children: - 1-6 years; 1000 mL - 7-10 years; 1170 mL Similar to E028 Splash (Nutricia – North America) and Neocate Jr. (Nutricia – North America).	Nutritionally complete elemental formula for children ages 1-13 years when an easily absorbed form of nutrition is needed for the following conditions: Crohn's disease, intractable diarrhea, impaired digestion and absorption, inflammatory bowel disease, limited gut function, enterocutaneous fistula, partial function or narrowing of the GI tract, short bowel syndrome. Contains CalciLock™ blend of essential nutrients including calcium, phosphorus, magnesium, zinc and vitamins D, C and K to help support healthy bone development. Vivonex Pediatric is lactose-free, gluten-free, low-residue and Kosher. Can be used as a tube feeding or consumed orally. Approved with prescription for children 1-10 years of age. Prescription valid up to 6 months. **CAUTION:** ♦ For use only under medical supervision. ♦ Not for parenteral use. ♦ Not for individuals with galactosemia.	*Powder:* 1.7-oz packets Each 1.7-oz packet when reconstituted with 220 mL water provides 250 mL of formula (250 mL = 8.45 fluid oz) 6 – 1.7 oz packets/carton 6 cartons/case *Flavor:* - unflavored Order by the carton from Ward Road Pharmacy; *not routinely stocked*	0-3:8 pkts 4-5: 9 pkts 6-11: 7 pkts	17 cartons of 6 (1.7-oz) packets -or- 102 1.7-oz packets	

Colorado WIC-Approved Infant Formulas and Medical Foods

PRODUCT LIST

Product / Description	Indication	Packaging	Monthly Maximum Amount:		
			Infant	Child	Women
VIVONEX T.E.N. (Nestlé HealthCare Nutrition) Complete elemental formula for adults ♦ 30 kcal / oz ♦ 300 kcal / 300 mL (1 reconstituted packet) ♦ Pro: - 15% of total kcal - 11.5 gm / packet (300 kcal) - 100% free amino acids - Enriched with glutamine - Gluten-free ♦ Fat: - 3% of total kcal - 0.8 gm / packet (300 kcal) - Safflower oil ♦ CHO: - 82% of total kcal - 61.7 gm / packet (300 kcal) - Maltodextrin, modified cornstarch - Lactose-free - Low residue ♦ Iron: 2.7 mg / packet (300 kcal) ♦ Osmolality: 630mOsm/kg water ♦ Enriched with glutamine to meet the total nutritional needs of patients with gastrointestinal impairment.	A low-fat, elemental tube feeding or beverage for adults that require higher protein. Contains 100% free amino acids and enriched with glutamine to meet the total nutritional needs of patients with gastrointestinal impairment. Indications for use include: bowel resection, irritated bowel, malabsorption syndrome, trauma/surgery, Crohn's disease, GI intestinal failure, pancreatic disorders, and limited gut function. Approved with prescription for adults. Prescription valid up to 6 months. **CAUTION:** ♦ For use only under medical supervision. ♦ Not for parenteral use. ♦ Not for individuals with galactosemia.	*Powder:* 2.84-oz packets Each 2.84 oz dry packet reconstituted with 250 mL water provides 300 mL of formula 10 packets/carton 6 inner cartons 60 cartons/case *Flavor:* - unflavored Order by the carton from Ward Road Pharmacy; *not routinely stocked*			8 cartons of 10 (2.84-oz) packets -or- 80 (2.84-oz) packets

Colorado WIC-Approved Infant Formulas and WIC-Eligible Medical Foods Classified by Type

This reference is provided to WIC professionals for the purpose of categorizing Colorado WIC-approved infant formulas and medical foods by type. For current and detailed information, go to the company's website. Website addresses are listed in the section: ***Contact Information*.**

Infant Formulas

Milk-based:
Enfamil Premium Infant – (*Mead Johnson)*
Enfamil AR – (*Mead Johnson)*

Partially hydrolyzed, reduced-lactose milk-based:
Enfamil Gentlease – (*Mead Johnson)*

Soy-based:
Enfamil ProSobee– (*Mead Johnson)*

Low Mineral:
Similac PM 60/40 – (*Abbott)*

Transitional Preterm:
Enfamil EnfaCare – (*Mead Johnson)*
Gerber Good Start Nourish - (*Nestlé Nutrition)*
Similac Expert Care NeoSure – (*Abbott)*

Hydrolyzed:
Nutramigen – (*Mead Johnson)*
Nutramigen with Enflora LGG – *(Mead Johnson)*
Pregestimil – (*Mead Johnson*)
Similac Expert Care Alimentum – (*Abbott)*

Elemental:
EleCare Infant– (*Abbott)*
Neocate Infant with DHA and ARA – (*Nutricia - North America)*
PurAmino - (*Mead Johnson)*

Children's Formulas & Medical Foods

Milk-based:
Enfamil Premium Infant – (*Mead Johnson)*
Enfamil AR – (*Mead Johnson)*

Partially hydrolyzed, reduced-lactose milk-based:
Enfamil Gentlease – (*Mead Johnson)*

Soy-based:
Enfagrow Toddler Transitions Soy – (*Mead Johnson)*
Enfamil ProSobee– (*Mead Johnson)*

Low Mineral:
Similac PM 60/40 – (*Abbott)*

Transitional Preterm:
Enfamil EnfaCare – (*Mead Johnson)*
Gerber Good Start Nourish - (*Nestlé Nutrition)*
Similac Expert Care NeoSure – (*Abbott)*

Hydrolyzed:
Nutramigen – (*Mead Johnson)*
Nutramigen with Enflora LGG – (*Mead Johnson)*
Pregestimil – (*Mead Johnson)*
Similac Expert Care Alimentum – (*Abbott)*

Milk-based with MCT oil:
Enfaport – (*Mead Johnson)*
Portagen (not a complete formula) – (*Mead Johnson)*

Elemental (may also be used for tube feeding):
E028 Splash – (*Nutricia - North America*)
EleCare Infant– (*Abbott)*
EleCare Junior – *(Abbott)*
Neocate Infant with DHA and ARA – (*Nutricia - North America*)

Children's Formulas & Medical Foods Cont.

Elemental (may also be used for tube feeding) cont:

Neocate Junior /with Prebiotics – (*Nutricia - North America)*
Peptamen Junior / with fiber – (*Nestlé Clinical Nutrition)*
PurAmino - (*Mead Johnson*
Vivonex Pediatric – (*Novartis)*

Nutritionally Complete Supplements (may also be used for tube feeding):

Boost Kids Essentials 1.5 cal / with Fiber – (*Nestlé Clinical Nutrition)*
Nutren Junior / with Fiber – (*Nestlé Clinical Nutrition)*
PediaSure / with Fiber – (*Abbott)*
PediaSure 1.5 cal / with Fiber – (*Abbott)*

Nutritionally Complete Soy Supplements (may also be used for tube feeding):

Bright Beginnings Soy Pediatric Drink *(PBM Products, LLC)*

Tube Feeding:

Compleat Pediatric – (*Nestlé Clinical Nutrition)*
PediaSure Enteral / with Fiber and ScFos – *(Abbott)*

Women's Formulas & Medical Foods

Soy-based:

Enfamil ProSobee – (*Mead Johnson)*

Nutritionally Complete Supplements (may also be used for tube feeding):

Boost High Protein – (*Mead Johnson)*
Ensure – (*Abbott)*
Ensure Plus – (*Abbott)*
Nutren 1.0 / with Fiber – (*Nestlé Clinical Nutrition)*
Nutren 1.5 – (*Nestlé Clinical Nutrition)*
Nutren 2.0 – (*Nestlé Clinical Nutrition*)

Milk-based with MCT oil:

Portagen (not a complete formula) – (*Mead Johnson*)

Nutritionally Complete Hydrolyzed Supplement (may also be used for tube feeding):

Peptamen – (*Nestlé Clinical Nutrition)*

Elemental (may also be used for tube feeding):

Tolerex – *(Novartis)*
Vivonex T.E.N. – (*Novartis)*

Tube Feeding:

Osmolite 1 Cal – (*Abbott)*
Tolerex – (*Novartis*)

Metabolic Formulas

Diet Modules:
- Pro-Phree – (*Abbott*)
- ProViMin – (*Abbott*)
- RCF – (*Abbott*)

Glutaric Acidemia:
- Glutarex-1 – (*Abbott*)
- Glutarex-2 – (*Abbott*)
- XLys, XTrp Analog – (*Nutricia - North America*)
- XLys, XTrp Maxamaid – (*Nutricia - North America*)
- XLys, XTrp Maxamum – (*Nutricia - North America*)

Hypercalcemia:
- Calcilo-XD – *(Abbott)*

Hypermethioninemia & Homocystinuria (Vitamin B6 – Nonresponsive):
- Hominex-1 – (*Abbott*)
- Hominex-2 – (*Abbott)*
- XMet Analog – (*Nutricia - North America*)
- XMet Maxamaid – (*Nutricia - North America*)
- XMet Maxamum – (*Nutricia - North America*)

Isovaleric Acidemia:
- I Valex-1 – (*Abbott*)
- I Valex-2 – (*Abbott*)
- XLeu Analog – (*Nutricia - North America*)
- XLeu Maxamaid – (*Nutricia - North America*)
- XLeu Maxamum – (*Nutricia – North America)*

Maple Syrup Urine Disease (MSUD):
- Ketonex-1 – (*Abbott*)
- Ketonex-2 – (*Abbott*)
- MSUD Analog – (*Nutricia - North America*)
- MSUD Maxamaid – (*Nutricia - North America*)
- MSUD Maxamum – (*Nutricia - North America*)

Phenylketonuria (PKU):
- Periflex Infant – (*Nutricia – North America)*
- Periflex Junior– (*Nutricia - North America*)
- Phenex-1 – (*Abbott*)
- Phenex-2 – (*Abbott*)
- PhenylAde Essential Drink Mix – *(Applied Nutrition Corp)*
- Phenyl-Free 1– *(Mead Johnson)*
- Phenyl-Free 2 – (*Mead Johnson)*
- Phenyl-Free HP – (*Mead Johnson)*
- XPhe Maxamaid – (*Nutricia - North America*)
- XPhe Maxamum – (*Nutricia - North America*)

Propionic Acidemia & Methylmalonic Acidemia (Vitamin B12 – Nonresponsive):
- Propimex-1 – (*Abbott*)
- Propimex-2 – (*Abbott*)
- XMTVI Analog – (*Nutricia - North America*)
- XMTVI Maxamaid – (*Nutricia - North America*)
- XMTVI Maxamum – (*Nutricia - North America*)

Tyrosinemia:
- Tyrex-1 – (*Abbott*)
- Tyrex-2 – (*Abbott*)
- TYROS-1 – *(Mead Johnson)*
- TYROS-2 – *(Mead Johnson)*
- XPhe, XTyr Analog – (*Nutricia - North America*)
- XPhe, XTyr Maxamaid – (*Nutricia - North America*)
- XPTM Analog – (*Nutricia - North America*)

Urea Cycle Disorders:
- Cyclinex-1 – *(Abbott)*
- Cyclinex-2 – *(Abbott)*

Infant Formula Ranges Cheat Sheet

Contract Infant Formulas

Partially Breastfed (In Range)

Formula	*Can Size*	*Yield*	*< 1 mo*	*1 – 3 mo*	*4 – 5 mo*	*6 – 11 mo*
Powder		oz				
Enfamil Premium Infant	12.5 oz	90	*	1 – 4	1 – 5	1 – 4
Enfamil ProSobee	12.9 oz	93	*	1 – 4	1 – 5	1 – 4
Enfamil Gentlease	12.4 oz	90	*	1 – 4	1 – 5	1 – 4
Enfamil AR	12.9 oz	91	*	1 – 4	1 – 5	1 – 4
Concentrate						
Enfamil Premium Infant	13 oz	26	*	1 – 14	1 – 17	1 – 12
Enfamil ProSobee	13 oz	26	*	1 – 14	1 – 17	1 – 12
Ready-to-Feed						
Enfamil Premium Infant	32 oz	32	*	1 – 12	1 – 14	1 – 10
Enfamil ProSobee	32 oz	32	*	1 – 12	1 – 14	1 – 10
Enfamil Gentlease	32 oz	32	*	1 – 12	1 – 14	1 – 10
Enfamil AR	32 oz	32	*	1 – 12	1 – 14	1 – 10

**There is no In Range amount of formula available during the first month of life.*

Novel Breastfed (Not in Range)

Formula	*Can Size*	*Yield*	*< 1 mo*	*1 – 3 mo*	*4 – 5 mo*	*6 – 11 mo*
Powder		oz				
Enfamil Premium Infant	12.5 oz	90	1 – 9	5 – 9	6 – 10	5 – 7
Enfamil ProSobee	12.9 oz	93	1 – 9	5 – 9	6 – 10	5 – 7
Enfamil Gentlease	12.4 oz	90	1 – 9	5 – 9	6 – 10	5 – 7
Enfamil AR	12.9 oz	91	1 – 9	5 – 9	6 – 10	5 – 7
Concentrate						
Enfamil Premium Infant	13 oz	26	1 – 31	15 – 31	18 – 34	13 – 24
Enfamil ProSobee	13 oz	26	1 – 31	15 – 31	18 – 34	13 – 24
Ready-to-Feed						
Enfamil Premium Infant	32 oz	32	1 – 26	13 – 26	15 – 28	11 – 20
Enfamil ProSobee	32 oz	32	1 – 26	13 – 26	15 – 28	11 – 20
Enfamil Gentlease	32 oz	32	1 – 26	13 – 26	15 – 28	11 – 20
Enfamil AR	32 oz	32	1 – 26	13 – 26	15 – 28	11 – 20

Fully Formula-Fed

Formula	*Can Size*	*Yield*	*< 1 mo*	*1 – 3 mo*	*4 – 5 mo*	*6 – 11 mo*
Powder		oz				
Enfamil Premium Infant	12.5 oz	90	9	9	10	7
Enfamil ProSobee	12.9 oz	93	9	9	10	7
Enfamil Gentlease	12.4 oz	90	9	9	10	7
Enfamil AR	12.9 oz	91	9	9	10	7
Concentrate						
Enfamil Premium Infant	13 oz	26	31	31	34	24
Enfamil ProSobee	13 oz	26	31	31	34	24
Ready-to-Feed						
Enfamil Premium Infant	32 oz	32	26	26	28	20
Enfamil ProSobee	32 oz	32	26	26	28	20
Enfamil Gentlease	32 oz	32	26	26	28	20
Enfamil AR	32 oz	32	26	26	28	20

Exempt Infant Formulas

Partially Breastfed (In Range)

Formula	*Can Size*	*Yield*	*< 1 mo*	*1 – 3 mo*	*4 – 5 mo*	*6 – 11 mo*
Powder	oz	oz				
Elecare Infant	14.1	95	*	1 – 4	1 – 5	1 – 4
Enfamil EnfaCare	12.8	82	*	1 – 5	1 – 6	1 – 4
Gerber Good Start Nourish	12.6	83	*	1 – 5	1 – 6	1 – 4
Neocate Infant	14.1	97	*	1 – 4	1 – 5	1 – 3
Nutramigen with Enflora LGG	12.6	87	*	1 – 5	1 – 6	1 – 4
Pregestimil	16.0	112	*	1 – 3	1 – 4	1 – 3
PurAmino	14.1	98	*	1 – 4	1 – 5	1 – 3
Similac Expert Care Alimentum	16.0	115	*	1 – 3	1 – 4	1 – 3
Similac Expert Care NeoSure	13.1	87	*	1 – 5	1 – 6	1 – 4
Similac PM 60/40	14.1	102	*	1 – 4	1 – 5	1 – 3
Concentrate						
Nutramigen	13 oz	26	*	1 – 14	1 – 17	1 – 12
Ready-to-Feed						
Enfamil EnfaCare	32	32	*	1 – 12	1 – 14	1 – 10
Enfaport	32	32	*	1 – 12	1 – 14	1 – 10
Nutramigen	32	32	*	1 – 12	1 – 14	1 – 10
Similac Expert Care Alimentum	32	32	*	1 – 12	1 – 14	1 – 10
Similac Expert Care NeoSure	32	32	*	1 – 12	1 – 14	1 – 10

**There is no In Range amount of formula available during the first month of life.*

Novel Breastfed (Not in Range)

Formula	*Can Size*	*Yield*	*< 1 mo*	*1 – 3 mo*	*4 – 5 mo*	*6 – 11 mo*
Powder	oz	oz				
Elecare Infant	14.1	95	1 – 9	5 – 9	6 – 10	5 – 7
Enfamil EnfaCare	12.8	82	1 – 10	6 – 10	7 – 11	5 – 8
Gerber Good Start Nourish	12.6	83	1 – 10	6 – 10	7 – 11	5 – 8
Neocate Infant	14.1	97	1 – 8	5 – 8	6 – 9	4 – 7
Nutramigen with Enflora LGG	12.6	87	1 – 10	6 – 10	7 – 11	5 – 8
Pregestimil	16.0	112	1 – 7	4 – 7	5 – 8	4 – 6
PurAmino	14.1	98	1 – 8	5 – 8	6 – 9	4 – 7
Similac Expert Care Alimentum	16.0	115	1 – 7	4 – 7	5 – 8	4 – 6
Similac Expert Care Neosure	13.1	87	1 – 10	6 – 10	7 – 11	5 – 8
Similac PM 60/40	14.1	102	1 – 8	5 – 8	6 – 9	4 – 6
Concentrate						
Nutramigen	13	26	1 – 31	15 – 31	18 – 34	13 – 24
Ready-to-Feed						
Enfamil EnfaCare	32	32	1 – 26	13 – 26	15 – 28	11 – 20
Enfaport	32	32	1 – 26	13 – 26	15 – 28	11 – 20
Nutramigen	32	32	1 – 26	13 – 26	15 – 28	11 – 20
Similac Expert Care Alimentum	32	32	1 – 26	13 – 26	15 – 28	11 – 20
Similac Expert Care NeoSure	32	32	1 – 26	13 – 26	15 – 28	11 – 20

Fully Formula-Fed

Formula	*Can Size*	*Yield*	*< 1 mo*	*1 – 3 mo*	*4 – 5 mo*	*6 – 11 mo*
Powder	oz	oz				
Elecare Infant	14.1	95	9	9	10	7
Enfamil EnfaCare	12.8	82	10	10	11	8
Gerber Good Start Nourish	12.6	83	10	10	11	8
Neocate Infant	14.1	97	8	8	9	7
Nutramigen with Enflora LGG	12.6	87	10	10	11	8
Pregestimil	16.0	112	7	7	8	6
PurAmino	14.1	98	8	8	9	7
Similac Expert Care Alimentum	16.0	115	7	7	8	6
Similac Expert Care Neosure	13.1	87	10	10	11	8
Similac PM 60/40	14.1	102	8	8	9	6
Concentrate						
Nutramigen	13	26	31	31	34	24
Ready-to-Feed						
Enfamil EnfaCare	32	32	26	26	28	20
Enfaport	32	32	26	26	28	20
Nutramigen	32	32	26	26	28	20
Similac Expert Care Alimentum	32	32	26	26	28	20
Similac Expert Care NeoSure	32	32	26	26	28	20
Similac PM 60/40	32	32	26	26	28	20

Metabolic Formula Dilution Chart

Formula Dilution–20 kcal/ounce

Product	Category	Kcal/ 100gm	Can size grams	Kcal/can	Ounces/ can
Calcio - XD	I	513	375	1924	96
Cyclinex 1	I, C	510	400	2040	102
Cyclinex 2	C, W	440	400	1760	88
Glutarex 1	I,C	480	400	1920	96
Glutarex 2	C, W	410	400	1640	82
Hominex 1	I, C	480	400	1920	96
Hominex 2	C, W	410	400	1640	82
I Valex 1	I, C	480	400	1920	96
I Valex 2	C, W	410	400	1640	82
Ketonex 1	I, C	480	400	1920	96
Ketonex 2	C, W	410	400	1640	82
Periflex Infant	I	421	400	1684	84
Periflex Junior – unflavored	C	394	454	1789	89
Periflex Junior – flavored	C	374	454	1698	85
Phenex 1	I, C	480	400	1920	96
Phenex 2	C, W	410	400	1640	82
Phenyl Free 1	I, C	500	454	2270	114
Phenyl Free 2	C, W	410	454	1861	93
Phenyl Free 2 HP	C, W	390	454	1771	89
Phenylade Essential Drink Mix	C, W	400	454	1816	91
Pro-Phree	I, C, W	510	400	2040	102
ProViMin	I, C, W	313	150	470	166
Propimex-1	I, C	480	400	1920	96
Propimex- 2	C, W	410	400	1640	82
RCF	I, C, W	81/100 ml	13 oz 384 ml	311	26
Tyrex 1	I, C	480	400	1920	96
Tyrex 2	C, W	410	400	1640	82
TYROS 1	I, C	500	454	2270	114
TYROS 2	C, W	410	454	1861	93

Formula Dilution – 21 kcal/ounce – Nutricia Analog Products

Product	Category	Kcal/ 100gm	Can size grams	Kcal/can	Ounces/ can
MSUD Analog	I	475	400	1900	90
XLeu Analog	I	475	400	1900	90
XLys XTrp Analog	I	475	400	1900	90
XMet Analog	I	475	400	1900	90
XMTVI Analog	I	475	400	1900	90
XPhe XTyr Analog	I	475	400	1900	90
XPTM Analog	I	475	400	1900	90

Formula Dilution – about 20 kcal/ounce – Nutricia Maxamaid Products

MSUD Maxamaid	C	324	454	1471	74
XLeu Maxamaid	C	324	454	1471	74
XLys XTrp Maxamaid	C	324	454	1471	74
XMet Maxamaid	C	324	454	1471	74
XMTVI Maxamaid	C	324	454	1471	74
XPhe Maxamaid	C	324	454	1471	74
XPhe XTyr Maxamaid	C	324	454	1471	74

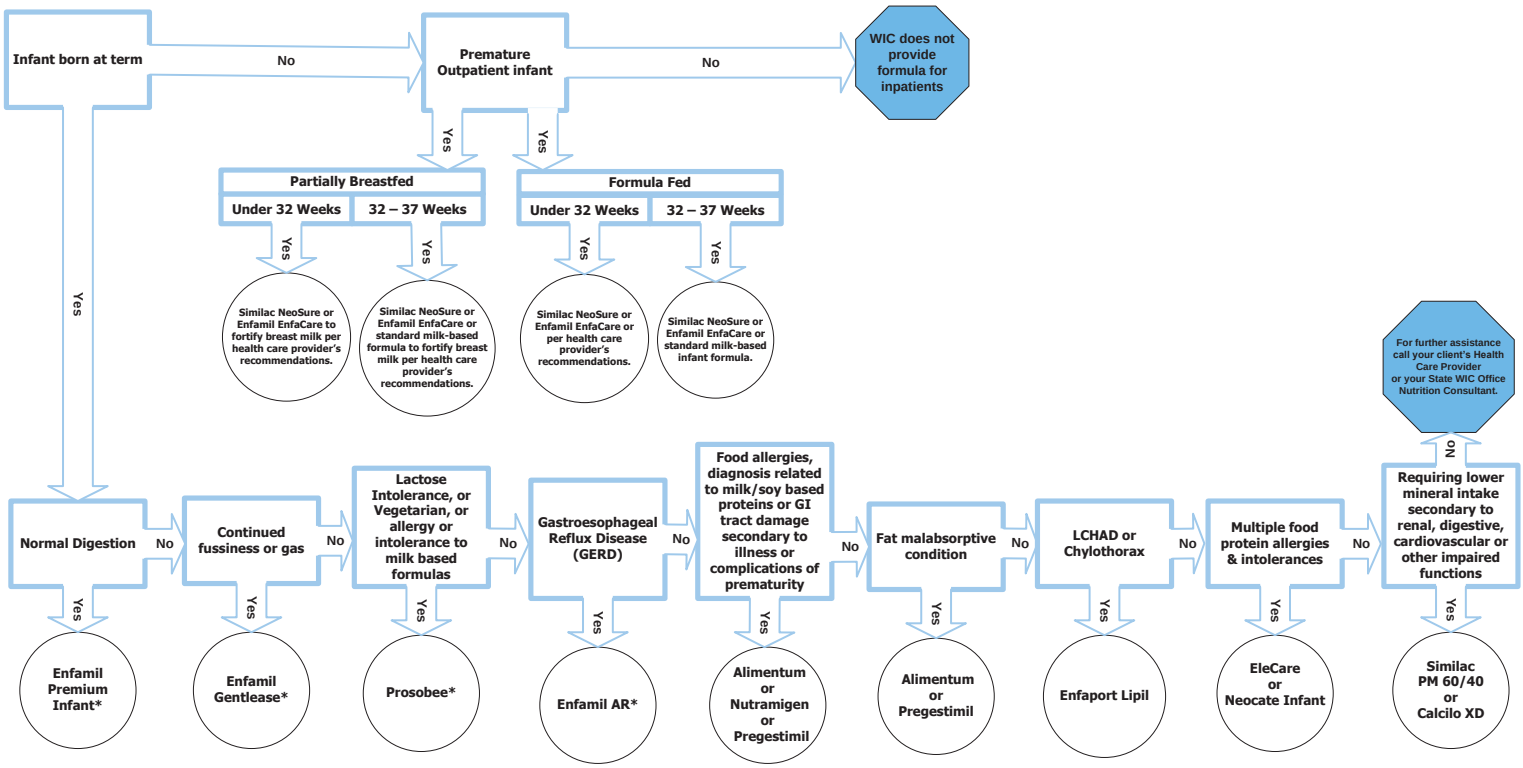
Formula Dilution – 30 kcal/ounce – Nutricia Maxamum Products

MSUD Maxamum	W	305	454	1385	46
XLeu Maxamum	W	305	454	1385	46
XLys XTrp Maxamum	W	305	454	1385	46
XMet Maxamum	W	305	454	1385	46
XMTVI Maxamum	W	305	454	1385	46
XPhe Maxamum	W	305	454	1385	46

I – Infant
C – Child
W - Women

Infant Formula Decision Tree

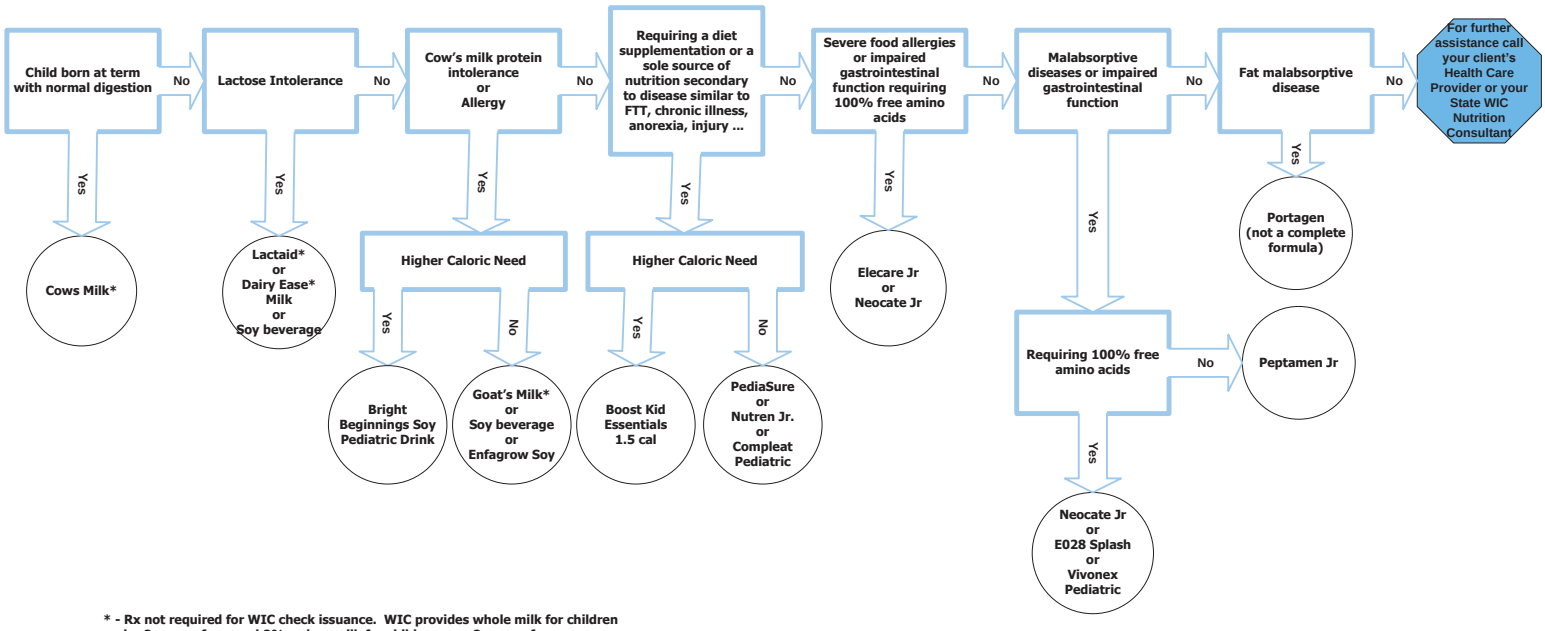
Breastfeeding is encouraged for all infants on the WIC Program. Formula is provided as the next alternative for women who choose not to or who are unable to breastfeed exclusively.



*** Rx not required for WIC check issuance**

04/2011

Pediatric Formula Decision Tree



*** - Rx not required for WIC check issuance. WIC provides whole milk for children under 2 years of age and 2% or less milk for children over 2 years of age.**

06/2011

CHANGING TO A NEW FORMULA

Changing the formula for a fragile infant or child may require a slower transition. This guide may be helpful when transitioning the fragile infant who could potentially experience a harmful reaction.

If the infant tried the new formula and appeared to dislike it, try again. Babies are sometimes untrusting of the unfamiliar.

POWDERED FORMULA (to make one 8-ounce bottle)

1.	FIRST FEW DAYS	Mix:	3 scoops old brand of formula 1 scoop new brand of formula 8 ounces water
2.	THEN TRY (next few days)	Mix:	2 scoops old brand of formula 2 scoops new brand of formula 8 ounces water
3.	FINALLY (by end of 7 days)	Mix:	1 scoop old brand of formula 3 scoops new brand of formula 8 ounces water
4.	ALL NEW FORMULA		

You will need about 2 cans of the new formula to follow these steps.

CONCENTRATE FORMULA (to make one 8-ounce bottle)

Mix one can concentrate of new formula and one can water in a pitcher or container.
Mix one can concentrate of old formula and one can water in a pitcher or container.

1.	FIRST FEW DAYS	Mix:	6 ounces old formula 2 ounces new formula
2.	THEN TRY (next few days)	Mix:	4 ounces old formula 4 ounces new formula
3.	FINALLY (by end of 7 days)	Mix:	2 ounces old formula 6 ounces new formula
4.	ALL NEW FORMULA		

You will need about 6-8 cans of the new formula to follow these steps.

CHANGING TO ANOTHER FORMULA . . .

Most infants will do well switching from one formula that they have been on to another formula. But each formula tastes a little different. If a baby notices this flavor difference, it may help to change formulas slowly. Use the following schedule when making a formula change. Let the WIC clinic know if there are any problems changing formulas.

To make a 4-ounce bottle of formula:

Pour 4 ounces of warm water into bottle. Add powdered formula as follows:

DAY 1

Mix _____scoops of _____

Plus_____ scoops of _____

DAY 2

Mix _____scoops of _____

Plus_____ scoops of _____

DAY 3

Mix _____scoops of _____

Plus_____ scoops of _____

DAY 4

Mix _____scoops of _____

Determining the Nutritional Needs of Children

This set of guidelines is intended to assist the WIC professional when developing nutritional recommendations for infants/children with insufficient growth or Failure to Thrive. The following dietary recommendations and formulas are tools routinely used by physicians and other health care professionals as they assess dietary intake and develop counseling recommendations.

I. The Reference Values: RDA and DRI

RDA: In the past, the Recommended Dietary Allowances (RDAs) published by the Food and Nutrition Board of the National Academy of Sciences, have served as the benchmark of nutritional adequacy in the United States. The following definition for the RDAs was adopted more than 20 years ago:

> *Recommended Dietary Allowances (RDA)* – the levels of intake of essential nutrients that, on the basis of scientific knowledge, are judged by the Food and Nutrition Board to be adequate to meet the known nutrient needs of practically all healthy persons.[1]

Scientific knowledge regarding the roles nutrients play has since expanded, from learning how to prevent classical nutritional deficiency diseases, to reducing the risk of chronic diseases, such as osteoporosis, cancer, and cardiovascular disease. From this grand expansion of nutritional knowledge arose the need to create the Dietary Reference Intakes (DRI).

DRI: is a generic term used to refer to multiple sets of reference values for designated age groups, physiologic states, and sexes: [2]

Estimated Average Requirement (EAR) – the average daily nutrient intake level estimated to meet the requirement of half the healthy individuals in a particular life stage and gender group.

Recommended Dietary Allowance (RDA) – the average daily nutrient intake level sufficient to meet the nutrient requirement of nearly all (97 to 98 percent) healthy individuals in a particular life stage and gender group.

Tolerable Upper Intake Level (UL) – the highest level of daily nutrient intake that is likely to pose no risk of adverse health effects for almost all individuals in the general population. As intake increases above the UL, the potential risk of adverse affects increases.

Adequate Intake (AI) – A recommended average daily nutrient intake level based on observed or experimentally determined approximations or estimates of nutrient intake by a group (or groups) of apparently healthy people that are assumed to be adequate – used when an RDA cannot be determined. AIs are used most commonly in calculating the nutritional requirements of infants. Human milk composition and average intakes of exclusively breastfed infants have been used to estimate AIs for infants 0 to 6 months of age.[3]

Table 1 represents Recommended Dietary Allowances (RDAs) in **bold type** and Adequate Intakes (AIs) in ordinary type followed by an asterisk (*). RDAs and AIs may both be used as goals for individual intake.

Table 1: DRI Values of Commonly Referenced Macronutrients and Minerals[3]

Life Stage Group	Protein and Amino Acids gm/day	Total Fat gm/day	CHO gm/day	Calcium mg/day	
	RDA / AI*	**RDA** / AI*	**RDA** / AI*	**RDA** / AI*	UL
Infants:					
0 – 6 mo	9.1*	31*	60*	210*	ND
7 – 12 mo	**13.5**	30*	95*	270*	ND
Children:					
1 – 3 y	**13**		**130**	500*	2,500
4 – 8 y	**19**		**130**	800*	2,500

ND (Not Determinable) - due to lack of data of adverse effects in this age group and concern with regard to lack of ability to handle excess amounts. Source of intake should be from food (or infant formula) only to prevent high levels of intake.

II. Assessing Nutritional Intake and Catch-up Needs of Children up to age 5 years

A. Estimating Fluid Requirements [4]

1. *Professionals often use standard guidelines as a starting point when determining how much fluid an infant or child needs. These are recommended guidelines. There is not an absolute minimum. Some infants may need more, some less, depending on their clinical situation.*

Table 2: Daily Fluid Requirements, by child's weight

Weight of child (kg)	Fluid requirement (ml)
1 – 10	100 ml / kg
11 – 20	1000ml + (50ml/kg for each kg > 10 kg)
> 20	1500ml + (20ml/kg for each kg > 20 kg)

Example:
How much fluid is required per day for a 3 year old who weighs 15 kg?
1000 ml + (50ml x 5) = 1250 ml fluid

2. Other health conditions need to be taken into consideration.

- Extra fluids are needed with:
- Fever
- Hot weather
- Sweating
- Diarrhea
- Vomiting

- Fluid restriction may be needed for VLBW infants with:
- Chronic lung disease
- Cardiac complications requiring diuretics
- Renal disease

3. **Free Water –** is the fluid from the product available for hydration but not used for metabolic processes.

Table 3: Guidelines to Evaluate the Amount of Free Water

Type of formula	Kcal / cc	Free fluid (%)
Infant	.66 (standard mix of 20 Kcal / fl oz)	100
Pediatric	1.0	85
	1.5	77
	2.0	58

Example:
How much free fluid is in:
20 oz Enfamil Premium Infant **(standard dilution infant formula) x 30 cc/oz = 600 cc of free fluid**
(Enfamil Premium Infant is so dilute that 100% is free fluid. This means that healthy infants under 6 months of age do not require additional water over that provided as part of the infant formula.)
20 oz PediaSure **(standard dilution pediatric formula) x 30 cc/oz = 600 cc x .85 = 510 cc of free fluid**

B. Estimating Energy and Protein needs: [5]

Table 4: Energy and Protein Requirements

Category:	Age:	Total energy needs (Kcal/kg/day)	Total Protein needs (g/kg/day)
Infant	1 – 6 months	108 Kcal	2.2
	6 – 12 months	98 Kcal	1.6
Child	1 – 3 years	102 Kcal	1.2
	4 – 6 years	90 Kcal	1.2

Energy needs vary greatly depending on activity levels, stage of growth phase, and with individual constitution. Calculations often include ideal body weight for length or height in kilograms, rather than actual weight if infant or child is markedly under or over weight for length or height.

Example:
What are the daily energy and protein needs of a 6 month 2 week old infant who weighs 16 pounds (7.2 kg)?
Estimated protein needs are: 7.2 kg x 1.6 g/kg/day = 12 gm pro / day
Estimated energy needs are: 7.2 kg x 98 kcal/kg/day = 706 kcal / day

C. Estimating Catch-up Growth [6]

With prematurity or children with special needs, the term "catch-up growth" refers to the increase in growth velocity following a period of impaired growth. Catch-up growth may also occur after a period of growth lag due to inadequate nutrition associated with illness or adverse environment, including Failure To Thrive.

Catch-up growth is calculated as:

Ideal Body Weight (length or height carried to the 50th percentile) and then follow that down to the 50th percentile in wt/age times (X) theoretical calorie needs/adjusted age.

Example: A 4 ½ year-old boy weighs 25 pounds, or 11.4 kg. He is 39 inches tall. What is his catch-up growth theoretical caloric need?

Step 1: Plot his current ht and carry it over to the 50th percentile in the ht/age. This is his adjusted height-age.

Step 2: Follow the adjusted height-age straight down to the 50th percentile wt/age.

39" = adjust ht-age of 3.5 years. At 3.5 years of age, the 50th percentile in wt/age is 34# or 15 kg.

To calculate his theoretical catch-up caloric needs:
Step 3: Use energy requirements for adjusted age from Table 4 (102 kcal) x IBW (15 kb)
102 kcal/kg/day X 15 kb = 1530 total kcal/day

Step 4: If intake was estimated at 1000 kcal/day then counsel on adding 530 kcal/day.

D. Additional thoughts:

- Calculating catch-up calories and protein is based on ideal weight as calculated above.
- Calculating catch-up fluids is based on actual weight

REFERENCES

1. NRC (National Research Council). 1989. Recommended Dietary Allowances. 10th Edition. National Academy Press. Washington, D.C.
2. IOM (Institute of Medicine). 2000. Dietary Reference Intakes. Applications in Dietary Assessment. A Report of the Subcommittee on Interpretation and Uses of Dietary Reference Intakes and the Standing Committee on the Scientific Evaluation of Dietary Reference Intakes. Food and Nutrition Board. National Academy Press. Washington, D.C.
3. This table was adapted from the DRI reports (see www.nap.edu/books/0309085373/html).
4. Adapted from Harriet Lane Handbook; Manual of Pediatric Parenteral Nutrition; Nelson's Textbook of Pediatrics.
5. Adapted from the World Health Organization. Energy and protein requirements, report of a joint FAO/WHO/UNU Expert Consultation.
6. Nutrition Practice Care Guidelines for Preterm Infants in the Community. Child Development and Rehabilitation Center, Department of Human Services – WIC Program and Oregon Pediatric Nutrition Practice Group.

Approximate Metric Conversions:

When you know	Multiply by	To find
Weight:		
Ounces	28	Grams (g or gm)
Pounds	0.45	Kilograms (kg)
Length:		
Inches	2.5	Centimeters (cm)
Feet	30	Centimeters (cm)
Yards	0.9	Meters (m)
Miles	1.6	Kilometers (km)
Volume:		
Teaspoons	5	Milliliters (ml) or Cubic Centimeters (cc)
Tablespoons	15	Milliliters (ml) or Cubic Centimeters (cc)
Fluid Ounces	30	Milliliters (ml) or Cubic Centimeters (cc)
Cups	0.24	Liters (L)
Pints	0.47	Liters (L)
Quarts	0.95	Liters (L)

Special thanks to Judy Fowler, CNSD, RD of the Jefferson County WIC Program for her guidance with this information.

COLORADO
Department of Public Health & Environment

Colorado WIC Program

Physician Authorization Form

For Specialty Formulas and WIC Supplemental Foods

Medical documentation is federally required to ensure that the patient under your care has a medical condition that requires the use of specialty formula and that conventional foods are precluded, restricted, or inadequate to meet their special nutritional needs.

Instructions: Complete sections A and D for <u>all patients.</u>
- **Complete Section B to approve specialty formula.**
- **Complete Section C to approve supplemental foods -or- leave blank to allow WIC RD/RN to determine appropriate supplemental foods.**

Fax form to WIC clinic or have WIC participant return form to clinic.

WIC clinic:
WIC fax #:
Attention:

A. Patient information

Patient's Name: (Last, First, MI):	**DOB:**
Parent/Caregiver's Name:	
Medical Reason/Diagnosis:	
Time needed: ❑ 1 month ❑ 2 months ❑ 3 months ❑ 4 months ❑ 5 months ❑ 6 months	

B. Specialty formula

Formula requested (see approved list on back):

Prescribed amount: ❑ maximum allowable **-OR-** ❑ _____ oz/day

Special instructions/comments:

❑ Issue additional formula for 6-11 month infant not developmentally ready for solid foods.

❑ Issue infant food fruits and vegetables for 1-4 year old child (only authorized if child is also receiving specialty formula).

C. WIC Supplemental Foods

WIC RD/RN will determine appropriate supplemental foods unless health care provider indicates otherwise.

❑ Issue full provision of age-appropriate supplemental foods.
❑ No WIC supplemental foods; provide formula only.
❑ Issue a modified food package omitting the supplemental foods checked below:

WIC Participant Category	WIC Supplemental Foods (check contraindicated foods)	Special Instructions
Infant 6- 11 months	❑ Infant cereal ❑ Infant fruits/vegetables ❑ Fresh bananas	
Child 1 - 4 years -and- **Woman**	❑ Milk ❑ Cheese ❑ Eggs ❑ Juice ❑ Breakfast cereals ❑ Legumes ❑ Peanut butter ❑ Fruits and vegetables ❑ Whole grains ❑ Fish (exclusively breastfeeding women only)	

D. Health care provider information

Signature of health care provider:		
Provider's name: (please print)		❑ **MD** ❑ **PA** ❑ **DO** ❑ **NP**
Medical office/clinic:		
Phone #:	**Fax#:**	**Date:**

WIC USE ONLY	**Approved by:**	**Date:** **Rx exp. date:**

COLORADO WIC PROGRAM
APPROVED FORMULAS

Standard Contract Infant Formulas

These formulas will be given unless a physician diagnoses a medical condition that warrants a specialty formula.

- No prescription is needed for infants.*
- A prescription is needed for adults and children over one-year of age and is valid for up to six (6) months.

Enfamil Infant
Enfamil ProSobee
Enfamil Gentlease
Enfamil AR

*A prescription is required to issue additional formula to 6-11 month old infants who are not developmentally ready for solid foods.

Specialty Formulas

Medical documentation is required for issuance of these formulas. Reasons such as "colic," "spitting up," or "constipation" will NOT be accepted as a substitute for a medical diagnosis.

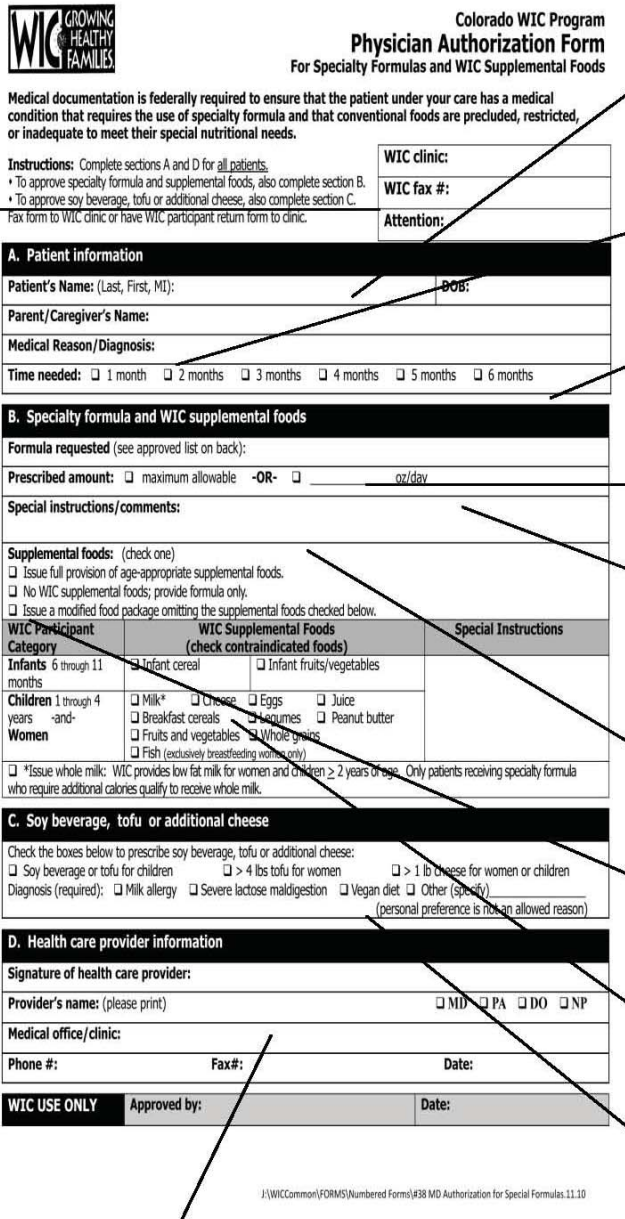
Boost High Protein
Boost Kid Essentials 1.5 cal
Boost Kid Essentials 1.5 cal with fiber
Bright Beginnings Soy Pediatric Drink
Compleat Pediatric
EleCare Infant
EleCare Junior
(only for children over 1 year)
Enfagrow Toddler Transitions Soy
(only for children over 1 year)
Enfamil EnfaCare
Enfaport
Ensure
Ensure Plus
Neocate Infant with DHA & ARA
Neocate Junior
Neocate Junior with Prebiotics
Neocate Splash
Nutramigen
Nutramigen with Enflora LGG
Nutren Junior
Nutren Junior with Prebio Fiber
Nutren 1.0
Nutren 1.0 with Fiber
Nutren 1.5
Nutren 2.0
Osmolite 1 Cal
PediaSure (any flavor)
PediaSure with Fiber (any flavor)
PediaSure Enteral
PediaSure Enteral with Fiber and scFOS
PediaSure 1.5 cal
PediaSure 1.5 cal with Fiber
Peptamen
Peptamen Junior
Peptamen Junior with Fiber
Portagen
Pregestimil
PurAmino
Similac Expert Care Alimentum
Similac Expert Care NeoSure
Similac PM 60/40
Tolerex
Vivonex Pediatric
Vivonex T.E.N.

Formulas for Inherited Metabolic Diseases

Calcilo-XD
Cyclinex-1 & 2
Glutarex-1 & 2
Hominex-1 & 2
I Valex-1 & 2
Ketonex-1 & 2
MSUD Analog, Maximaid & Maximum
Periflex Infant
Periflex Junior
Phenex-1 & 2
PhenylAde Essential Drink Mix
Phenyl-Free 1 & 2
Phenyl-Free HP
Pro-Phree
ProViMin
Propimex-1 & 2
RCF
Tyrex-1 & 2
TYROS-1 & 2
XLeu Analog, Maxamaid & Maxamum
XLys, XTrp Analog, Maxamaid & Maxamum
XMet Analog, Maxamaid & Maxamum
XMTVI Analog, Maxamaid & Maxamum
XPhe Maxamaid & Maximum
XPhe, XTyr Analog & Maxamaid
XPTM Analog

For questions about Colorado WIC approved formulas contact the State WIC Office at (303) 692-2400.
Electronic copy of this form available at: http://www.coloradowic.com

Instructions for completing Rx for Colorado WIC formula



Colorado WIC Program

Physician Authorization Form

For Specialty Formulas and WIC Supplemental Foods

Medical documentation is federally required to ensure that the patient under your care has a medical condition that requires the use of specialty formula and that conventional foods are precluded, restricted, or inadequate to meet their special nutritional needs.

Instructions: Complete sections A and D for all patients.
- To approve specialty formula and supplemental foods, also complete section B.
- To approve soy beverage, tofu or additional cheese, also complete section C.

Fax form to WIC clinic or have WIC participant return form to clinic.

WIC clinic:	
WIC fax #:	
Attention:	

A. Patient information

Patient's Name: (Last, First, MI):	**DOB:**
Parent/Caregiver's Name:	
Medical Reason/Diagnosis:	
Time needed: ❑ 1 month ❑ 2 months ❑ 3 months ❑ 4 months ❑ 5 months ❑ 6 months	

B. Specialty formula and WIC supplemental foods

Formula requested (see approved list on back):

Prescribed amount: ❑ maximum allowable **-OR-** ❑ _____ oz/day

Special instructions/comments:

Supplemental foods: (check one)
❑ Issue full provision of age-appropriate supplemental foods.
❑ No WIC supplemental foods; provide formula only.
❑ Issue a modified food package omitting the supplemental foods checked below.

WIC Participant Category	WIC Supplemental Foods (check contraindicated foods)		Special Instructions
Infants 6 through 11 months	❑ Infant cereal	❑ Infant fruits/vegetables	
Children 1 through 4 years -and- **Women**	❑ Milk* ❑ Cheese ❑ Eggs ❑ Juice ❑ Breakfast cereals ❑ Legumes ❑ Peanut butter ❑ Fruits and vegetables ❑ Whole grains ❑ Fish (exclusively breastfeeding women only)		

❑ *Issue whole milk: WIC provides low fat milk for women and children > 2 years of age. Only patients receiving specialty formula who require additional calories qualify to receive whole milk.

C. Soy beverage, tofu or additional cheese

Check the boxes below to prescribe soy beverage, tofu or additional cheese:
❑ Soy beverage or tofu for children ❑ > 4 lbs tofu for women ❑ > 1 lb cheese for women or children
Diagnosis (required): ❑ Milk allergy ❑ Severe lactose maldigestion ❑ Vegan diet ❑ Other (specify) _____
(personal preference is not an allowed reason)

D. Health care provider information

Signature of health care provider:	
Provider's name: (please print)	❑ MD ❑ PA ❑ DO ❑ NP
Medical office/clinic:	
Phone #: **Fax#:**	**Date:**

WIC USE ONLY	**Approved by:**	**Date:**

J:\WICCommon\FORMS\Numbered Forms\#38 MD Authorization for Special Formulas.11.10

1. **Record patient's name, date of birth and parent's name**
2. **Record medical diagnosis**
3. **Indicate amount of time the product is needed**
4. **Record name of formula (from list on back of page)**
5. **Indicate amount needed per day (i.e., 1 can/day). See attached list for maximum amounts that can be provided.**
6. **Note any special mixing instructions or comments.**
7. **Check the box to indicate if patient can eat all, none, or some supplemental foods**
8. **Indicate which foods are CONTRAINDICATED**
9. **Check the box to prescribe soy beverage, tofu or additional cheese and note diagnosis**
10. **Sign, date, and include your credentials and contact information**

Ordering Instructions for Products Not on Retail Shelves

(March 2013 revision)

POLICY:

Local Agency WIC staff may special order exempt infant formulas and WIC-eligible medical foods when a special formula is not locally available within the required time or in the quantities needed, or is excessively priced. No more than one month's issuance of special formula may be ordered at a time. Ward Road Pharmacy is the Colorado WIC Program's retail source for special formulas not available locally.

Procedures to issue Food Instruments (FIs) and order/receive special formulas for participants with special nutritional needs require modification from those established for routine food benefit issuance.

One necessary modification is that WIC FIs for special formulas may be printed immediately prior to creating and emailing the special formula order to State Office. Once printed, these FIs must be maintained in a secure place accessible only to WIC staff until the participant/endorser/proxy picks up the formula at the WIC clinic and the FIs are forwarded to Ward Road Pharmacy as payment.

A second necessary modification is that, in those instances when the special formula is not picked up at the WIC clinic by the endorser/participant/proxy, WIC staff signs their own name to the FIs and mails them to Ward Road Pharmacy.

PROCEDURE:

Perform the following steps when a prescription is approved for a new participant or for a reoccurring order:

1. **Prior to placing the special formula order, local agency WIC staff is responsible to ensure (within reason) that the formula is the correct issuance for that month and will be picked up by the endorser/participant.**

2. **Print the food instruments (FIs)** at the proper time so that the FIs specify the correct amount of formula.
    a. In order to print a full month's issuance in Compass, printing must occur between the last few days of the previous month and before the 10th day of the issuance month. Proration occurs when FIs are printed after the 10th day of the issuance month. In Compass, it is not necessary to bring the participants/endorser in during the first 10 days of the month. Their appointment schedule need not be disrupted as long as FIs are printed within the time frame specified above. When feasible, print the next month's FIs at the same time the endorser is picking up the current month's formula.

    b. When the endorser/participant is present during the check printing, capture her signature on the signature pad to acknowledge issuance of the FIs. When the endorser/participant is not present, WIC staff clicks the "No signature available" checkbox.

    c. Maintain the next month's FIs in a secure place accessible only to WIC staff.

3. **Create one email order per participant.**

   a. Email contents:

      From: person sending the email order
      To: CDPHE.WICFormula@state.co.us
      Subject: participant's first name.clinic name.email date
      (example: Joe.Englewood.06.24.12)
      NOTE: For agencies that prohibit emailing of participant first name, the subject line can list "WIC order" followed by the clinic name and email date.

      Provide all the information in the order as listed below:

      - Participant first name:
      - Family WIC ID number:
      - Date of birth:
      - Formula:
      - Order amount:
      - Amount in clinic:
      - Valid check date:
      - Appointment date:
      - WIC Clinic name:
      - Attention:
      - Email address of person placing the order:

   b. Additional clarifications:

      - "Name"- the participant's first name only. Those local agencies that prohibit the emailing of participant first name can leave this field blank.
      - "Family WIC ID Number" as printed on the FI.
      - "Formula" - the complete formula name. Specify added ingredients, fiber or flavors, such as "Neocate Jr. – tropical fruit" or "Peptamen Jr. with fiber." The *Ward Road Pharmacy Ordering Guide* posted on the CO WIC web page indicates the available options and whether the formula is available by the can or by the case.
      - "Order amount" refers to the amount of formula requested from Ward Road Pharmacy.
      - "Amount in clinic" refers to the amount of formula (number of cans or cases) already in the clinic. Often this is WIC-purchased formula that was not picked up by the endorser/participant or was "leftover" when Ward Road Pharmacy would not break cases.
      - "Appointment Date" must fall within the FI's valid date range.
      - "Attention"- name of clinic person to receive the formula shipment.

4. **Email the special formula order** to State Office's central mailbox: CDPHE.WICFormula@state.co.us.

5. **Staff ordering the formula will receive two emails:** 1) Copied on the order State Office places to Ward Road Pharmacy; 2) email from Ward Road Pharmacy with the date the formula should arrive at the clinic.

6. **Formula pick-up: Endorser picks up the formula on a day within the FI's valid date range.**

    a) **WIC staff writes in the total invoice amount** (sum of the formula cost and shipping fees) into the *Actual Amount of Sale* box on the WIC FI. Divide the shipping costs between the FIs. On the back of the FIs, WIC staff writes the **date the formula is picked up** in the space above "For Deposit Only."

    Example #1: Number of cans specified on invoice exceeds the number of cans stated on the FI and issued to the participant (as may happen when Ward Road does not split cases):

    WIC staff always writes in the total invoice amount (sum of the formula cost and shipping fees) into the *Actual Amount of Sale* box on the WIC FI. The formula that's paid for but not issued to the endorser can be part of the next month's issuance.

    Example #2: Monthly issuance includes two or more FIs:
    Invoice indicates $288.00 for 9 cans of formula and $10.00 for shipping.
    To determine the cost per can, divide 9 into $288.00. Each can costs $32.00.

    FI #1 is for 4 cans (4 multiplied by $32.00) = $128
    Half of the shipping cost = $5.00
    Write $133 into the *Actual Amount of Sale* box on WIC FI #1.

    FI #2 is for 5 cans (5 multiplied by $32.00) = $160
    Half of the shipping cost = $5.00.
    Write $165 into the *Actual Amount of Sale* box on WIC FI #2.

    b) **Endorser/participant signs the FIs and leaves the clinic with the formula.**

    c) **WIC staff person mails the signed FIs along with copy of the invoice to:**
    Ward Road Pharmacy
    5656 Ward Way, Unit A
    Arvada, CO 80002

7. **Maintain the original invoice** in a central file within the clinic.

8. **Staff may print the next month's FIs** at the same time the endorser picks up the special formula. Securely store these FIs at the clinic until the endorser/participant arrives to pick up that month's issuance.

9. **Staff orders formula for the next month.**

Example:

On 7/25: Mom signs the July formula FIs. WIC staff confirms with mom that August formula will be needed and prints the August FIs. Mom's signature is captured in Compass during August FI issuance. Mom takes the July formula home.
Soon after the 7/25 visit: the WIC staff person writes the invoice amount and the 7/25 redemption date on the July FIs and mails them to Ward Road Pharmacy. WIC staff person securely stores the August FIs in the clinic.
About a week before the next appointment: WIC staff person places the August order with State Office, who then forwards the order to Ward Road Pharmacy.
On 8/25: Mom returns to sign the August FIs and takes the August formula home. If no changes in the formula order, repeat this process for September.

10. When endorser/participant does not pick up the special formula:

a. **Make every effort to contact the endorser/participant** to learn whether the formula will be picked up. If formula will not be picked up, learn why and document details in the participant's care plan.

b. **Once established that the formula will not be issued to the participant for whom it was originally intended, the local agency WIC staff person signs his/her own name on the FIs and sends the FIs to Ward Road Pharmacy.** Best practice: whenever possible, the WIC RD/RN signs the FIs.

c. **The WIC RD/RN decides what to do with the unissued formula.** The allowable options are:

Option #1**: Issue this special formula to another WIC participant**

- All assurances must be made to ensure that the formula is consistently maintained at a safe temperature. Mailing of formula is prohibited.
- Print the FIs (for the receiving participant) and have the endorser/participant/proxy sign the Compass signature pad.
- WIC Staff Person manually writes "VOID" on each of the FIs. Do **not** mail these FIs to Ward Road since WIC has already paid for the formula. Maintain voided FIs in a clinic file for 3.5 years.

Option #2: **Donate to a local hospital or medical clinic (when appropriate)**

Option #3: **Dispose of the formula**. Open each can and discard it in such a way that it cannot be ingested.

Additional Details:

1. This ordering process has no effect on the direct order process between Ward Road Pharmacy and the WIC Nutritionists from Denver, Tri County and El Paso. That process continues as established.

2. Jefferson County WIC staff may continue to send the endorser/participant directly to Ward Road, as presently established.

3. The box on the FI is designated for Ward Road Pharmacy's stamp **only**.

4. During the bank's edit process, the bank will reject all FIs that appear to be altered. For example, the bank rejects those FIs where the number of cans have been altered and those where white-out was used.

5. Local agency staff can direct questions regarding the special formula order to Ward Road Pharmacy. Email Theresa TMakelky@wardroadrx.com. Their phone number is (303) 420-7979.

Ward Road Pharmacy Ordering Guide

FORMULA	FORM	SIZE	UNITS/ CASE	ORDERING by CAN OR CASE	OTHER INSTRUCTIONS
Boost High Protein	RTF	8 oz	27	Case	Specify flavor; vanilla, chocolate, strawberry
Boost Kid Essentials 1.5 cal	RTF	8 oz	27	Case	Specify flavor; vanilla, chocolate, strawberry
Boost Kid Essentials 1.5 cal with fiber	RTF	8 oz	27	Case	Vanilla flavor only
Bright Beginnings Soy Pediatric Drink	RTF	8 oz	24	Can	
Compleat Pediatric	RTF	8.45 oz	24	Case	
E028 Splash	RTF	8 oz	27	Case	Specify flavor: orange-pineapple, tropical fruit, grape
Elecare Infant	pwd	14.1 oz	6	Can	Unflavored only
Elecare Junior	pwd	14.1 oz	6	Can	Specify flavor: unflavored, vanilla
Enfagrow Soy Toddler	pwd	24 oz	4	Can	
Enfamil EnfaCare	pwd	12.8 oz	6	Case	Often available in local stores
Enfaport	RTF	8 oz	24	Case	
Ensure	RTF	8 oz 6-pk	24	Case	Often available in local stores Specify flavor: vanilla, dark chocolate, milk chocolate, strawberries & cream, butter pecan, coffee latte
Ensure Plus	RTF	8 oz 6-pk	24	Case	Often available in local stores Specify flavor: vanilla, chocolate, strawberry, butter pecan, coffee latte
Gerber Good Start Nourish	pwd	12.6	6	Can	
Neocate Infant with DHA and ARA	pwd	14.1 oz	4	Can	
Neocate Jr.	pwd	14 oz	4	Can	Specify flavor: unflavored, tropical fruit, chocolate
Neocate Jr with Prebiotics	pwd	14 oz	4	Can	Specify flavor: unflavored, vanilla
Nutramigen	Conc	13 oz	12	Case	Often available in local stores
Nutramigen	RTF	32 oz	6	Case	Often available in local stores
Nutramigen with Enflora LGG	Pwd	12.6 oz	6	Case	Often available in local stores
Nutren Jr.	RTF	8.45 oz	24	Case	Vanilla flavor only
Nutren Jr. with Prebio fiber	RTF	8.45 oz	24	Case	Vanilla flavor only
Nutren 1.0	RTF	8.45 oz	24	Case	Vanilla flavor only
Nutren 1.0 with fiber	RTF	8.45 oz	24	Case	Vanilla flavor only
Nutren 1.5	RTF	8.45 oz	24	Case	Vanilla flavor only
Nutren 2.0	RTF	8.45 oz	24	Case	Vanilla flavor only
Osmolite 1 cal	RTF	8 oz	24	Case	

FORMULA	FORM	SIZE	UNITS/ CASE	ORDERING by CAN OR CASE	OTHER INSTRUCTIONS
PediaSure	RTF	8 oz 6-pk	24	Can	Typically available in local stores Specify flavor: vanilla, chocolate, strawberry, banana, berry
PediaSure with fiber	RTF	8 oz 6-pk	24	Can	Vanilla flavor only
PediaSure Enteral	RTF	8 oz 6-pk	24	Can	Vanilla flavor only
PediaSure Enteral with fiber and ScFOS	RTF	8 oz 6-pk	24	Can	Vanilla flavor only
PediaSure 1.5 cal	RTF	8 oz 6-pk	24	Can	Vanilla flavor only
PediaSure 1.5 cal with fiber	RTF	8 oz 6-pk	24	Can	Vanilla flavor only
Peptamen	RTF	8.45 oz	24	Case	Specify flavor: unflavored, vanilla
Peptamen Jr.	RTF	8.45 oz	24	Case	Specify flavor: unflavored, vanilla, chocolate, strawberry
Peptamen Jr. with fiber	RTF	8.45 oz	24	Case	Vanilla flavor only
Portagen	pwd	16 oz	6	Case	
Pregestimil	pwd	16 oz	6	Case	Often available in local stores
PurAmino (formerly Nutramigen AA)	Pwd	14.1 oz	4	Can	
Similac Expert Care Alimentum	pwd	16 oz	6	Case	Often available in local stores
Similac Expert Care Alimentum	RTF	32 oz	12	Case	Often available in local stores
Similac Expert Care NeoSure	pwd	13.1 oz	6	Case	Often available in local stores
Similac Expert Care NeoSure	RTF	32 oz	12	Case	Often available in local stores
Similac PM 60/40	pwd	14.1 oz	6	Case	
Tolerex	pwd	2.82 oz pkt	6/carton 10 ctn/case	Case	
Vivonex Pediatric	pwd	1.7-oz pkt	6 pkt/carton	Carton	
Vivonex T.E.N.	pwd	2.84-oz pkt	10 pkt/ctn 60 ctn/case	Case	

NOTE: If product is available in both flavored and unflavored and no flavor is specified, product will be ordered as unflavored

Ward Road Ordering Guide for Metabolic Formulas

Metabolic Formula	Form	Size in grams	Units/ case	Ordering by can or case	Other information
Calcio - XD	pwd	375	6	Case	
Cyclinex 1 & 2	pwd	400	6	Case	Specify: 1 or 2
Glutarex 1 & 2	pwd	400	6	Case	Specify: 1 or 2
Hominex 1 & 2	pwd	400	6	Case	Specify: 1 or 2
I Valex 1 & 2	pwd	400	6	Case	Specify: 1 or 2
Ketonex 1 & 2	pwd	400	6	Case	Specify: 1 or 2
MSUD Analog	pwd	400	6	Case	
MSUD Maxamaid	pwd	454	6	Case	
MSUD Maxamum	pwd	454	6	Case	
Periflex Infant	pwd	400	6	Case	
Periflex Junior	pwd	454	6	Case	Specify flavor: unflavored, orange, chocolate
Phenex 1 & 2	pwd	400	6	Case	Specify: 1 or 2
Phenylade Essential Drink Mix	pwd	454	4	Case	Specify flavor: vanilla, chocolate, strawberry, orange cream
Phenyl Free 1 & 2	pwd	454	6	Case	Specify: 1 or 2
Phenyl Free 2 HP	pwd	454	6	Case	
Pro-Phree	pwd	400	6	Case	
ProViMin	pwd	150	6	Case	
Propimex-1 & 2	pwd	400	6	Case	Specify: 1 or 2
RCF	pwd	13 oz	12	Case	
Tyrex 1 & 2	pwd	400	6	Case	Specify: 1 or 2
TYROS 1 & 2	pwd	454	6	Case	Specify: 1 or 2
XLeu Analog	pwd	400	6	Case	

Metabolic Formula	Form	Size in grams	Units/ case	Ordering by can or case	Other information
XLeu Maxamaid	pwd	454	6	Case	
XLeu Maxamum	pwd	454	6	Case	
XLys XTrp Analog	pwd	400	6	Case	
XLys XTrp Maxamaid	pwd	454	6	Case	
XLys XTrp Maxamum	pwd	454	6	Case	
XMet Analog	pwd	400	6	Case	
XMet Maxamaid	pwd	454	6	Case	
XMet Maxamum	pwd	454	6	Case	
XMTVI Analog	pwd	400	6	Case	
XMTVI Maxamaid	pwd	454	6	Case	
XMTVI Maxamum	pwd	454	6	Case	
XPhe Maxamaid	pwd	454	6	Case	
XPhe Maxamum	pwd	454	6	Case	
XPhe XTyr Analog	pwd	400	6	Case	
XPhe XTyr Maxamaid	pwd	454	6	Case	
XPTM Analog	pwd	400	6	Case	

Concentrating Standard Infant Formulas*

READY TO FEED FORMULA**

Formula	Powder	Caloric Concentration
3 oz	½ teaspoon	22 kcal/oz
3 oz	1 tsp	24 kcal/oz

POWDER **

Water	Powder	Caloric Concentration
5.5 oz	3 scoops	22 kcal/oz
5 oz	3 scoops	24 kcal/oz

LIQUID CONCENTRATE

Water	Concentrate	Caloric Concentration
5 oz	6 oz	22kcal/oz
11 oz	13 oz	22 kcal/oz
2 oz	3 oz	24 kcal/oz
9 oz	13 oz	24 kcal/oz

*Not intended for specialty formulas

**Can be doubled for larger quantities

Adapted from "Selecting & Concentrating Infant Formula, Guidelines for Healthcare Professionals" written & compiled by the Oregon Pediatric Nutrition Practice Group and Oregon Dietetic Association, 2005.

Calculations to determine calories/oz of powdered formula (20 kcal/oz to 24 kcal/oz)

1 scoop powder = 40 calories
40 calories ÷ the ounces of water added = calories/ounce
Example: 3 scoops powder/5 ounces water
40 calories/scoop x 3 = 120
120 ÷ 5 ounces water = 24 calories/ounce

Always use the scoop that came with the formula being mixed. Formulas vary in their fluffiness, and scoop sizes are not interchangeable between brands.

Calculations to determine calories/ounce of concentrate formula (20 kcal/oz to 22 kcal/oz)

1 ounce concentrated formula = 40 calories
40 calories ÷ the total ounces yielded after water is added = calories/ounce
Example: 13 ounces concentrate/9 ounces of water
40 calories/ounce x 13 ounces = 520 ounces
520 ounces ÷ 22 ounces = 24 (23.6) calories/ounce

Calculations to determine other caloric density (22 kcal/oz to 24 kcal/oz)

1 scoop powder = 44 calories
44 calories ÷ *the total ounces yielded after water is added = calories/ounce*
Example: 3 scoops powder/5.5ounces water
44 calories/scoop x 3 = 132
132 ÷ 5.5 ounces water = 24 kcal/ounce

Please call a State nutrition consultant at (303) 692-2400 for additional information and calculations for formula dilution.

Preparation and Storage of Infant Formula: Questions & Answers

Q **How should cans of unopened formula be stored?**

A Store in a cool, dry indoor place – not in a refrigerator or in vehicles, garages, or outdoors where they can be exposed to extreme temperatures.

Q **How long can formula be kept after being opened and prepared?**

A An opened can of liquid formula can be kept up to 48 hours, if tightly covered and immediately placed in the refrigerator. An opened can of powdered formula should be tightly covered and stored in a cool, dry place and used within a month after opening.

Bottles of concentrate or ready-to feed formula should be refrigerated and used within 48 hours from the time they were prepared.

Bottles prepared from powdered formula should be refrigerated and used within 24 hours.

Q **How long should a bottle of formula remain unrefrigerated?**

A Prepared formula that is removed from refrigeration should be used within one hour or discarded. Discard any formula remaining after a feeding. The mixture of infant formula with saliva promotes the growth of disease-causing germs. Before being reused, bottles and parts should be thoroughly washed using soap and hot water. For infants under 3 months of age, it is also recommended to sterilize bottles and bottle parts.

Q **Should infant formula be frozen?**

A The use of infant formula after freezing is not recommended. Although freezing does not affect nutritional quality or sterility, physical separation of the product's components may occur.

Q **How should formula be warmed?**

A Warm the bottle immediately before feeding by holding it under running warm water. Always test the temperature of the liquid before feeding. Shake the bottle and squirt a couple of drops of the liquid on the back of your hand. The temperature is correct if it feels neither warm nor cold.

Q **Can formula be heated in a microwave oven?**

A Microwave ovens should NEVER be used for heating infant formula since there is a danger of overheating the liquid. During the microwaving process, the bottle may remain cool while hot spots develop in the formula. Overheated formula can cause serious burns to the baby. Covered bottles, especially vacuum-sealed, metal-capped bottles of ready-to-feed formula, can explode when heated in a microwave.

Q **Should parents be concerned about lead or other substances in the tap water when preparing formula?**

A Any concern about the lead or other substances in water should be discussed with your physician. Generally, the following steps should be taken when using tap water in preparing infant formula powder or concentrate:

- Avoid using hot tap water for formula preparation.
- Allow cold tap water to run for a short period of time (about two minutes) before collecting water for formula preparation.
- Bring the water to a rolling boil, boil for 1-2 minutes and then allow it to cool. Prolonged boiling (over 5 minutes) is not recommended because it can concentrate lead and nitrate in the water

A ready-to-feed formula that requires no addition of water is one alternative if you have concerns about lead pipes in your home. Preparing powder or concentrate formula with bottled water is also an option. If bottled water is used, distilled bottled water may be the best choice as it may contain fewer contaminants than bottled spring or mineral water

Q **Should parents be concerned about using formulas that have expired?**

A All cans of formula have "use by" or "use before" dates printed on them. Formula should not be bought or used beyond the "use by" date. Old formula may have lower levels of vitamins and may be discolored or separated. If you buy formula after the date on the can, it should be returned to the store where it was purchased and exchanged. The formula companies will replace this formula for the store.

Q **What advice is there for traveling with infant formula?**

A Caregivers can take along a can of powdered formula and separate water in clean bottles (or sterilized bottles for infants under 3 months of age.) Then the infant formula can be mixed up to make single bottles when needed. Alternatively, 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.

Adapted from: Infant Nutrition and Feeding: A Reference Handbook for Nutrition and Health Counselors in the WIC and CACFP Programs, USDA, Food and Nutrition Service, 2007.

Manufacturers of Colorado WIC-Approved Formulas/Medical Foods

Manufacturer:	Colorado WIC-Approved Formulas/Products:
ABBOTT NUTRITION 625 Cleveland Avenue Columbus, OH 43215-1724 (800) 986-8510 – consumer relations (800) 986-8755 – metabolic line www.abbottnutrition.com	EleCare Infant EleCare Junior Ensure / Ensure Plus Osmolite 1 Cal PediaSure / PediaSure with Fiber PediaSure Enteral / with Fiber PediaSure 1.5 cal / with Fiber Similac Expert Care Alimentum Similac Expert Care NeoSure Similac PM 60/40
APPLIED NUTRITION CORP V10 Saddle Road Cedar Knolls, NJ 07927 Phone: (800) 605-0410 Fax: (973) 734-0029 http://www.medicalfood.com	PhenylAde Essential Drink Mix
AZUMAYA TOFU Vitasoy-USA INC. One New England Way Ayer, MA 01432 Phone: (978)772-6881 Fax: (978) 772-6881 www.azumaya.com	Extra Firm Tofu Firm Tofu
8TH CONTINENT SOYMILK Stremicks Heritage Foods 4002 Westminster Avenue Santa Ana, CA 92703 Phone: (714) 775-5056 Fax: (714) 554-56-5 www.8thcontinent.com	Regular Original
LAND O LAKES White Wave Foods Company 12002 Airport Way Broomfield, CO 80021 1-800-878-9762 www.dairyease.com	Dairy Ease Milk

Manufacturer:	*Colorado WIC-Approved* **Formulas/Products:**
McNEIL NUTRITIONALS, LLC 7050 Camp Hill Road Fort Washington, PA 19034-2299 1-800-LACTAID (522-8243) www.lactaid.com	Lactaid Milk
MEAD JOHNSON NUTRITION Evansville, IN 47721 (812) 429-6399 Email: MJMedicalAffairs@mjn.com www.meadjohnson.com/professional	Enfagrow Soy Toddler Enfamil A.R. Enfamil EnfaCare Enfamil Gentlease Enfamil Premium Infant Enfamil Prosobee Enfaport LIPIL Nutramigen Nutramigen with Enflora LGG Portagen Pregestimil PurAmino
WIC Contact: Kathy Decker Associate Manager, WIC Business Team E-mail: Kathy.Decker@mjn.com Phone: 812-429-8758 Fax: 812-429-8610	
MEYENBERG Jackson-Mitchell P.O. Box 934 Turlock, CA 95381 (800) 891-GOAT (4628) Email: info@meyenberg.com www.meyenberg.com	Meyenberg Goat Milk

Manufacturer:	Colorado WIC-Approved Formulas/Products:
NESTLE HEALTHCARE NUTRITION 10801 Red Circle Drive Minnetonka, MN 55343 (800) 422-2752 www.nestle-nutrition.com Business contact: 12 Vreeland Road – 2nd Floor Florham Park, NJ 07932 (973) 593-7500	Boost Kid Essentials 1.5 cal/ Fiber Boost High Protein Compleat Pediatric Nutren Junior / with Prebio Fiber Nutren 1.0 / with fiber Nutren 1.5 Nutren 2.0 Peptamen Peptamen Junior / with Fiber Tolerex Vivonex Pediatric Vivonex T.E.N.
NESTLE INFANT NUTRITION (GERBER) 445 State Street Fremont, MI 49413-0001 (800) 284-9488 www.gerber.com	Gerber Good Start Nourish
NUTRICIA – NORTH AMERICA P.O. Box 117 Gaithersburg, MD 20884 (800) 365-7354 Email: nutritionservices@shsna.com Fax: 301-795-2301 www.shsna.com	E028 Splash Neocate Infant with DHA & ARA Neocate Junior / with Prebiotics
PACIFIC NATURAL FOODS 19480 SW 97th Avenue Tualatin, Oregon 97062 Phone: (503) 692-9666 Fax: (503) 692-9610 www.pacificfoods.com	Ultra Soy Plain Ultra Soy Vanilla
PBM PRODUCTS, LLC 204 N. Main Street Gordonsville, VA 22942 Phone: 1-800-410-9629 Email: info@pbmproducts.com www.brightbeginnings.com	Bright Beginnings Soy Pediatric Drink

WEB SITES

United States Government:

http://www.usa.gov/
The U.S. government's official web portal.

http://www.fns.usda.gov/fns/
The Food and Nutrition Service of USDA home page. Contains information about Nutrition Assistance Programs such as Food Stamps, WIC, School Meal Program, Commodity Supplemental Food Program and the Child and Adult Care Food Program.

http://www.hhs.gov/
The Department of Health and Human Services (HHS) is the United States government's principal agency for protecting the health of all Americans and providing essential services, especially for those who are least able to help themselves. Services include Medicaid, Medicare, Disability Services, Dental Health and Long-Term Care facilities.

http://wicworks.nal.usda.gov/
The **WIC Works Resource System** provides nutrition service tools for health and nutrition professionals. It includes *WIC talk*, an online nutrition discussion and information exchange. It also includes the WIC Learning Center, a site full of updates for WIC staff.

http://wicworks.nal.usda.gov/nal_web/wicworks/formulas/FormulaSearch.php
The **WIC Formula Database** includes information about all infant formulas, exempt infant formulas and medical foods approved for use in the WIC program. It is updated every 6 months.

http://ndb.nal.usda.gov/
The USDA National Nutrient Data Laboratory. Contains the National Nutrient Database for Standard Reference.

http://fnic.nal.usda.gov/
The Food and Nutrition Information Center (USDA National Agricultural Library) provides credible, accurate and practical resources for nutrition and health professionals, educators, government personnel and consumers.

http://www.fda.gov/Food/FoodSafety/Product-SpecificInformation/InfantFormula/
An FDA produced site containing infant formula information helpful to industry, consumers, government agencies, and other interested parties. It includes the following: information about FDA's regulation of commercial infant formulas, commonly-asked questions about infant formulas, information about how to report problems, and links to other relevant resources.

http://www.fda.gov/Safety/MedWatch/
An FDA produced site containing safety and product information on drugs and other medical products regulated by the U.S. Food and Drug Administration.

American Academy of Pediatrics:

http://aapnews.aappublications.org/
The official newsmagazine of the American Academy of Pediatrics.

Medical Conditions:

http://www.webmd.com/
WebMD provides valuable health information, tools for managing health, and support to those who seek information.

Special Needs Children:

http://depts.washington.edu/growing/
This site is designed to provide information to community health professionals who work with premature infants, especially those with very low birth weight (<1500 g) in hopes that assuring adequate nutritional status will improve outcomes and family life for these children. This excellent resource includes sections on Nutrition Assessment (including subsections on anthropometric measurements, growth expectations, failure-to-thrive, information on growth grids for preterm infants and much more), Nourishing the Very Low Birth Weight Infant After Discharge, Feeding the Very Low Birth Weight Infant at Home, Decision Trees for Clinics Services. This site is funded by a grant from the Maternal child Health Bureau.

http://www.new-vis.com/p-fym.htm
New Visions provides continuing education and therapy services to professionals and parents working with infants and children with feeding, swallowing, oral-motor, and pre-speech problems. Suzanne Evans Morris, PhD, established New Visions in 1985.

Miscellaneous Nutrition –related sites:

http://www.fruitsandveggiesmorematters.org/
This is the home site for the Produce for Better Health Foundation (PBH), a 501(c)(3) nonprofit organization that has partnered with the Centers for Disease Control & Prevention (CDC) to help spread the word about the health benefits of adding MORE fruits & veggies to the diet. Materials and publications can be ordered from this site.

http://abc.herbalgram.org/site/PageServer
Resource for herbal news and information, presented by the American Botanical Council.

http://ods.od.nih.gov/
Information on supplements from the National Institutes of Health.

http://www.vrg.org/
Vegetarian Resource Group home page.

Breastfeeding:

www.breastfeedcolorado.com
The Colorado Department of Public Health and Environment official Breastfeeding Essentials website listing resources such as breastfeeding position papers and training opportunities and links to other breastfeeding resources.

http://www.infantrisk.com/
Dr. Thomas Hale's site that features up-to-date evidence-based information on the use of medications during pregnancy and breastfeeding.

http://www.llli.org//
La Leche League International web site.

Search Engines Specifically for Health and Nutrition Information

http://www.nlm.nih.gov/medlineplus/
MEDLINEplus -National Library of Medicine. Allows the user to search for health information from the National Institutes of Health and other reputable sources. Alternatively, user may browse by topic. Other useful features include medical dictionaries and directories. The Spanish language version is available at http://www.nlm.nih.gov/medlineplus/spanish/aboutmedlineplus.html

http://www.healthfinder.gov/
Healthfinder – U.S. Department of Health and Human Services. Allows user to search for health information from government agencies and other reputable sources. Has other useful features including a directory of health organizations. The Spanish language version, Healthfinder® EspaZol, is available at http://www.healthfinder.gov/espanol/

PDA Download Sites:

http://www.ars.usda.gov/Services/docs.htm?docid=5720 Values of the USDA National Nutrient Database for Standard Reference.

meadjohnsonprofessional.com/ The PDF format of the Mead Johnson Pediatric Product Handbook can be downloaded.

http://www.skyscape.com/estore/ProductAdvisor.aspx- Skyscape has data bases for clinical nutrition, drugs and drug interactions, medical references for easy access to diagnostic guidelines, recommended tests, therapeutics, and dosage schedules.

COMMON TERMS

AMINO ACIDS - Amino acids are proteins that are broken down into particles that are easy to digest and less likely to cause an allergic reaction than intact, or "whole" milk protein such as milk or soy protein. They are used in formulas designed for malabsorption and protein allergy.

ARACHIDONIC ACID (ARA) – An omega-6 fatty acid necessary for the infant brain development and small amounts are required for overall fetal development. ARA is produced in the body from dietary Linoleic Acid. It is also found in meat, eggs, and some shellfish.

CASEIN AND HYDROLYZED CASEIN - Casein is a milk protein or the curds after milk clots. Hydrolyzed casein is milk protein that has been broken down or "predigested" to provide an easily digested high quality protein that is unlikely to trigger an allergy.

COW'S MILK ALLERGY - Cow's milk has long been a common cause of allergic disease in infants. In sensitive children it causes gastrointestinal difficulties such as vomiting, diarrhea, colic, or respiratory and skin problems. The problem is generally identified by clinical symptoms, family history, and a trial on a milk-free diet, using a substitute formula such as a soybean formula. Often symptoms appear and disappear spontaneously, regardless of dietary changes, making diagnosis difficult. Symptoms tend to be more often caused by food if gastrointestinal problems are present. Symptoms can be confused with lactose intolerance instead of a milk allergy. All lactose-free formulas are not milk-free. Soy formulas are both milk-free and lactose-free. Some children are allergic to both cow's milk and soy protein. Older children are often able to tolerate cow's milk later.

DOCOSAHEXENOIC ACID (DHA) – An omega-3 essential fatty acid, thought to be important to the development of infants, particularly as regards their eyes and brain. DHA is present in breast milk and has been added to some infant formulas. DHA is most commonly found in fish oil.

ELEMENTAL FORMULA – A nutrition support formula composed of simple elemental nutrient components that require no further digestive breakdown and are thus readily absorbed; formulas with the protein as free amino acids and the carbohydrate as the simple sugar glucose.

ENTERAL FEEDING – A mode of feeding that uses the gastrointestinal tract; oral or tube feeding.

FOOD ALLERGY - An adverse reaction to foods involving an immune mechanism. The actual chain of events in the body that triggers an allergic reaction is caused by the union of protein substances known as antibodies with particles from foreign substances, leading to the release of a chemical called histamine. The usual type of allergy is manifested by mild varied symptoms delayed hours or days after eating. Urticaria, wheezing, asthma, abdominal pain, vomiting, diarrhea, and coma may occur when the highly sensitized patient develops prompt and violent symptoms.

FRUCTOOLIGOSACCHARIDES (FOS) – Highly fermentable carbohydrates that occur naturally in common foods. FOS are undigested in the upper gastrointestinal tract; thus they reach the colon where they can be fermented by microflora. FOS have benefits similar to those of soluble fibers and can be classified as a dietary fiber. However, FOS do no contribute to residue in the stool. FOS are referred to as prebiotics because they stimulate the growth of beneficial intestinal bacteria.

GLUCOSE - Glucose is a form of sugar that has been broken down so that it is easy to digest. Glucose is used in formulas designed for allergies to more complex carbohydrates, such as corn syrup solids, and for problems with malabsorption.

GLUCOSE POLYMERS - Glucose polymers are particles of complex carbohydrates, such as corn starch, used in formulas, such as Isomil SF, designed for malabsorption or carbohydrate intolerance. Glucose polymers are bland, easy to digest, and unlikely to trigger carbohydrate allergy.

HYDROLYSATE - A hydrolysate is a substance broken down by water process (hydrolysis) to make it easier to digest and less likely to cause an allergy. Hydrolyzed casein (casein hydrolysate) is an example of a hydrolysate.

INTESTINAL SOLUTE LOAD - Because the intestine is a semipermeable membrane, rapid introduction of a high-solute (osmolar) load results in a shift of water from the bloodstream into the lumen of the bowel, causing diarrhea. Because the infant is particularly prone to osmotic diarrhea, care must be taken not to select a formula with high osmolality. If an elemental formula with a high osmolality must be used, it should be carefully introduced to allow the bowel to adapt.

INULIN – A polysaccharide that belongs to a group of naturally occurring carbohydrates containing non-digestible fructooligosaccharids (FOS). It is found naturally in more than 36,000 types of plants worldwide, including dahlias, asparagus, bananas, wheat, chicory, onions, and garlic.

IRON-FORTIFIED FORMULA - This is formula fortified with approximately 12 milligrams of iron per quart. The WIC Program's requirement for iron-fortified formula is 10 milligrams of iron per liter.

LACTOSE - Lactose is the sugar, or carbohydrate, in cow's milk.

LACTOSE INTOLERANCE - Lactose intolerance is a reaction to the milk sugar, lactose that occurs when the body lacks the enzyme lactase used to digest lactose. The first symptoms of intolerance—diarrhea, bloating, and discomfort—occur after feeding with milk or milk formula. Constipation can sometimes be a symptom. The intolerance may be present at birth (rare) or acquired with age and is most common in Black, Hispanic, Asian, American Indian children, and adults. It is almost non-existent in White preschoolers. Intolerance may also occur after a viral infection or bacterial gastrointestinal infection when there is prolonged diarrhea or long-term use of antibiotics. Lactose may be the last enzyme to return after recovery from an illness.

L-METHIONINE - An essential amino acid added to infant formulas to enhance the quality of the protein.

LOW-IRON FORMULA - Low-iron formula contains approximately 6 milligrams of iron per quart or about one-half the iron in iron-fortified formula.

MCT OIL - MCT is an abbreviation for medium chain triglycerides. MCT oil is absorbed in the intestine rather than in the liver where fat is usually absorbed. For this reason, it is used in formulas such as Portagen, designed for infants and children who have difficulty absorbing fat, such as with biliary atresia.

MEGALOBLASTIC ANEMIA - This is an anemia that results from a lack of folic acid and/or vitamin B_{12} in the diet. It is common in infants who drink unfortified goat's milk, which is low in folic acid, B_{12}, and vitamin C, who do not have other sources of these nutrients in their diet.

MILK INTOLERANCE - Cow's milk intolerance may mean an allergy to cow's milk protein or a lactase deficiency. (See Lactose Intolerance and Cow's Milk Allergy.)

OSMOLALITY - Refers to the number of osmoles of the particles (solutes) in a kilogram of solvent. (See additional discussion at the end of this Section).

PARENTERAL – A mode of feeding that does not use the gastrointestinal tract but provides nutrition by intravenous delivery of nutrient solutions.
PREBIOTICS - Prebiotics are non-digestible food ingredients that stimulate the growth or activity of bacteria in the digestive system which are beneficial to the health of the body.

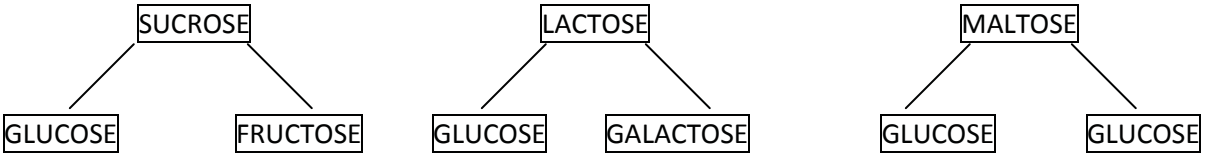
PROBIOTICS – Probiotics are dietary supplements of live microorganisms which when administered in adequate amounts confer a health benefit on the host.

RENAL SOLUTE LOAD - Solutes excreted by the kidney comprise the renal solute load. It consists primarily of nitrogenous waste products and electrolytes. Water is required to excrete these materials, which include urea, sodium, potassium, chloride, and to a lesser extent, sulfates and phosphates. Each gram of protein ingested contributes about 4 mOsm of renal solute and each milliequivalent of sodium, potassium, and chloride, 1 mOsm. The kidneys use water to excrete the metabolic waste. Because insensible water loss (i.e., usual loss through the lungs, skin, and urine) requires at least half of the ingested water of an infant, nothing is left to cover increased loss of water in situations such as sweating, diarrhea, fever, and so on. This makes the infant very vulnerable to fluid and electrolyte abnormalities if fed substances with a high renal solute load such as cow's milk.

WHEY - A protein in milk. The clear fluid left after the milk clots is whey.

WHEY TO CASEIN RATIO - Ratio of whey to casein in human milk is 60:40, compared with a 20:80 ratio in cow's milk.

BREAKDOWN OF CARBOHYDRATES



S.R. Williams, Nutrition and Diet Therapy, 2001, pp. 321, 323, 339
E.B. Feldman, Essentials of Clinical Nutrition, 1988, pp. 182-190.
American Dietetic Association, Handbook of Clinical Dietetics, 1981, pg. I47.
P. Pipes, Nutrition in Infancy and Childhood 1985, pg. 287.

OSMOLALITY

Osmolality for some formulas are listed in the Formula and Medical Nutritional Product List. This information is very helpful when comparing formulas or approving a formula for infants and young children or any person with a health condition that may impair gastrointestinal tolerance of enteral feedings.

Osmolality refers to the number of osmoles of the particles (solutes) in a kilogram of solvent. It is generally expressed as milliosmoles (mOsm), a measure of osmotically active particles per kilogram of water. *Osmolarity*, a term often confused with osmolality, refers to the number of osmoles per liter of solution (solvent plus solute). In body fluids there is a minor and unimportant difference between osmolality and osmolarity. In liquid diets and certain other foods, however, the value for osmolarity is always less than the value of osmolality, usually about 80% as much. Osmolarity is influenced by the values of all solutes contained in a solution and by the temperature, while osmolality is not.

In comparing potential hypertonic effects of various tube feedings or liquid diets, osmolality is the preferred term. The osmolality of blood serum and other body fluids should normally be no greater than 300 mOsm/kg of water. The body attempts to keep the osmolality of the contents of the stomach and intestine at this level.

At a given concentration (gram/liter), the smaller the particle size the greater the number of particles present and therefore the higher the osmolality. Simple sugars or low molecular weight carbohydrates increase osmolality of solutions much more than complex carbohydrates with higher molecular weights and large particle size.

Fats, which are complex and water insoluble, do not increase the osmolality of solutions. Electrolytes, such as sodium and potassium, and amino acids, all contribute significantly to the osmolality of a solution or liquid feeding.

Approximate Osmolality of Some Common Foods

Food	*mOsm/kg water*	*Food*	*mOsm/kg water*
Cow's milk	280	Apple juice	870
Ginger ale	510	Orange juice	935
Gelatin dessert	535	Malted milk	940
Tomato juice	595	Ice cream	1,150
7-Up	640	Grape juice	1,170
Coca-Cola	680	Sherbet	1,225
Eggnog	695		

The American Academy of Pediatrics recommends that infant formulas not exceed 450 mOsm/kg water, and ideally approximate that of human milk (277-303 mOsm). In milk- and soy-based formulas minerals and carbohydrates are the main determinants of osmolality. Solutions of high osmolality may draw water into the small intestine, causing diarrhea and possible dehydration and electrolyte imbalance. Division into several doses and dilution with feedings is recommended to reduce the osmotic effects.

Adapted from Handbook of Clinical Dietetics, The American Dietetic Association, New Haven and London: Yale University Press, 1981 and Manual of Clinical Dietetics, The American Dietetic Association, 1988.

KOSHER SYMBOLS REFERENCE

Definition of Kosher

- *Conforming to or prepared in accordance with Jewish dietary laws.*

Kosher Symbols

- *Formula is identified as Kosher with the following most common symbols:*

Ⓚ Symbol that represents supervision by the OK Laboratories.

Ⓤ Symbol that represents supervision by the Union of Orthodox Jewish Congregation, Kashruth Division. 212-563-4000.

Ⓤ Ⓚ Indicates formula of food item is kosher.

Ⓤ$_{D}$ Ⓚ$_{D}$ Formula or food item is a dairy product that indicates kosher.

Ⓤ$_{P}$ Ⓚ$_{P}$ Indicates formula or food item is kosher and is appropriate for Passover.

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Breastfeeding and the Use of Human Milk

SECTION ON BREASTFEEDING

Pediatrics 2012;129;e827; originally published online February 27, 2012;
DOI: 10.1542/peds.2011-3552

American Academy of Pediatrics
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FROM THE AMERICAN ACADEMY OF PEDIATRICS

Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

POLICY STATEMENT

Breastfeeding and the Use of Human Milk

SECTION ON BREASTFEEDING

KEY WORDS

breastfeeding, complementary foods, infant nutrition, lactation, human milk, nursing

ABBREVIATIONS

AAP—American Academy of Pediatrics
AHRQ—Agency for Healthcare Research and Quality
CDC—Centers for Disease Control and Prevention
CI—confidence interval
CMV—cytomegalovirus
DHA—docosahexaenoic acid
NEC—necrotizing enterocolitis
OR—odds ratio
SIDS—sudden infant death syndrome
WHO—World Health Organization

www.pediatrics.org/cgi/doi/10.1542/peds.2011-3552

doi:10.1542/peds.2011-3552

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

abstract

FREE

Breastfeeding and human milk are the normative standards for infant feeding and nutrition. Given the documented short- and long-term medical and neurodevelopmental advantages of breastfeeding, infant nutrition should be considered a public health issue and not only a lifestyle choice. The American Academy of Pediatrics reaffirms its recommendation of exclusive breastfeeding for about 6 months, followed by continued breastfeeding as complementary foods are introduced, with continuation of breastfeeding for 1 year or longer as mutually desired by mother and infant. Medical contraindications to breastfeeding are rare. Infant growth should be monitored with the World Health Organization (WHO) Growth Curve Standards to avoid mislabeling infants as underweight or failing to thrive. Hospital routines to encourage and support the initiation and sustaining of exclusive breastfeeding should be based on the American Academy of Pediatrics-endorsed WHO/UNICEF "Ten Steps to Successful Breastfeeding." National strategies supported by the US Surgeon General's Call to Action, the Centers for Disease Control and Prevention, and The Joint Commission are involved to facilitate breastfeeding practices in US hospitals and communities. Pediatricians play a critical role in their practices and communities as advocates of breastfeeding and thus should be knowledgeable about the health risks of not breastfeeding, the economic benefits to society of breastfeeding, and the techniques for managing and supporting the breastfeeding dyad. The "Business Case for Breastfeeding" details how mothers can maintain lactation in the workplace and the benefits to employers who facilitate this practice. *Pediatrics* 2012;129:e827–e841

INTRODUCTION

Six years have transpired since publication of the last policy statement of the American Academy of Pediatrics (AAP) regarding breastfeeding.[1] Recently published research and systematic reviews have reinforced the conclusion that breastfeeding and human milk are the reference normative standards for infant feeding and nutrition. The current statement updates the evidence for this conclusion and serves as a basis for AAP publications that detail breastfeeding management and infant nutrition, including the *AAP Breastfeeding Handbook for Physicians*,[2] *AAP Sample Hospital Breastfeeding Policy for Newborns*,[3] *AAP Breastfeeding Residency Curriculum*,[4] and the *AAP Safe and Healthy Beginnings Toolkit*.[5] The AAP reaffirms its recommendation of exclusive breastfeeding for about 6 months, followed by continued breastfeeding as complementary foods are introduced, with continuation

of breastfeeding for 1 year or longer as mutually desired by mother and infant.

EPIDEMIOLOGY

Information regarding breastfeeding rates and practices in the United States is available from a variety of government data sets, including the Centers for Disease Control and Prevention (CDC) National Immunization Survey,[6] the NHANES,[7] and Maternity Practices and Infant Nutrition and Care.[8] Drawing on these data and others, the CDC has published the "Breastfeeding Report Card," which highlights the degree of progress in achieving the breastfeeding goals of the Healthy People 2010 targets as well as the 2020 targets (Table 1).[9–11]

The rate of initiation of breastfeeding for the total US population based on the latest National Immunization Survey data are 75%.[11] This overall rate, however, obscures clinically significant sociodemographic and cultural differences. For example, the breastfeeding initiation rate for the Hispanic or Latino population was 80.6%, but for the non-Hispanic black or African American population, it was 58.1%. Among low-income mothers (participants in the Special Supplemental Nutrition Program for Women, Infants, and Children [WIC]), the breastfeeding initiation rate was 67.5%, but in those with a higher income ineligible for WIC, it was 84.6%.[12] Breastfeeding initiation rate was 37% for low-income non-Hispanic black mothers.[7] Similar disparities are age-related; mothers younger than 20 years initiated breastfeeding at a rate of 59.7% compared with the rate of 79.3% in mothers older than 30 years. The lowest rates of initiation were seen among non-Hispanic black mothers younger than 20 years, in whom the breastfeeding initiation rate was 30%.[7]

Although over the past decade, there has been a modest increase in the rate of "any breastfeeding" at 3 and 6 months, in none of the subgroups have the Healthy People 2010 targets been reached. For example, the 6-month "any breastfeeding" rate for the total US population was 43%, the rate for the Hispanic or Latino subgroup was 46%, and the rate for the non-Hispanic black or African American subgroup was only 27.5%. Rates of exclusive breastfeeding are further from Healthy People 2010 targets, with only 13% of the US population meeting the recommendation to breastfeed exclusively for 6 months. Thus, it appears that although the breastfeeding initiation rates have approached the 2010 Healthy People targets, the targets for duration of any breastfeeding and exclusive breastfeeding have not been met.

Furthermore, 24% of maternity services provide supplements of commercial infant formula as a general practice in the first 48 hours after birth. These observations have led to the conclusion that the disparities in breastfeeding rates are also associated with variations in hospital routines, independent of the populations served. As such, it is clear that greater emphasis needs to be placed on improving and standardizing hospital-based practices to realize the newer 2020 targets (Table 1).

TABLE 1 Healthy People Targets 2010 and 2020(%)

	2007[a]	2010 Target	2020 Target
Any breastfeeding			
Ever	75.0	75	81.9
6 mo	43.8	50	60.5
1 y	22.4	25	34.1
Exclusive breastfeeding			
To 3 mo	33.5	40	44.3
To 6 mo	13.8	17	23.7
Worksite lactation support	25	—	38.0
Formula use in first 2 d	25.6	—	15.6

[a] 2007 data reported in 2011.[10]

INFANT OUTCOMES

Methodologic Issues

Breastfeeding results in improved infant and maternal health outcomes in both the industrialized and developing world. Major methodologic issues have been raised as to the quality of some of these studies, especially as to the size of the study populations, quality of the data set, inadequate adjustment for confounders, absence of distinguishing between "any" or "exclusive" breastfeeding, and lack of a defined causal relationship between breastfeeding and the specific outcome. In addition, there are inherent practical and ethical issues that have precluded prospective randomized interventional trials of different feeding regimens. As such, the majority of published reports are observational cohort studies and systematic reviews/meta-analyses.

To date, the most comprehensive publication that reviews and analyzes the published scientific literature that compares breastfeeding and commercial infant formula feeding as to health outcomes is the report prepared by the Evidence-based Practice Centers of the Agency for Healthcare Research and Quality (AHRQ) of the US Department of Health Human Services titled *Breastfeeding and Maternal and Infant Health Outcomes in Developed Countries*.[13] The following sections summarize and update the AHRQ meta-analyses and provide an expanded analysis regarding health outcomes. Table 2 summarizes the dose-response relationship between the duration of breastfeeding and its protective effect.

Respiratory Tract Infections and Otitis Media

The risk of hospitalization for lower respiratory tract infections in the first year is reduced 72% if infants breastfed exclusively for more than 4 months.[13,14] Infants who exclusively breastfed for 4

TABLE 2 Dose-Response Benefits of Breastfeeding[a]

Condition	% Lower Risk[b]	Breastfeeding	Comments	OR[c]	95% CI
Otitis media[13]	23	Any	—	0.77	0.64–0.91
Otitis media[13]	50	≥3 or 6 mo	Exclusive BF	0.50	0.36–0.70
Recurrent otitis media[15]	77	Exclusive BF ≥6 mo[d]	Compared with BF 4 to <6 mo[d]	1.95	1.06–3.59
Upper respiratory tract infection[17]	63	>6 mo	Exclusive BF	0.30	0.18–0.74
Lower respiratory tract infection[13]	72	≥4 mo	Exclusive BF	0.28	0.14–0.54
Lower respiratory tract infection[15]	77	Exclusive BF ≥6 mo[d]	Compared with BF 4 to <6 mo[d]	4.27	1.27–14.35
Asthma[13]	40	≥3 mo	Atopic family history	0.60	0.43–0.82
Asthma[13]	26	≥3 mo	No atopic family history	0.74	0.6–0.92
RSV bronchiolitis[16]	74	>4 mo	—	0.26	0.074–0.9
NEC[19]	77	NICU stay	Preterm infants Exclusive HM	0.23	0.51–0.94
Atopic dermatitis[27]	27	>3 mo	Exclusive BFnegative family history	0.84	0.59–1.19
Atopic dermatitis[27]	42	>3 mo	Exclusive BFpositive family history	0.58	0.41–0.92
Gastroenteritis[13,14]	64	Any	—	0.36	0.32–0.40
Inflammatory bowel disease[32]	31	Any	—	0.69	0.51–0.94
Obesity[13]	24	Any	—	0.76	0.67–0.86
Celiac disease[31]	52	>2 mo	Gluten exposure when BF	0.48	0.40–0.89
Type 1 diabetes[13,42]	30	>3 mo	Exclusive BF	0.71	0.54–0.93
Type 2 diabetes[13,43]	40	Any	—	0.61	0.44–0.85
Leukemia (ALL)[13,46]	20	>6 mo	—	0.80	0.71–0.91
Leukemia (AML)[13,45]	15	>6 mo	—	0.85	0.73–0.98
SIDS[13]	36	Any >1 mo	—	0.64	0.57–0.81

ALL, acute lymphocytic leukemia; AML, acute myelogenous leukemia; BF, breastfeeding; HM, human milk; RSV, respiratory syncytial virus.

[a] Pooled data.

[b] % lower risk refers to lower risk while BF compared with feeding commercial infant formula or referent group specified.

[c] OR expressed as increase risk for commercial formula feeding.

[d] Referent group is exclusive BF ≥6 months.

to 6 months had a fourfold increase in the risk of pneumonia compared with infants who exclusively breastfed for more than 6 months.[15] The severity (duration of hospitalization and oxygen requirements) of respiratory syncytial virus bronchiolitis is reduced by 74% in infants who breastfed exclusively for 4 months compared with infants who never or only partially breastfed.[16]

Any breastfeeding compared with exclusive commercial infant formula feeding will reduce the incidence of otitis media (OM) by 23%.[13] Exclusive breastfeeding for more than 3 months reduces the risk of otitis media by 50%. Serious colds and ear and throat infections were reduced by 63% in infants who exclusively breastfed for 6 months.[17]

Gastrointestinal Tract Infections

Any breastfeeding is associated with a 64% reduction in the incidence of nonspecific gastrointestinal tract infections, and this effect lasts for 2 months after cessation of breastfeeding.[13,14,17,18]

Necrotizing Enterocolitis

Meta-analyses of 4 randomized clinical trials performed over the period 1983 to 2005 support the conclusion that feeding preterm infants human milk is associated with a significant reduction (58%) in the incidence of necrotizing enterocolitis (NEC).[13] A more recent study of preterm infants fed an exclusive human milk diet compared with those fed human milk supplemented with cow-milk-based infant formula products noted a 77% reduction in NEC.[19] One case of NEC could be prevented if 10 infants received an exclusive human milk diet, and 1 case of NEC requiring surgery or resulting in death could be prevented if 8 infants received an exclusive human milk diet.[19]

Sudden Infant Death Syndrome and Infant Mortality

Meta-analyses with a clear definition of degree of breastfeeding and adjusted for confounders and other known risks for sudden infant death syndrome (SIDS) note that breastfeeding is associated with a 36% reduced risk of SIDS.[13] Latest data comparing any versus exclusive breastfeeding reveal that for any breastfeeding, the multivariate odds ratio (OR) is 0.55 (95% confidence interval [CI], 0.44–0.69). When computed for exclusive breastfeeding, the OR is 0.27 (95% CI, 0.27–0.31).[20] A proportion (21%) of the US infant mortality has been attributed, in part, to the increased rate of SIDS in infants who were never breastfed.[21] That the positive effect of breastfeeding on SIDS rates is independent of sleep position was confirmed in a large case-control study of supine-sleeping infants.[22,23]

It has been calculated that more than 900 infant lives per year may be saved in the United States if 90% of mothers exclusively breastfed for 6 months.[24] In the 42 developing countries in which 90% of the world's childhood deaths occur, exclusive breastfeeding for 6 months and weaning after 1 year is the most effective intervention, with the potential of preventing more than 1 million infant deaths per year, equal to preventing 13% of the world's childhood mortality.[25]

Allergic Disease

There is a protective effect of exclusive breastfeeding for 3 to 4 months in

reducing the incidence of clinical asthma, atopic dermatitis, and eczema by 27% in a low-risk population and up to 42% in infants with positive family history.[13,26] There are conflicting studies that examine the timing of adding complementary foods after 4 months and the risk of allergy, including food allergies, atopic dermatitis, and asthma, in either the allergy-prone or nonatopic individual.[26] Similarly, there are no convincing data that delaying introduction of potentially allergenic foods after 6 months has any protective effect.[27–30] One problem in analyzing this research is the low prevalence of exclusive breastfeeding at 6 months in the study populations. Thus, research outcomes in studies that examine the development of atopy and the timing of introducing solid foods in partially breastfed infants may not be applicable to exclusively breastfed infants.

Celiac Disease

There is a reduction of 52% in the risk of developing celiac disease in infants who were breastfed at the time of gluten exposure.[31] Overall, there is an association between increased duration of breastfeeding and reduced risk of celiac disease when measured as the presence of celiac antibodies. The critical protective factor appears to be not the timing of the gluten exposure but the overlap of breastfeeding at the time of the initial gluten ingestion. Thus, gluten-containing foods should be introduced while the infant is receiving only breast milk and not infant formula or other bovine milk products.

Inflammatory Bowel Disease

Breastfeeding is associated with a 31% reduction in the risk of childhood inflammatory bowel disease.[32] The protective effect is hypothesized to result from the interaction of the immunomodulating effect of human milk and the underlying genetic susceptibility of the infant. Different patterns of intestinal colonization in breastfed versus commercial infant formula–fed infants may add to the preventive effect of human milk.[33]

Obesity

Because rates of obesity are significantly lower in breastfed infants, national campaigns to prevent obesity begin with breastfeeding support.[34,35] Although complex factors confound studies of obesity, there is a 15% to 30% reduction in adolescent and adult obesity rates if any breastfeeding occurred in infancy compared with no breastfeeding.[13,36] The Framingham Offspring study noted a relationship of breastfeeding and a lower BMI and higher high-density lipoprotein concentration in adults.[37] A sibling difference model study noted that the breastfed sibling weighed 14 pounds less than the sibling fed commercial infant formula and was less likely to reach BMI obesity threshold.[38] The duration of breastfeeding also is inversely related to the risk of overweight; each month of breastfeeding being associated with a 4% reduction in risk.[14]

The interpretation of these data is confounded by the lack of a definition in many studies of whether human milk was given by breastfeeding or by bottle. This is of particular importance, because breastfed infants self-regulate intake volume irrespective of maneuvers that increase available milk volume, and the early programming of self-regulation, in turn, affects adult weight gain.[39] This concept is further supported by the observations that infants who are fed by bottle, formula, or expressed breast milk will have increased bottle emptying, poorer self-regulation, and excessive weight gain in late infancy (older than 6 months) compared with infants who only nurse from the breast.[40,41]

Diabetes

Up to a 30% reduction in the incidence of type 1 diabetes mellitus is reported for infants who exclusively breastfed for at least 3 months, thus avoiding exposure to cow milk protein.[13,42] It has been postulated that the putative mechanism in the development of type 1 diabetes mellitus is the infant's exposure to cow milk β-lactoglobulin, which stimulates an immune-mediated process cross-reacting with pancreatic β cells. A reduction of 40% in the incidence of type 2 diabetes mellitus is reported, possibly reflecting the long-term positive effect of breastfeeding on weight control and feeding self-regulation.[43]

Childhood Leukemia and Lymphoma

There is a reduction in leukemia that is correlated with the duration of breastfeeding.[14,44] A reduction of 20% in the risk of acute lymphocytic leukemia and 15% in the risk of acute myeloid leukemia in infants breastfed for 6 months or longer.[45,46] Breastfeeding for less than 6 months is protective but of less magnitude (approximately 12% and 10%, respectively). The question of whether the protective effect of breastfeeding is a direct mechanism of human milk on malignancies or secondarily mediated by its reduction of early childhood infections has yet to be answered.

Neurodevelopmental Outcomes

Consistent differences in neurodevelopmental outcome between breastfed and commercial infant formula–fed infants have been reported, but the outcomes are confounded by differences in parental education, intelligence, home environment, and socioeconomic status.[13,47] The large, randomized Promotion of Breastfeeding Intervention Trial provided evidence that adjusted outcomes of intelligence scores and teacher's ratings are significantly greater in breastfed infants.[48–50] In

addition, higher intelligence scores are noted in infants who exclusively breastfed for 3 months or longer, and higher teacher ratings were observed if exclusive breastfeeding was practiced for 3 months or longer. Significantly positive effects of human milk feeding on long-term neurodevelopment are observed in preterm infants, the population more at risk for these adverse neurodevelopmental outcomes.[51–54]

PRETERM INFANTS

There are several significant short- and long-term beneficial effects of feeding preterm infants human milk. Lower rates of sepsis and NEC indicate that human milk contributes to the development of the preterm infant's immature host defense.[19,55–59] The benefits of feeding human milk to preterm infants are realized not only in the NICU but also in the fewer hospital readmissions for illness in the year after NICU discharge.[51,52] Furthermore, the implications for a reduction in incidence of NEC include not only lower mortality rates but also lower long-term growth failure and neurodevelopmental disabilities.[60,61] Clinical feeding tolerance is improved, and the attainment of full enteral feeding is hastened by a diet of human milk.[51,52,59]

Neurodevelopmental outcomes are improved by the feeding of human milk. Long-term studies at 8 years of age through adolescence suggest that intelligence test results and white matter and total brain volumes are greater in subjects who had received human milk as infants in the NICU.[53,54] Extremely preterm infants receiving the greatest proportion of human milk in the NICU had significantly greater scores for mental, motor, and behavior ratings at ages 18 months and 30 months.[51,52] These data remain significant after adjustment for confounding factors, such as maternal age, education, marital status, race, and infant morbidities. These neurodevelopmental outcomes are associated with predominant and not necessarily exclusive human milk feeding. Human milk feeding in the NICU also is associated with lower rates of severe retinopathy of prematurity.[62,63] Long-term studies of preterm infants also suggest that human milk feeding is associated with lower rates of metabolic syndrome, and in adolescents, it is associated with lower blood pressures and low-density lipoprotein concentrations and improved leptin and insulin metabolism.[64,65]

The potent benefits of human milk are such that all preterm infants should receive human milk (Table 3). Mother's own milk, fresh or frozen, should be the primary diet, and it should be fortified appropriately for the infant born weighing less than 1.5 kg. If mother's own milk is unavailable despite significant lactation support, pasteurized donor milk should be used.[19,66] Quality control of pasteurized donor milk is important and should be monitored. New data suggest that mother's own milk can be stored at refrigerator temperature (4°C) in the NICU for as long as 96 hours.[67] Data on thawing, warming, and prolonged storage need updating. Practices should involve protocols that prevent misadministration of milk.

TABLE 3 Recommendations on Breastfeeding Management for Preterm Infants

1. All preterm infants should receive human milk.
   - Human milk should be fortified, with protein, minerals, and vitamins to ensure optimal nutrient intake for infants weighing <1500 g at birth.
   - Pasteurized donor human milk, appropriately fortified, should be used if mother's own milk is unavailable or its use is contraindicated.
2. Methods and training protocols for manual and mechanical milk expression must be available to mothers.
3. Neonatal intensive care units should possess evidence-based protocols for collection, storage, and labeling of human milk.[150]
4. Neonatal intensive care units should prevent the misadministration of human milk (http://www.cdc.gov/breastfeeding/recommendations/other_mothers_milk.htm).
5. There are no data to support routinely culturing human milk for bacterial or other organisms.[151]

MATERNAL OUTCOMES

Both short- and long-term health benefits accrue to mothers who breastfeed. Such mothers have decreased postpartum blood loss and more rapid involution of the uterus. Continued breastfeeding leads to increased child spacing secondary to lactational amenorrhea. Prospective cohort studies have noted an increase in postpartum depression in mothers who do not breastfeed or who wean early.[68] A large prospective study on child abuse and neglect perpetuated by mothers found, after correcting for potential confounders, that the rate of abuse/neglect was significantly increased for mothers who did not breastfeed as opposed to those who did (OR: 2.6; 95% CI: 1.7–3.9).[69]

Studies of the overall effect of breastfeeding on the return of the mothers to their pre-pregnancy weight are inconclusive, given the large numbers of confounding factors on weight loss (diet, activity, baseline BMI, ethnicity).[13] In a covariate-adjusted study of more than 14 000 women postpartum, mothers who exclusively breastfed for longer than 6 months weighed 1.38 kg less than those who did not breastfeed.[70] In mothers without a history of gestational diabetes, breastfeeding duration was associated with a decreased risk of type 2 diabetes mellitus; for each year of breastfeeding, there was a decreased risk of 4% to 12%.[71,72] No beneficial effect for breastfeeding was noted in mothers who were diagnosed with gestational diabetes.

The longitudinal Nurses Health Study noted an inverse relationship between the cumulative lifetime duration of breastfeeding and the development of rheumatoid arthritis.[73] If cumulative duration of breastfeeding exceeded 12

months, the relative risk of rheumatoid arthritis was 0.8 (95% CI: 0.8–1.0), and if the cumulative duration of breastfeeding was longer than 24 months, the relative risk of rheumatoid arthritis was 0.5 (95% CI: 0.3–0.8).[73] An association between cumulative lactation experience and the incidence of adult cardiovascular disease was reported by the Women's Health Initiative in a longitudinal study of more than 139 000 postmenopausal women.[74] Women with a cumulative lactation history of 12 to 23 months had a significant reduction in hypertension (OR: 0.89; 95% CI: 0.84–0.93), hyperlipidemia (OR: 0.81; 95% CI: 0.76–0.87), cardiovascular disease (OR: 0.90; 95% CI: 0.85–0.96), and diabetes (OR: 0.74; 95% CI: 0.65–0.84).

Cumulative lactation experience also correlates with a reduction in both breast (primarily premenopausal) and ovarian cancer.[13,14,75] Cumulative duration of breastfeeding of longer than 12 months is associated with a 28% decrease in breast cancer (OR: 0.72; 95% CI: 0.65–0.8) and ovarian cancer (OR: 0.72; 95% CI: 0.54–0.97).[76] Each year of breastfeeding has been calculated to result in a 4.3% reduction in breast cancer.[76,77]

ECONOMIC BENEFITS

A detailed pediatric cost analysis based on the AHRQ report concluded that if 90% of US mothers would comply with the recommendation to breastfeed exclusively for 6 months, there would be a savings of $13 billion per year.[24] The savings do not include those related to a reduction in parental absenteeism from work or adult deaths from diseases acquired in childhood, such as asthma, type 1 diabetes mellitus, or obesity-related conditions. Strategies that increase the number of mothers who breastfeed exclusively for about 6 months would be of great economic benefit on a national level.

DURATION OF EXCLUSIVE BREASTFEEDING

The AAP recommends exclusive breastfeeding for about 6 months, with continuation of breastfeeding for 1 year or longer as mutually desired by mother and infant, a recommendation concurred to by the WHO[78] and the Institute of Medicine.[79]

Support for this recommendation of exclusive breastfeeding is found in the differences in health outcomes of infants breastfed exclusively for 4 vs 6 months, for gastrointestinal disease, otitis media, respiratory illnesses, and atopic disease, as well as differences in maternal outcomes of delayed menses and postpartum weight loss.[15,18,80]

Compared with infants who never breastfed, infants who were exclusively breastfed for 4 months had significantly greater incidence of lower respiratory tract illnesses, otitis media, and diarrheal disease than infants exclusively breastfed for 6 months or longer.[15,18] When compared with infants who exclusively breastfed for longer than 6 months, those exclusively breastfed for 4 to 6 months had a fourfold increase in the risk of pneumonia.[15] Furthermore, exclusively breastfeeding for 6 months extends the period of lactational amenorrhea and thus improves child spacing, which reduces the risk of birth of a preterm infant.[81]

The AAP is cognizant that for some infants, because of family and medical history, individual developmental status, and/or social and cultural dynamics, complementary feeding, including gluten-containing grains, begins earlier than 6 months of age.[82,83] Because breastfeeding is immunoprotective, when such complementary foods are introduced, it is advised that this be done while the infant is feeding only breastmilk.[82] Mothers should be encouraged to continue breastfeeding through the first year and beyond as more and varied complementary foods are introduced.

CONTRAINDICATIONS TO BREASTFEEDING

There are a limited number of medical conditions in which breastfeeding is contraindicated, including an infant with the metabolic disorder of classic galactosemia. Alternating breastfeeding with special protein-free or modified formulas can be used in feeding infants with other metabolic diseases (such as phenylketonuria), provided that appropriate blood monitoring is available. Mothers who are positive for human T-cell lymphotrophic virus type I or II[84] or untreated brucellosis[85] should not breastfeed nor provide expressed milk to their infants Breastfeeding should not occur if the mother has active (infectious) untreated tuberculosis or has active herpes simplex lesions on her breast; however, expressed milk can be used because there is no concern about these infectious organisms passing through the milk. Breastfeeding can be resumed when a mother with tuberculosis is treated for a minimum of 2 weeks and is documented that she is no longer infectious.[86] Mothers who develop varicella 5 days before through 2 days after delivery should be separated from their infants, but their expressed milk can be used for feeding.[87] In 2009, the CDC recommended that mothers acutely infected with H1N1 influenza should temporarily be isolated from their infants until they are afebrile, but they can provide expressed milk for feeding.[88]

In the industrialized world, it is not recommended that HIV-positive mothers breastfeed. However, in the developing world, where mortality is increased in non-breastfeeding infants from a combination of malnutrition and infectious diseases, breastfeeding may outweigh the risk of the acquiring HIV infection

from human milk. Infants in areas with endemic HIV who are exclusively breastfed for the first 3 months are at a lower risk of acquiring HIV infection than are those who received a mixed diet of human milk and other foods and/or commercial infant formula.[89] Recent studies document that combining exclusive breastfeeding for 6 months with 6 months of antiretroviral therapy significantly decreases the postnatal acquisition of HIV-1.[90,91]

There is no contraindication to breastfeeding for a full-term infant whose mother is seropositive for cytomegalovirus (CMV). There is a possibility that CMV acquired from mother's milk may be associated with a late-onset sepsis-like syndrome in the extremely low birth weight (birth weight <1500 g) preterm infant. Although not associated with long-term abnormalities, such a syndrome may warrant antiviral therapy.[92] The value of routinely feeding human milk from seropositive mothers to preterm infants outweighs the risks of clinical disease, especially because no long-term neurodevelopmental abnormalities have been reported.[93] Freezing of milk reduces but does not eliminate CMV.[94] Heating, either as Holder pasteurization (heating at 62.5°C for 30 minutes) or high-temperature short pasteurization (72°C for 5–10 seconds) eliminates the viral load from the milk but also affects bioactive factors and nutrients.[95] Thus, fresh mother's own milk is preferable for routinely feeding all preterm infants.

Maternal substance abuse is not a categorical contraindication to breastfeeding. Adequately nourished narcotic-dependent mothers can be encouraged to breastfeed if they are enrolled in a supervised methadone maintenance program and have negative screening for HIV and illicit drugs.[96] Street drugs such as PCP (phencyclidine), cocaine, and cannabis can be detected in human milk, and their use by breastfeeding mothers is of concern, particularly with regard to the infant's long-term neurobehavioral development and thus are contraindicated.[97] Alcohol is not a galactogogue; it may blunt prolactin response to suckling and negatively affects infant motor development.[98,99] Thus, ingestion of alcoholic beverages should be minimized and limited to an occasional intake but no more than 0.5 g alcohol per kg body weight, which for a 60 kg mother is approximately 2 oz liquor, 8 oz wine, or 2 beers.[100] Nursing should take place 2 hours or longer after the alcohol intake to minimize its concentration in the ingested milk.[101] Maternal smoking is not an absolute contraindication to breastfeeding but should be strongly discouraged, because it is associated with an increased incidence in infant respiratory allergy[102] and SIDS.[103] Smoking should not occur in the presence of the infant so as to minimize the negative effect of secondary passive smoke inhalation.[104] Smoking is also a risk factor for low milk supply and poor weight gain.[105,106]

MATERNAL DIET

Well-nourished lactating mothers have an increased daily energy need of 450 to 500 kcal/day that can be met by a modest increase in a normally balanced varied diet.[107–109] Although dietary reference intakes for breastfeeding mothers are similar to or greater than those during pregnancy, there is no routine recommendation for maternal supplements during lactation.[108,109,110] Many clinicians recommend the continued use of prenatal vitamin supplements during lactation.[109]

The mother's diet should include an average daily intake of 200 to 300 mg of the ω-3 long-chain polyunsaturated fatty acids (docosahexaenoic acid [DHA]) to guarantee a sufficient concentration of preformed DHA in the milk.[111,112] Consumption of 1 to 2 portions of fish (eg, herring, canned light tuna, salmon) per week will meet this need. The concern regarding the possible risk from intake of excessive mercury or other contaminants is offset by the neurobehavioral benefits of an adequate DHA intake and can be minimized by avoiding the intake of predatory fish (eg, pike, marlin, mackerel, tile fish, swordfish).[113] Poorly nourished mothers or those on selective vegan diets may require a supplement of DHA as well as multivitamins.

MATERNAL MEDICATIONS

Recommendations regarding breastfeeding in situations in which the mother is undergoing either diagnostic procedures or pharmacologic therapy must balance the benefits to the infant and the mother against the potential risk of drug exposure to the infant. There are only a limited number of agents that are contraindicated, and an appropriate substitute usually can be found. The most comprehensive, up-to-date source of information regarding the safety of maternal medications when the mother is breastfeeding is LactMed, an Internet-accessed source published by the National Library of Medicine/National Institutes of Health.[114] A forthcoming AAP policy statement on the transfer of drugs and other chemicals into human milk will provide additional recommendations, with particular focus on psychotropic drugs, herbal products, galactagogues, narcotics, and pain medications.[115] In general, breastfeeding is not recommended when mothers are receiving medication from the following classes of drugs: amphetamines, chemotherapy agents, ergotamines, and statins.

There are a wide variety of maternally administered psychotropic agents for which there are inadequate pharmacologic data with regard to human milk and/or nursing infant's blood

concentrations. In addition, data regarding the long-term neurobehavioral effects from exposure to these agents during the critical developmental period of early infancy are lacking. A recent comprehensive review noted that of the 96 psychotropic drugs available, pharmacologic and clinical information was only available for 62 (65%) of the drugs.[116] In only 19 was there adequate information to allow for defining a safety protocol and thus qualifying to be compatible for use by lactating mothers. Among the agents considered to be least problematic were the tricyclic antidepressants amitriptyline and clomipramine and the selective serotonin-reuptake inhibitors paroxetine and sertraline.

Detailed guidelines regarding the necessity for and duration of temporary cessation of breastfeeding after maternal exposure to diagnostic radioactive compounds are provided by the US Nuclear Regulatory Commission and in medical reviews.[117–119] Special precaution should be followed in the situation of breastfeeding infants with glucose-6-phosphate-dehydrogenase deficiency. Fava beans, nitrofurantoin, primaquine, and phenazopyridine should be avoided by the mother to minimize the risk of hemolysis in the infant.[120]

HOSPITAL ROUTINES

The Sections on Breastfeeding and Perinatal Pediatrics have published the Sample Hospital Breastfeeding Policy that is available from the AAP Safe and Healthy Beginnings Web site.[3,5] This sample hospital policy is based on the detailed recommendations of the previous AAP policy statement "Breastfeeding and the Use of Human Milk"[1] as well as the principles of the 1991 WHO/UNICEF publication "Tens Steps to Successful Breastfeeding" (Table 4)[121] and provides a template for developing a uniform hospital policy for support of breastfeeding.[122] In particular, emphasis is placed on the need to revise or discontinue disruptive hospital policies that interfere with early skin-to-skin contact, that provide water, glucose water, or commercial infant formula without a medical indication, that restrict the amount of time the infant can be with the mother, that limit feeding duration, or that provide unlimited pacifier use.

In 2009, the AAP endorsed the Ten Steps program (see Table 4). Adherence to these 10 steps has been demonstrated to increase rates of breastfeeding initiation, duration, and exclusivity.[122,123] Implementation of the following 5 postpartum hospital practices has been demonstrated to increase breastfeeding duration, irrespective of socioeconomic status: breastfeeding in the first hour after birth, exclusive breastfeeding, rooming-in, avoidance of pacifiers, and receipt of telephone number for support after discharge from the hospital.[124]

The CDC National Survey of Maternity Practices in Infant Nutrition and Care has assessed the lactation practices in more than 80% of US hospitals and noted that the mean score for implementation of the Ten Steps was only 65%.[34,125] Fifty-eight percent of hospitals erroneously advised mothers to limit suckling at the breast to a specified length of time, and 41% of the hospitals gave pacifiers to more than some of their newborns—both practices that have been documented to lower breastfeeding rates and duration.[126] The survey noted that in 30% of all birth centers, more than half of all newborns received supplementation commercial infant formula, a practice associated with shorter duration of breastfeeding and less exclusivity.[34,125] As indicated in the benefits section, this early supplementation may affect morbidity outcomes in this population. The survey also reported that 66% of hospitals reported that they distributed to breastfeeding mothers discharge packs that contained commercial infant formula, a practice that has been documented to negatively affect exclusivity and duration of breastfeeding.[127] Few birth centers have model hospital policies (14%) and support breastfeeding mothers after hospital discharge (27%). Only 37% of centers practice more than 5 of the 10 Steps and only 3.5% practice 9 to 10 Steps.[34]

There is, thus, a need for a major conceptual change in the organization of the hospital services for the mother and infant dyad (Table 5). This requires that medical and nursing routines and practices adjust to the principle that breastfeeding should begin within the first hour after birth (even for Cesarean deliveries) and that infants must be continuously accessible to the mother by rooming-in

TABLE 4 WHO/UNICEF Ten Steps to Successful Breastfeeding

1. Have a written breastfeeding policy that is routinely communicated to all health care staff.
2. Train all health care staff in the skills necessary to implement this policy.
3. Inform all pregnant women about the benefits and management of breastfeeding.
4. Help mothers initiate breastfeeding within the first hour of birth.
5. Show mothers how to breastfeed and how to maintain lactation even if they are separated from their infants.
6. Give newborn infants no food or drink other than breast milk, unless medically indicated.
7. Practice rooming-in (allow mothers and infants to remain together) 24 h a day.
8. Encourage breastfeeding on demand.
9. Give no artificial nipples or pacifiers to breastfeeding infants.[a]
10. Foster the establishment of breastfeeding support groups and refer mothers to them on discharge from hospital.

[a] The AAP does not support a categorical ban on pacifiers because of their role in SIDS risk reduction and their analgesic benefit during painful procedures when breastfeeding cannot provide the analgesia. Pacifier use in the hospital in the neonatal period should be limited to specific medical indications such as pain reduction and calming in a drug-exposed infant, for example. Mothers of healthy term breastfed infants should be instructed to delay pacifier use until breastfeeding is well-established, usually about 3 to 4 wk after birth.

arrangements that facilitate around-the-clock, on-demand feeding for the healthy infant. Formal staff training should not only focus on updating knowledge and techniques for breastfeeding support but also should acknowledge the need to change attitudes and eradicate unsubstantiated beliefs about the supposed equivalency of breastfeeding and commercial infant formula feeding. Emphasis should be placed on the numerous benefits of exclusive breastfeeding. The importance of addressing the issue of the impact of hospital practices and policies on breastfeeding outcomes is highlighted by the decision of The Joint Commission to adopt the rate of exclusive breast milk feeding as a Perinatal Care Core Measure.[127] As such, the rate of exclusive breastfeeding during the hospital stay has been confirmed as a critical variable when measuring the quality of care provided by a medical facility.

Pacifier Use

Given the documentation that early use of pacifiers may be associated with less successful breastfeeding, pacifier use in the neonatal period should be limited to specific medical situations.[128] These include uses for pain relief, as a calming agent, or as part of structured program for enhancing oral motor function. Because pacifier use has been associated with a reduction in SIDS incidence, mothers of healthy term infants should be instructed to use pacifiers at infant nap or sleep time after breastfeeding is well established, at approximately 3 to 4 weeks of age.[129–131]

Vitamins and Mineral Supplements

Intramuscular vitamin K_1 (phytonadione) at a dose of 0.5 to 1.0 mg should routinely be administered to all infants on the first day to reduce the risk of hemorrhagic disease of the newborn.[132] A delay of administration until after the first feeding at the breast but not later than 6 hours of age is recommended. A single oral dose of vitamin K should not be used, because the oral dose is variably absorbed and does not provide adequate concentrations or stores for the breastfed infant.[132]

Vitamin D deficiency/insufficiency and rickets has increased in all infants as a result of decreased sunlight exposure secondary to changes in lifestyle, dress habits, and use of topical sunscreen preparations. To maintain an adequate serum vitamin D concentration, all breastfed infants routinely should receive an oral supplement of vitamin D, 400 U per day, beginning at hospital discharge.[133]

Supplementary fluoride should not be provided during the first 6 months. From age 6 months to 3 years, fluoride supplementation should be limited to infants residing in communities where the fluoride concentration in the water is <0.3 ppm.[134] Complementary food rich in iron and zinc should be introduced at about 6 months of age. Supplementation of oral iron drops before 6 months may be needed to support iron stores.

Premature infants should receive both a multivitamin preparation and an oral iron supplement until they are ingesting a completely mixed diet and their growth and hematologic status are normalized.

GROWTH

The growth pattern of healthy term breastfed infants differs from the existing CDC "reference" growth curves, which are primarily based on data from few breastfeeding infants. The WHO multicenter curves are based on combined longitudinal data from healthy breastfed infants from birth to 24 months and cross-sectional data from 2 to 5 years of the same children from 6 diverse geographical areas

TABLE 5 Recommendations on Breastfeeding Management for Healthy Term Infants

1. Exclusive breastfeeding for about 6 mo
   - Breastfeeding preferred; alternatively expressed mother's milk, or donor milk
   - To continue for at least the first year and beyond for as long as mutually desired by mother and child
   - Complementary foods rich in iron and other micronutrients should be introduced at about 6 mo of age
2. Peripartum policies and practices that optimize breastfeeding initiation and maintenance should be compatible with the AAP and Academy of Breastfeeding Medicine Model Hospital Policy and include the following:
   - Direct skin-to-skin contact with mothers immediately after delivery until the first feeding is accomplished and encouraged throughout the postpartum period
   - Delay in routine procedures (weighing, measuring, bathing, blood tests, vaccines, and eye prophylaxis) until after the first feeding is completed
   - Delay in administration of intramuscular vitamin K until after the first feeding is completed but within 6 h of birth
   - Ensure 8 to 12 feedings at the breast every 24 h
   - Ensure formal evaluation and documentation of breastfeeding by trained caregivers (including position, latch, milk transfer, examination) at least for each nursing shift
   - Give no supplements (water, glucose water, commercial infant formula, or other fluids) to breastfeeding newborn infants unless medically indicated using standard evidence-based guidelines for the management of hyperbilirubinemia and hypoglycemia
   - Avoid routine pacifier use in the postpartum period
   - Begin daily oral vitamin D drops (400 IU) at hospital discharge
3. All breastfeeding newborn infants should be seen by a pediatrician at 3 to 5 d of age, which is within 48 to 72 h after discharge from the hospital
   - Evaluate hydration (elimination patterns)
   - Evaluate body wt gain (body wt loss no more than 7%
   from birth and no further wt loss by day 5: assess feeding and consider more frequent follow-up)
   - Discuss maternal/infant issues
   - Observe feeding
4. Mother and infant should sleep in proximity to each other to facilitate breastfeeding
5. Pacifier should be offered, while placing infant in back-to-sleep-position, no earlier than 3 to 4 wk of age and after breastfeeding has been established

(Brazil, Ghana, India, Norway, Oman, and the United States).[135] As such, the WHO curves are "standards" and are the normative model for growth and development irrespective of infant ethnicity or geography reflecting the optimal growth of the breastfed infant.[136] Use of the WHO curves for the first 2 years allows for more accurate monitoring of weight and height for age and, in comparison with use of the CDC reference curves, results in more accurate (lower) rates of undernutrition and short stature and (higher) rates of overweight. Furthermore, birth to 6-month growth charts are available where the curves are magnified to permit monitoring of weight trajectories. As such, the WHO curves serve as the best guide for assessing lactation performance because they minimize mislabeling clinical situations as inadequate breastfeeding and identify more accurately and promptly overweight and obese infants. As of September 2010, the CDC, with the concurrence of the AAP, recommended the use of the WHO curves for all children younger than 24 months.[137,138]

ROLE OF THE PEDIATRICIAN

Pediatricians have a critical role in their individual practices, communities, and society at large to serve as advocates and supporters of successful breastfeeding (Table 6).[139] Despite this critical role, studies have demonstrated lack of preparation and knowledge and declining attitudes regarding the feasibility of breastfeeding.[140] The AAP Web site[141] provides a wealth of breastfeeding-related material and resources to assist and support pediatricians in their critical role as advocates of infant well-being. This includes the Safe and Healthy Beginnings toolkit,[5] which includes resources for physician's office for promotion of breastfeeding in a busy pediatric practice setting, a pocket guide for coding to facilitate appropriate payment, suggested guidelines for telephone triage of maternal breastfeeding concerns, and information regarding employer support for breastfeeding in the workplace. Evidence-based protocols from organizations such as the Academy of Breastfeeding Medicine provide detailed clinical guidance for management of specific issues, including the recommendations for frequent and unrestricted time for breastfeeding so as to minimize hyperbilirubinemia and hypoglycemia.[4,142,143] The critical role that pediatricians play is highlighted by the recommended health supervision visit at 3 to 5 days of age, which is within 48 to 72 hours after discharge from the hospital, as well as pediatricians support of practices that avoid non–medically indicated supplementation with commercial infant formula.[144]

Pediatricians also should serve as breastfeeding advocates and educators and not solely delegate this role to staff or nonmedical/lay volunteers. Communicating with families that breastfeeding is a medical priority that is enthusiastically recommended by their personal pediatrician will build support for mothers in the early weeks postpartum. To assist in the education of future physicians, the AAP recommends using the evidence-based Breastfeeding Residency Curriculum,[4] which has been demonstrated to improve knowledge, confidence, practice patterns, and breastfeeding rates. The pediatrician's own office-based practice should serve as a model for how to support breastfeeding in the workplace. The pediatrician should also take the lead in encouraging the hospitals with which he or she is affiliated to provide proper support and facilities for their employees who choose to continue to breastfeed.

TABLE 6 Role of the Pediatrician

1. Promote breastfeeding as the norm for infant feeding.
2. Become knowledgeable in the principles and management of lactation and breastfeeding.
3. Develop skills necessary for assessing the adequacy of breastfeeding.
4. Support training and education for medical students, residents and postgraduate physicians in breastfeeding and lactation.
5. Promote hospital policies that are compatible with the AAP and Academy of Breastfeeding Medicine Model Hospital Policy and the WHO/UNICEF "Ten Steps to Successful Breastfeeding."
6. Collaborate with the obstetric community to develop optimal breastfeeding support programs.
7. Coordinate with community-based health care professionals and certified breastfeeding counselors to ensure uniform and comprehensive breastfeeding support.

BUSINESS CASE FOR BREASTFEEDING

A mother/baby-friendly worksite provides benefits to employers, including a reduction in company health care costs, lower employee absenteeism, reduction in employee turnover, and increased employee morale and productivity.[145,146] The return on investment has been calculated that for every $1 invested in creating and supporting a lactation support program (including a designated pump site that guarantees privacy, availability of refrigeration and a handwashing facility, and appropriate mother break time) there is a $2 to $3 dollar return.[147] The Maternal and Child Health Bureau of the US Department of Health and Human Services, with support from the Office of Women's Health, has created a program, "The Business Case for Breastfeeding," that provides details of economic benefits to the employer and toolkits for the creation of such programs.[148] The Patient Protection and Affordable Care Act passed by Congress in March 2010 mandates that employers provide "reasonable break time" for nursing mothers and private non-bathroom areas to express

breast milk during their workday.[149] The establishment of these initiatives as the standard workplace environment will support mothers in their goal of supplying only breast milk to their infants beyond the immediate postpartum period.

CONCLUSIONS

Research and practice in the 5 years since publication of the last AAP policy statement have reinforced the conclusion that breastfeeding and the use of human milk confer unique nutritional and nonnutritional benefits to the infant and the mother and, in turn, optimize infant, child, and adult health as well as child growth and development. Recently, published evidence-based studies have confirmed and quantitated the risks of not breastfeeding. Thus, infant feeding should not be considered as a lifestyle choice but rather as a basic health issue. As such, the pediatrician's role in advocating and supporting proper breastfeeding practices is essential and vital for the achievement of this preferred public health goal.[35]

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Breastfeeding and the Use of Human Milk

SECTION ON BREASTFEEDING

Pediatrics 2012;129;e827; originally published online February 27, 2012;
DOI: 10.1542/peds.2011-3552

Hypoallergenic Infant Formulas

Committee on Nutrition

Pediatrics 2000;106;346

AMERICAN ACADEMY OF PEDIATRICS

Committee on Nutrition

Hypoallergenic Infant Formulas

ABSTRACT. The American Academy of Pediatrics is committed to breastfeeding as the ideal source of nutrition for infants. For those infants who are formula-fed, either as a supplement to breastfeeding or exclusively during their infancy, it is common practice for pediatricians to change the formula when symptoms of intolerance occur. Decisions about when the formula should be changed and which formula should be used vary significantly, however, among pediatric practitioners. This statement clarifies some of these issues as they relate to protein hypersensitivity (protein allergy), one of the causes of adverse reactions to feeding during infancy.

ABBREVIATION. IgE, immunoglobulin E.

Symptoms of food protein allergy include those commonly associated with immunoglobulin E (IgE)-associated reactions, such as angioedema, urticaria, wheezing, rhinitis, vomiting, eczema, and anaphylaxis.[1] Non–IgE-associated, immunologically mediated conditions have also been associated with the ingestion of cow's milk, soy, and other dietary proteins in infant feedings. These disorders include pulmonary hemosiderosis,[2] malabsorption with villous atrophy,[3] eosinophilic proctocolitis,[4] enterocolitis,[5] and esophagitis.[6] Finally, some infants may experience extreme irritability or colic as the only symptom of food protein allergy.[7] The prevalence in infancy of milk protein allergy is low—2% to 3%.[8–10] Thus, the use of hypoallergenic-labeled infant formulas, which cost as much as 3 times more than standard formulas, should be limited to infants with well-defined clinical indications. Adverse reactions to cow's milk associated with other conditions such as phenylketonuria and lactose intolerance may also be alleviated by the use of alternative formulas, although not necessarily those intended to treat infants with protein allergy.

FORMULA DEVELOPMENT AND LABELING

Before new potential hypoallergenic formulas are tested in trials using human infants, comprehensive preclinical testing must be conducted to examine for toxicity and suitability to maintain a positive nitrogen balance and to attempt to predict whether infants allergic to cow's milk will react adversely to them. This testing should include efforts to determine the molecular weight profile of residual peptides, the amount of immunologically recognizable material present, and the ability of the product to sensitize or provoke reactions in animal models of allergenicity.[11–14]

To establish the risk of hypersensitivity in infants, carefully conducted preclinical studies must be performed that demonstrate a formula may be hypoallergenic. The formula needs to be tested in infants with hypersensitivity to cow's milk or cow's milk-based formula and the findings verified by properly conducted elimination-challenge tests.[15] These tests should, at a minimum, ensure with 95% confidence that 90% of infants with documented cow's milk allergy will not react with defined symptoms to the formula under double-blind, placebo-controlled conditions.[16] Such formulas can be labeled hypoallergenic. If the formula being tested is not derived from cow's milk proteins, the formula must also be evaluated in infants or children with documented allergy to the protein from which the formula was derived. It is also recommended that after a successful double-blind challenge, the clinical testing should include an open challenge using an objective scoring system to document allergic symptoms during a period of 7 days.[16] This is particularly important to detect late-onset reactions to the formula.[17]

Any formula with residual peptides may provoke reactions in infants allergic to cow's milk.[17,18] Extensively hydrolyzed proteins derived from cow's milk, in which most of the nitrogen is in the form of free amino acids and peptides <1500 kDa, have been used in formulas for >50 years for infants with severe inflammatory bowel diseases or cow's milk allergy. These formulas, as well as the newer free amino acid-based formulas, have been subjected to extensive clinical testing and meet the standard for hypoallergenicity.[19–21]

Hypoallergenic formulas are intended for use by infants with existing allergic symptoms. Recently formulas have also been promoted to prevent the development of allergy in infants at high risk for developing allergic symptoms. The ability to determine which infants are at high risk is imperfect, although many markers, including elevated levels of cord blood IgE and serum IgE in infancy and an atopic family history, have been identified.[22] Because a family history of allergy is at least as sensitive and specific as any other marker,[23] infants from families with a history of allergy should serve as the study participants in clinical testing of formulas that claim the ability to prevent allergy from developing. These infants should be fed the formula exclusively from birth for at least 6 months under the conditions of a

The recommendations in this statement do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

controlled, randomized study and observed for at least 12 additional months. Allergic symptoms during the period of observation should be documented with a validated clinical scoring system and allergic symptoms verified by double-blind, placebo-controlled testing. When compared with infants fed a standard cow's milk formula, infants fed formulas that claim to prevent or delay allergy should have a statistically significant lower prevalence of allergy at the end of the observation period.[16]

CLINICAL PRACTICE TREATMENT

Breast milk is the optimal sole source of nutrition for healthy infants for the first 6 months of life. Breastfeeding should be continued for the first 12 months of life or longer. Although the incidence of food allergy is very low in breastfed infants compared with formula-fed infants, rare cases of anaphylaxis to cow's milk proteins have been reported in those breastfed as well as more frequent cases of cow's milk-induced proctocolitis.[24–26] The pathophysiology of these reactions in the breastfed infant is not well-understood. However, immunologically recognizable proteins from the maternal diet can be found in breast milk.[27,28]

Elimination of cow's milk, eggs, fish, peanuts and tree nuts, and other foods from the maternal diet may lead to resolution of allergic symptoms in the nursing infant. For those infants whose symptoms do not improve or whose mothers are unable to participate in a very restricted diet regimen and for formula-fed infants with cow's milk allergy, alternative formulas can be used to relieve the symptoms.

In infants allergic to cow's milk, milk from goats and other animals[29] or formulas containing large amounts of intact animal protein are inappropriate substitutes for breast milk or cow's milk-based infant formulas. Soy formulas have a long history as alternative formulas in infants who are allergic. Eight to 14% of infants with symptoms of IgE-associated cow's milk allergy will also react adversely to soy,[30] but reports of anaphylaxis to soy are extremely rare. Those infants allergic to cow's milk and who do not have an adverse reaction at the start of feeding on a soy formula tolerate it very well.[31] Thus, although soy formulas are not hypoallergenic, they can be fed to infants with IgE-associated symptoms of milk allergy, particularly after the age of 6 months.[29] There is a significantly higher prevalence of concomitant reactions between cow's milk and soy proteins (25%–60%) among those infants with proctocolitis and enterocolitis[32] and therefore soy is not recommended for the treatment of infants with these non–IgE-associated syndromes.[31]

Formulas based on partially hydrolyzed cow's milk proteins (1000–100 000 times higher concentrations of intact cow's milk proteins compared with extensively hydrolyzed protein) have provoked significant reactions in a high percentage of infants allergic to cow's milk[33,34] and are not intended to be used to treat cow's milk allergy. Extensively hydrolyzed formulas have also provoked allergic reactions in infants allergic to cow's milk,[17,18] but at least 90% of these infants tolerate extensively hydrolyzed formulas as well as the more recently introduced free amino acid-based infant formulas. Although the majority of infants with colic will not respond to a hypoallergenic formula, those with severe colic may benefit from a 1- to 2-week trial of a hypoallergenic formula.[7]

PROPHYLAXIS

Recent studies, one a randomized and prospectively controlled study of preterm infants followed up for 18 months[35] and a second prospective nonrandomized and uncontrolled study of full-term infants followed up for 17 years,[36] have demonstrated that breastfeeding exclusively for at least 6 months reduces the risk of later respiratory allergic symptoms and eczema. Although many of the studies that have examined the ability of breastfeeding to delay or prevent allergic disease have significant methodologic shortcomings,[22,37] the total of these studies suggests that breastfeeding exclusively has a protective effect, at least in high-risk infants and particularly if it is combined with maternal avoidance of cow's milk, egg, fish, peanuts and tree nuts during lactation.

More definitive prospective studies of the use of alternative formulas for allergy prophylaxis in high-risk infants are needed. However, the prospective studies available that utilized blinded food challenges to confirm allergic symptoms suggest that asymptomatic formula-fed infants at high risk for allergy given alternatives to cow's milk formulas may have a lower future risk of allergic disease or delayed onset of allergic symptoms. In one recently reported study, infants at high risk for allergy fed an extensively hydrolyzed formula or breastfed infants whose mothers avoided cow's milk, egg, and peanuts and did not introduce these foods into their infants' diets had a reduced prevalence of all allergic disorders at 1 year compared with the control group fed a standard cow's milk formula.[38] However, at 7 years of age there were no differences in allergic respiratory symptoms between the 2 groups.

A recent meta-analysis of all prospective controlled trials of a partially hydrolyzed formula showed a significant prophylactic effect of the partially hydrolyzed formula on the development of atopic symptoms at 60 months of age.[39] The studies analyzed did not all include confirmation of allergic symptoms by blinded challenge. In the only prospective study of allergy prophylaxis in high-risk infants that compared a partially and extensively hydrolyzed formula, only the extensively hydrolyzed formula prevented the development of allergy during the first 18 months of life in high-risk infants.[40] The other comparison groups in this study were fed a cow's milk-based formula or were breastfed exclusively for more than 9 months. Solid feedings were delayed until 4 months of age, and eggs, cow's milk, and fish were eliminated from the mothers' diets and their introduction delayed in their infants' diets until after the first year of life. Randomized prospective studies of soy protein-based formulas have not shown a preventive effect of these formulas on the development of allergy in high-risk infants.[41,42] No

published studies have examined the effectiveness of free amino acid-based formulas on allergy prevention in high-risk infants.

CONCLUSION

Hypoallergenic formulas, like all formulas intended for infant feeding, must demonstrate nutritional suitability to support infant growth and development. To be labeled hypoallergenic, these formulas, after appropriate preclinical testing, must demonstrate in clinical studies that they do not provoke reactions in 90% of infants or children with confirmed cow's milk allergy with 95% confidence when given in prospective randomized, double-blind, placebo-controlled trials.

Extensively hydrolyzed and free amino acid-based formulas have been subjected to such studies and are hypoallergenic. Currently available, partially hydrolyzed formulas are not hypoallergenic. Carefully conducted randomized controlled studies in infants from families with a history of allergy must be performed to support a formula claim for allergy prevention. Allergic responses must be established prospectively, evaluated with validated scoring systems, and confirmed by double-blind, placebo-controlled challenge. These studies should continue for at least 18 months and preferably for 60 to 72 months or longer where possible.

RECOMMENDATIONS

1. Breast milk is an optimal source of nutrition for infants through the first year of life or longer. Those breastfeeding infants who develop symptoms of food allergy may benefit from:
   a) maternal restriction of cow's milk, egg, fish, peanuts and tree nuts and if this is unsuccessful,
   b) use of a hypoallergenic (extensively hydrolyzed or if allergic symptoms persist, a free amino acid-based formula) as an alternative to breastfeeding. Those infants with IgE-associated symptoms of allergy may benefit from a soy formula, either as the initial treatment or instituted after 6 months of age after the use of a hypoallergenic formula. The prevalence of concomitant is not as great between soy and cow's milk in these infants compared with those with non–IgE-associated syndromes such as enterocolitis, proctocolitis, malabsorption syndrome, or esophagitis. Benefits should be seen within 2 to 4 weeks and the formula continued until the infant is 1 year of age or older.
2. Formula-fed infants with confirmed cow's milk allergy may benefit from the use of a hypoallergenic or soy formula as described for the breastfed infant.
3. Infants at high risk for developing allergy, identified by a strong (biparental; parent, and sibling) family history of allergy may benefit from exclusive breastfeeding or a hypoallergenic formula or possibly a partial hydrolysate formula. Conclusive studies are not yet available to permit definitive recommendations. However, the following recommendations seem reasonable at this time:
   a) Breastfeeding mothers should continue breastfeeding for the first year of life or longer. During this time, for infants at risk, hypoallergenic formulas can be used to supplement breastfeeding. Mothers should eliminate peanuts and tree nuts (eg, almonds, walnuts, etc) and consider eliminating eggs, cow's milk, fish, and perhaps other foods from their diets while nursing. Solid foods should not be introduced into the diet of high-risk infants until 6 months of age, with dairy products delayed until 1 year, eggs until 2 years, and peanuts, nuts, and fish until 3 years of age.
   b) No maternal dietary restrictions during pregnancy are necessary with the possible exception of excluding peanuts;
4. Breastfeeding mothers on a restricted diet should consider the use of supplemental minerals (calcium) and vitamins.

ACKNOWLEDGMENT

The technical assistance of and review by the Section on Allergy and Immunology Executive Committee is appreciated.

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Iron Fortification of Infant Formulas

Committee on Nutrition

Pediatrics 1999;104;119

AMERICAN ACADEMY OF PEDIATRICS

Committee on Nutrition

Iron Fortification of Infant Formulas

ABSTRACT. Despite the American Academy of Pediatrics' (AAP) strong endorsement for breastfeeding, most infants in the United States are fed some infant formula by the time they are 2 months old. The AAP Committee on Nutrition has strongly advocated iron fortification of infant formulas since 1969 as a way of reducing the prevalence of iron-deficiency anemia and its attendant sequelae during the first year.[1] The 1976 statement titled "Iron Supplementation for Infants" delineated the rationale for iron supplementation, proposed daily dosages of iron, and summarized potential sources of iron in the infant diet.[2] In 1989, the AAP Committee on Nutrition published a statement that addressed the issue of iron-fortified infant formulas[3] and concluded that there was no convincing contraindication to iron-supplemented formulas and that continued use of "low-iron" formulas posed an unacceptable risk for iron deficiency during infancy. The current statement represents a scientific update and synthesis of the 1976 and 1989 statements with recommendations about the use of iron-fortified and low-iron formulas in term infants.

ABBREVIATION. FDA, Food and Drug Administration.

IRON REQUIREMENTS DURING THE FIRST YEAR: INTAKE, ABSORPTION, AND LOSSES

At birth, most term infants have 75 mg of elemental iron per kilogram of body weight, found primarily as hemoglobin (75%), but also as storage (15%) and tissue protein iron (10%).[4] Infants of mothers with poorly controlled diabetes and small-for-gestational-age infants have approximately 10% and 40% of normal storage iron, respectively, meaning that they may have less of a buffer for protection from postnatal iron deficiency.[5,6]

During the first 4 postnatal months, excess fetal red blood cells break down and the infant retains the iron. This iron is used, along with dietary iron, to support the expansion of the red blood cell mass as the infant grows. The estimated iron requirement of the term infant to meet this demand and maintain adequate stores is 1 mg/kg per day.[1]

Because more than 80% of the iron of the newborn term infant is accreted during the third trimester of gestation, infants born before term must accrete more iron postnatally to "catch up" to their term counterparts during the first year. Thus, the requirements for preterm infants range from 2 mg/kg per day for infants with birth weights between 1500 and 2500 g[2] to 4 mg/kg per day for infants weighing less than 1500 g at birth.[7] Preterm infants who receive erythropoietin in lieu of red blood cell transfusions appear to need at least 6 mg/kg per day of iron.[8]

Daily iron dosing recommendations can only be estimates because they represent the "supply side" of iron economics. Multiple postingestion variables alter the amount of metabolizable iron ultimately absorbed and retained by the infant. The greatest of these factors is the percentage of iron absorbed from the diet. Estimates of iron absorption from infant formulas range from less than 5% in term infants fed casein-predominant formula to 40% in very low birth weight infants fed whey-predominant formula.[9–11] Values of 7% to 12% appear to be most representative for term infants fed cow milk formula, with the lower values seen when formulas supplemented with higher concentrations of iron are used.[11] The percentage of iron absorbed from soy formula is lower than from cow milk formula and ranges from less than 1% to 7%.[12] Nevertheless, infants fed soy formula containing 12 mg/L of iron remain comparably iron sufficient to infants fed iron-fortified cow milk formula.[12]

Factors such as the milk source of iron (eg, human vs cow), type of iron compound consumed, the food with which it is eaten, and the iron status of the infant greatly affect iron absorption. For example, greater than 50% of iron from human milk is absorbed compared with typically less than 12% of iron from cow milk–derived formula. In the older infant, iron from meat sources and iron from ferrous sulfate is better absorbed than iron from nonmeat sources or in its pyrophosphate form. Infants with poorer iron status or in negative iron balance absorb a higher percentage of dietary iron. Potential iron losses (such as occult gastrointestinal bleeding associated with exposure to cow milk protein or infectious agents) must also be considered. Larger dietary doses will be necessary under those conditions to maintain iron balance.

THE RATIONALE FOR IRON-FORTIFIED INFANT FORMULAS

The American Academy of Pediatrics' Committee on Nutrition stated more than a quarter century ago that "the early use of fortified formula results in augmentation of iron stores which help prevent later development of iron deficiency."[1] The strategy to improve iron stores during the first year was a response to the high rates of iron deficiency before the 1970s when the rate of cow milk consumption during the first year and the concordant rate of iron defi-

The recommendations in this statement do not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

ciency were unacceptably high. The strategy was designed to promote at least neutral but preferably positive iron balance after 4 months of age. The rationale for no net loss in iron balance is clear, because humans have relatively low amounts of iron stores compared with total body iron. Thus, there is a relatively small buffer zone to protect developing tissues, such as the brain, heart, skeletal muscle, and gastrointestinal tract, from iron deficiency.

The increased use of iron-fortified infant formulas from the early 1970s to the late 1980s has been a major public health policy success. During the early 1970s, formulas were fortified with 10 mg/L to 12 mg/L of iron in contrast with nonfortified formulas that contained less than 2 mg/L of iron. The rate of iron-deficiency anemia dropped dramatically during that time from more than 20% to less than 3%.[3,13] Nevertheless, *low-iron* formulas, defined by the US Food and Drug Administration (FDA) as containing less than 6.7 mg/L of iron, continue to be available and account for 9% to 30% of elective (non-Women, Infants, and Children program) formula consumption in the United States. Currently, most infants in the United States are not breastfed beyond 3 months of age. Therefore, the number of infants who could potentially receive low-iron formula (or cow milk) during late infancy remains high.

Although anemia is the endpoint of most studies of infant iron supplementation, the physiologic deficits of iron deficiency are apparently not attributable solely to the anemia. The onset of nonheme tissue effects of iron deficiency predate the onset of anemia because the body prioritizes iron for heme synthesis. When iron supply during the first year does not meet the iron demand of the rapidly expanding red blood cell mass, first iron stores in the liver and then nonstorage iron in other tissues will be compromised.[14] These changes take place before any hematologic findings are evident. The nonheme effects, thought to be attributable in part to reduction of iron-containing cellular proteins, are responsible for many of the clinical manifestations of iron deficiency. The combination of hematologic and nonhematologic iron deficiency produces clinical symptoms of weakness, muscle fatigue, abnormal gastrointestinal motility, and, of most concern, permanent reduction of cognitive ability.[14,15]

Because of the prioritization toward the hematopoietic system, many infants consuming low-iron formula who have reduced iron stores or frank tissue iron deficiency will not be given a diagnosis of iron deficiency because they are not anemic when their hemoglobin is routinely assayed at 9 months of age. Studies that assess the iron storage capacity of the infant (serum ferritin) or the infant's compensatory response to reduced iron availability (increased iron binding capacity) are not routinely performed during infancy. Thus, early warning signs of negative iron balance are missed.

IRON CONCENTRATIONS IN LOW-IRON VERSUS IRON-FORTIFIED COW MILK FORMULAS

Infant formulas have been classified as low-iron or iron-fortified based on whether they contain less or more than 6.7 mg/L of iron. Nevertheless, traditional low-iron formula contains the amount of iron inherent to the cow milk plus a small amount added for stabilization during formulation. This results in iron concentrations of approximately 1.1 mg/L to 1.5 mg/L of iron. Recently, one manufacturer increased the iron concentration of low-iron formula to 4.5 mg/L.

In contrast with low-iron formulas, iron-fortified formulas signified a conscious attempt to "fortify" the infant's iron stores to protect against the later development of iron deficiency. In the United States, iron concentrations of iron-fortified formulas range from 10 mg/L to 12 mg/L. In Europe, infant formula tends to contain 4 mg/L to 7 mg/L of iron.

Determining the acceptable range of iron concentration in infant formula depends on what standard is used to assess iron sufficiency. The most common approach is to document the prevalence of iron deficiency in populations of infants fed formulas with various iron concentrations with a target of ensuring that all infants are protected from iron deficiency. Numerous studies have documented the unequivocal reduction in iron deficiency (clinical and subclinical) in infants fed iron-fortified vs low-iron formula.[13,16,17] The rate of iron deficiency anemia in 9-month-old infants fed formulas containing 1.1 mg/L of iron has ranged from 28% to 38%,[16,17] even when supplemental foods are consumed. This unacceptably high rate decreases to 0.6% when formula fortified with 12 mg/L or 15 mg/L of iron is used.[16,17] Recently, Fomon et al[18] demonstrated similar iron status in infants fed formula containing 8 mg/L or 12 mg/L of iron. Fewer studies have assessed the long-term effect of intermediate formula iron concentrations (4 mg/L to 7 mg/L) on iron status. Lonnerdal and Hernell[19] recently reported a trend toward higher ferritin concentrations and lower transferrin receptor concentrations in infants fed a cow milk–based formula containing 7 mg/L of iron compared with a group fed a formula containing 4 mg/L. These data suggest that iron balance is stressed by the formulas with lower iron concentration and that iron stores are better in the more highly supplemented group, although there were no differences in hemoglobin at the relatively early study endpoint of 6 months of age. There appeared to be no adverse effect on copper or zinc status in the more highly supplemented iron group.

Hokama[20] estimated that breastfed 4- to 5-month-old infants retain 0.06 mg/kg per day of iron from that source. Using 0.06 mg/kg per day of iron as a target accretion rate assumes that the prevalence of iron deficiency in human milk–fed infants is acceptably low. In studies in which infants were exclusively breastfed, the prevalence of decreased iron stores appears to range between 6% and 20%,[21,22] suggesting that this rate of daily iron accretion may be near the lower borderline of promoting iron sufficiency. Assuming a 12% absorption rate,[11] an infant consuming 130 mL/kg per day of low-iron cow milk formula containing 1.5 mg/L of iron would retain only 0.02 mg/kg of iron daily. Conversely, even with an absorption rate as low as 7%, an infant consuming

a formula fortified with 12 mg/L of iron will retain 0.06 mg/kg of iron per day.

A relatively small percentage of infants continues to be nourished predominantly by formulas made at home by using evaporated milk as the base and fortifying with additional sugar in the form of glucose polymers. These formulas would have the same low-iron availability of nonformula cow milk. Therefore, infants receiving these formulas should receive exogenous iron supplementation from the time of birth to ensure maintenance of iron storage pools as the infant grows.

CAUSES OF RESISTANCE TO THE USE OF IRON-FORTIFIED FORMULAS

The persistent use of low-iron formulas despite recommendations of the American Academy of Pediatrics and multiple studies supporting the use of iron-fortified formulas suggests that the reasons for continued use may be multifactorial and largely nonmedical. Four issues appear to influence physician-prescribing and consumer-buying practices: 1) the perception that iron fortification causes gastrointestinal or infectious problems, 2) the continued availability of low-iron products to consumers, 3) the low-iron concentration of human milk, and 4) the Infant Formula Act requirement that the phrase "with iron" be prominently displayed on the front label of iron-fortified formula containers.

IRON FORTIFICATION AND GASTROINTESTINAL DISTRESS

There is a misconception by some health professionals and parents that infants fed iron-fortified formulas have more gastrointestinal distress, such as colic, constipation, diarrhea, or gastroesophageal reflux. Of these, constipation and irritability appear to be the most common concern. An association between iron and constipation is appealing to mothers who remember the association between taking prenatal iron in large doses and changes in their own gastrointestinal tract function when they were pregnant.

A controlled study by Oski[23] and a double-blind crossover study by Nelson et al[24] compared iron-fortified and low-iron formulas and found no differences in prevalence of fussiness, cramping, colic, gastroesophageal reflux, or flatulence. Moreover, therapeutic iron up to 6 mg/kg per day given to infants is well-tolerated.[25]

Although these studies are recognized by most pediatricians, dealing with the fussy baby and the frustrated mother who is convinced that the problem is due to iron in the formula remains difficult for some. Parental education (particularly anticipatory guidance) is laudable, yet it may remain temptingly easier to prescribe a low-iron formula, achieve a placebo effect, and ignore the more insidious long-term consequences of iron deficiency.

CONTINUED MANUFACTURE OF LOW-IRON FORMULAS

The low-iron formulas produced in the United States contain a range of 1.5 mg/L to 4.5 mg/L of iron, well below the cutoff of 6.7 mg/L as defined by the FDA. All formula manufacturers in the United States who produce low-iron formulas have attempted through their field representatives to discourage the use of formulas that are deficient in iron. Nevertheless, these formulas account for 9% to 30% of elective infant formula sales in the United States. Manufacturers appear reluctant to unilaterally discontinue providing a product for which there is substantial consumer demand. This impasse is unlikely to be resolved without a change in FDA regulations implemented in the Infant Formula Act.

HUMAN MILK IS LOW IN IRON

Some physicians rationalize the prescription of low-iron formula by stating that the concentration of iron in human milk is approximately 20% of that found in low-iron cow milk formula (0.3 mg/L vs 1.5 mg/L). Iron found in human milk is far more bioavailable, resulting in much lower rates of iron-deficiency anemia compared with low-iron cow milk formula. Nevertheless, 6% to 20% of exclusively breastfed infants remain at risk for reduced iron stores.[21,22] A higher rate (20%–30%) of iron deficiency has been reported in breastfed infants who were not exclusively breastfed.[17,21] The effect of iron obtained from formula or beikost supplementation on the iron status of the breastfed infant remains largely unknown and needs further study.

LABELING REQUIREMENTS

The Infant Formula Act required that formulas fortified with greater than 6.7 mg/L of iron be labeled "with iron." Initially, this label was a positive message because iron fortification was considered desirable given the prevalence of iron deficiency in the population. Over time, however, this type of labeling has come to function as a reminder of the presence of iron in the formula, making it a convenient scapegoat for the many aspects of infant formula intolerance. No other nutrient, supplemented or in natural abundance, in cow milk formula receives special consideration on the front label. It may be appropriate to remove the term "with iron" from the front label of the iron-fortified formulas. Instead, formulas with iron concentrations that promote negative iron balance could be labeled as "nutritionally incomplete," with a warning that "this formula is not a complete diet for your infant because it lacks sufficient iron and may lead to iron deficiency."

POTENTIAL CONTRAINDICATIONS TO IRON-FORTIFIED FORMULAS

There are no known medical contraindications to using iron-fortified formulas in formula-fed infants. In light of controlled studies,[23,24] gastrointestinal symptoms are not an indication for switching to a low-iron formula. The condition of the rare infant with an iron overload syndrome can be carefully monitored. However, the dose of iron received from human milk or infant formula is minute in comparison with the total body iron load. Because these infants undergo chelation therapy, the additional iron received from infant formula that then needs to

be chelated is negligible in determining the chelator dose.

A theoretical concern has been raised about the use of iron-fortified formulas as supplements for breastfed infants.[26] The proposed mechanism is that the higher iron content of iron-fortified formulas may saturate lactoferrin, a protein important in protecting the intestine from overgrowth with *Escherichia coli*. Infants fed iron-fortified formula, partially breastfed infants supplemented with iron-fortified formula, and exclusively breastfed infants who receive iron supplements may have a higher prevalence of *E coli* in the fecal flora compared with exclusively breastfed infants who receive no iron supplementation. In the latter, lactobacillus predominates.[27] The physiologic significance of this difference in flora with respect to diarrheal disease remains to be shown. A recent study demonstrated no evidence of increased diarrhea in breastfed infants supplemented with iron-fortified formula compared with those supplemented with low-iron formula.[28] The conclusions of this study were somewhat clouded by the lack of measurement of the amount of formula supplementation and whether iron containing beikost or vitamins was consumed. A well-controlled, dose-response study of iron-fortified infant formula supplementation of breastfed infants with infection and iron endpoints is needed to resolve this issue. Because no data currently support the use of a low-iron formula as an alternative supplement for breastfed infants and low-iron formula is associated with an unacceptably high risk of iron deficiency, the Committee on Nutrition recommends the use of iron-fortified cow milk or soy formula as a supplement for breastfed infants whose mothers choose not to exclusively breastfeed.

CONCLUSIONS

1. Iron sufficiency is important for normal human growth and development.
2. The goal of early iron supplementation is to meet the rapidly growing child's need for hemoglobin and tissue iron and to fortify iron stores in anticipation of later switching to an iron-poor cow milk–based diet. The use of iron-fortified formulas has dramatically reduced the rate of iron-deficiency anemia during infancy in the last 25 years.
3. Infants who were growth retarded in utero or were born to mothers with poorly controlled diabetes have reduced iron stores at birth and may require further iron supplementation.
4. Formula-fed infants receiving iron-fortified formula (up to 12 mg/L) during their first year have greater assurance of adequate iron stores and very low rates of iron deficiency between 6 and 18 months of age.
5. Barriers to the use of iron-fortified formula include unsubstantiated fears of gastrointestinal distress, availability of low-iron formula, inappropriate comparisons with the iron content of human milk, and inadequate and potentially misleading rules related to formula labeling.
6. There are no known medical contraindications to iron-fortified formulas (eg, iron overload syndromes, colic, constipation, cramps, or gastroesophageal reflux).

RECOMMENDATIONS

1. In the absence of underlying medical factors (which are rare), human milk is the preferred feeding for all infants.
2. Infants who are not breastfed or are partially breastfed should receive an iron-fortified formula (containing between 4.0–12 mg/L of iron) from birth to 12 months. Ideally, iron fortification of formulas should be standardized based on long-term studies that better define iron needs in this range.
3. The manufacture of formulas with iron concentrations less than 4.0 mg/L should be discontinued. If these formulas continue to be made, low-iron formulas should be prominently labeled as potentially nutritionally inadequate with a warning specifying the risk of iron deficiency. These formulas should not be used to treat colic, constipation, cramps, or gastroesophageal reflux.
4. If low-iron formula continues to be manufactured, iron-fortified formulas should have the term "with iron" removed from the front label. Iron content information should be included in a manner similar to all other nutrients on the package label.
5. Parents and health care clinicians should be educated about the role of iron in infant growth and cognitive development, as well as the lack of data about negative side effects of iron and current fortification levels.

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Pediatrics 1999;104;119

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Use of Soy Protein-Based Formulas in Infant Feeding

Jatinder Bhatia and Frank Greer

Pediatrics 2008;121;1062
DOI: 10.1542/peds.2008-0564

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CLINICAL REPORT

Use of Soy Protein-Based Formulas in Infant Feeding

Guidance for the Clinician in Rendering Pediatric Care

Jatinder Bhatia, MD, Frank Greer, MD, and the Committee on Nutrition

ABSTRACT

Soy protein-based formulas have been available for almost 100 years. Since the first use of soy formula as a milk substitute for an infant unable to tolerate a cow milk protein-based formula, the formulation has changed to the current soy protein isolate. Despite very limited indications for its use, soy protein-based formulas in the United States may account for nearly 25% of the formula market. This report reviews the limited indications and contraindications of soy formulas. It will also review the potential harmful effects of soy protein-based formulas and the phytoestrogens contained in these formulas.

www.pediatrics.org/cgi/doi/10.1542/peds.2008-0564

doi:10.1542/peds.2008-0564

Key Words
soy protein, infant formula, infant feeding, cow milk protein allergy, nutrition, galactosemia, vegetarian

Abbreviations
AAP—American Academy of Pediatrics
IgE—immunoglobulin E

THE AMERICAN ACADEMY of Pediatrics (AAP) is committed to the use of human milk as the ideal source of nutrition for infant feeding. However, by 2 months of age, the majority of infants in North America are receiving at least some formula. Soy-based infant formulas have been available for almost 100 years.[1] Despite limited indications, soy protein-based formula accounts for approximately 20% of the formula market in the United States. Because an infant formula provides a source of nutrition for an extended interval, its nutritional adequacy must be proven, and the indications for its use must be substantiated and well understood. This statement updates the 1998 AAP review of soy protein-based formulas and addresses the ongoing concern of phytoestrogens in soy formulas.

COMPOSITION

Isolated soy protein-based formulas currently on the market are all free of cow milk protein and lactose and provide 67 kcal/dL. All are iron-fortified and meet the vitamin, mineral, and electrolyte specifications addressed in the 2004 guidelines from the AAP for feeding term infants[2] and established by the US Food and Drug Administration.[3] The protein is a soy isolate supplemented with L-methionine, L-carnitine, and taurine to provide a protein content of 2.45 to 2.8 g per 100 kcal or 1.65 to 1.9 g/dL. The fat content of soy protein-based formulas is derived primarily from vegetable oils. The quantity of specific fats varies by manufacturer and is usually similar to those in the manufacturer's corresponding cow milk-based formula. The fat content ranges from 5.02 to 5.46 g per 100 kcal or 3.4 to 3.6 g/dL. The oils used include soy, palm, sunflower, olein, safflower, and coconut. Docosahexaenoic and arachidonic acids now are added routinely.

In formulas, carbohydrate sources are corn maltodextrin, corn syrup solids, and sucrose, with content ranging from 10.26 to 10.95 g per 100 kcal or 6.9 to 7.4 g/dL. Until 1980, mineral absorption from soy formulas was erratic because of poor stability of the suspensions and the presence of excessive soy phytates.[4] Because soy protein isolate formulas still contain 1.5% phytates, and up to 30% of the total phosphorus is phytate bound, they contain 20% more calcium and phosphorus than cow milk-based formulas and maintain the ratio of calcium to available phosphorus of 1.1 to 2.0:1. With the current formulations, bone mineralization, serum concentrations of calcium and phosphorus, and alkaline phosphatase concentrations in term infants through 12 months of age are equivalent to those observed in infants fed cow milk-based formulas.[5–7] Because soy phytates and fiber oligosaccharides also bind iron and zinc,[9] all soy-based formulas are fortified with iron and zinc.[8,9]

Phytoestrogens in Soy Protein-Based Formulas

Of the many heat-stable factors present in soy formulas, the phytoestrogens are of particular interest in human health. Phytoestrogens consist of several groups of nonsteroidal estrogens, including isoflavones. Isoflavones are commonly found in legumes, with the highest amount found in soybeans.[1,10] Concerns raised in relation to phytoestrogens/isoflavones include their potential negative effects on sexual development and reproduction, neurobehavioral development, immune function, and thyroid function. On the other hand, epidemiologic studies have

suggested a protective effect of isoflavones against a number of adult chronic diseases, including coronary heart disease and breast, endometrial, and prostate cancers.[11,12]

The structural similarity of phytoestrogens with 17-estradiol has prompted studies on the possible effects of soy isoflavones on reproductive function and growth. Numerous toxicity studies in rats have demonstrated some effects on estrogen-related tissues, but overall maternal reproductive function and fetal development were unaffected.[13–15] A recent study of the isoflavone genistein demonstrated adverse consequences of neonatal exposure in mice[16]; however, feeding of soy formula (and not individual components) has not demonstrated these adverse effects in animals.[17]

The possible effects of soy isoflavones on various forms of carcinogen-induced and estrogen-induced tumorigenesis have been investigated in animal models, but no clear conclusion can be drawn.[18,19] Soy diets were reported to stimulate growth of estrogen-dependent mammary tumors in mice in a dose-dependent manner.[20,21] Contrary to these results, phytoestrogens in typical dietary quantities were reported not to have estrogen-like activity in female ovariectomized macaque monkeys, but they antagonized estrogen-induced cellular proliferation in the breast.[22]

In humans, very limited data to date suggest that soy phytoestrogens have a low affinity for human postnatal estrogen receptors and low potency in bioassays.[23] The absorption, distribution, metabolism, and excretion of soy isoflavones vary, depending on age and gender and among cultural groups; interindividual variability has been documented in several studies.[24,25] However, differences in gender have been inconclusive.[26–28] Analysis of maternal and cord plasma and amniotic fluid indicates placental transfer of these compounds after soy consumption; no deleterious effects were discerned in the fetuses of Japanese mothers with relatively high soy consumption.[29]

Isoflavones are excreted in human milk, although the concentration is very low. The concentration of isoflavones in human milk reflects maternal diet, with omnivores demonstrating considerably lower concentrations of isoflavones compared with vegans.[30,31] Setchell and Cassidy[32] estimated that the amount of isoflavones ingested by infants fed soy-based formulas on a body weight basis exceeded those reported to increase the length of the menstrual cycle in adult women. However, an increased incidence of feminization in male infants[33] or an increased incidence of hypospadias in high soy-consuming populations[34] have not been observed. Even in infants fed soy-based formulas exclusively, the sulfate and glucuronide conjugates of phytoestrogens are identified in plasma, although both of these are rapidly excreted.[27] Data on reproductive health in young adults 20 to 34 years of age who had previously participated in a controlled feeding study of soy formula as infants demonstrated a longer duration of menstrual bleeding and greater discomfort in women exposed to soy as infants.[35] We cautioned against overinterpretation of their data, however, because there was no increase in menstrual blood flow in the women exposed to soy formula as infants and no statistically significant differences in >30 other outcome variables measured.[35]

Consumption of soy products by infants with congenital hypothyroidism complicates their management, as evidenced by a prolonged increase in thyroid-stimulating hormone when compared with infants not fed soy formula; the authors of 2 studies suggested closer monitoring and a possible need for an increased dose of levothyroxine.[36,37] In infants receiving replacement hormone, the phytates may interfere with the uptake of exogenous thyroid hormone by binding the thyroxine within the lumen, increasing fecal loss, and reducing the efficacy of oral thyroid hormone.[36,38] In an extensive review of the effects of soy protein and soybean isoflavones, little evidence was found that soy foods or isoflavones adversely affect thyroid function in iodine-replete individuals with euthyroidism.[39] This review also found that, similar to infants, adults with hypothyroidism may need additional doses of thyroid hormone with the concomitant use of soy foods because of the effects on absorption. Trials with dietary soy isoflavones have not reported adverse effects on thyroid function in rats.[40] These data suggest that there is a lack of sufficient evidence suggesting short-term or long-term adverse effects of soy consumption on endocrine function.

In summary, although studied by numerous investigators in various species, there is no conclusive evidence from animal, adult human, or infant populations that dietary soy isoflavones may adversely affect human development, reproduction, or endocrine function.

Aluminum in Soy Protein-Based Formulas

In 1996, the AAP issued a statement (since retired) on aluminum toxicity in infants and children and discussed the relatively high content of aluminum in soy-based formulas.[41] Although the aluminum content of human milk is 4 to 65 ng/mL, that of soy protein-based formula is 600 to 1300 ng/mL.[42,43] Mineral salts used in formula production are the source of the aluminum. Aluminum, which makes up 8% of the earth's crust as the third most common element, has no known biological function in humans.[43] The toxicity of aluminum is traced to increased deposition in bone and in the central nervous system, particularly in the presence of reduced renal function in preterm infants and children with renal failure. Because aluminum competes with calcium for absorption, increased amounts of dietary aluminum from isolated soy protein-based formula may contribute to the reduced skeletal mineralization (osteopenia) observed in preterm infants and infants with intrauterine growth retardation.[44] Term infants with normal renal function do not seem to be at substantial risk of developing aluminum toxicity from soy protein-based formulas.[42]

USE IN TERM AND PRETERM INFANTS

Numerous studies have documented normal growth and development in term neonates fed methionine-supplemented isolated soy protein-based formulas.[42,45–48] Average energy intakes in infants receiving soy protein-based

formulas are equivalent to those achieved with cow milk formulas.[42] In infants fed soy protein-based formulas, the serum albumin concentration, as a marker of nutritional adequacy, is normal,[46,49–51] and bone mineralization is equivalent to that documented with cow milk-based formulas in term infants.[5–7] Literature reviews and clinical studies of infants fed soy protein-based infant formulas raise no clinical concerns with respect to nutritional adequacy, sexual development, thyroid disease, immune function, or neurodevelopment.[1] Additional studies confirm that soy protein-based formulas do not interfere with normal immune responses to oral immunization with poliovirus vaccine.[52,53] The US Food and Drug Administration has approved these formulas as safe for use with infants.

On the other hand, soy protein-based formulas are not recommended for preterm infants. Serum phosphorus concentrations are lower, and alkaline phosphatase concentrations are higher in preterm infants fed soy protein-based formula than they are in preterm infants fed cow milk-based formula.[54,55] As anticipated from these observations, the degree of osteopenia is increased in infants with low birth weight receiving soy protein-based formulas.[50,56] Even with supplemental calcium and vitamin D, radiographic evidence of significant osteopenia was present in 32% of 125 preterm infants fed soy protein-based formula.[56] The cow milk protein-based formulas designed for preterm infants are clearly superior to soy protein-based formula for preterm infants.

USE IN DISORDERS OF CARBOHYDRATE METABOLISM

When strict dietary lactose elimination is required in the management of infants with galactosemia or primary lactase deficiency (extremely rare), soy protein-based formulas are safe and cost-effective. In addition, soy protein-based formulas can be a dietetic alternative for families wishing to avoid feeding their infants formulas containing animal products. Soy protein-based formulas with sucrose as the carbohydrate are contraindicated in sucrase-isomaltase deficiency and in hereditary fructose intolerance.

USE IN ACUTE DIARRHEA AND SECONDARY LACTASE DEFICIENCY

A number of studies have addressed the role of these formulas in the recovery from acute infantile diarrhea complicated by secondary or transient lactase deficiency. However, after immediate rehydration, most infants can be managed successfully with continued breastfeeding or standard cow milk or soy formula.[57,58] In an extensive review, Brown[57] noted that the dietary failure rate of lactose-containing formulas was 22%, whereas that of lactose-free formulas was 12%. In a study comparing human milk, cow milk-based formula, and soy protein-based formula, no difference was found in the rate of recovery from rotavirus or nonrotavirus diarrhea on the basis of nutritional therapy.[49] However, the duration of diarrhea has been reported to be shorter in infants receiving soy protein-based formula,[51,59] and the duration of liquid stools may also be reduced by adding additional soy polysaccharide fiber[60] or by resuming a mixed-staple diet.[61]

Lactose free and reduced lactose-containing cow milk formulas are now available and could be used for circumstances in which elimination or a reduction in lactose in the diet, respectively, is required. Because primary or congenital lactase deficiency is rare, very few individuals would require a total restriction of lactose. Lactose intolerance is more likely to be dose dependent. Thus, the use of soy protein-based lactose-free formulas for this indication should be restricted.

USE IN COLIC AND "FORMULA INTOLERANCE"

Perhaps the most common reason for use of soy formulas by infant care providers is for relief of perceived formula intolerance (spitting, vomiting, fussiness) or symptoms of colic. Colicky discomfort is described by the parents of 10% to 20% of infants during the first 3 months of age.[62] Although many factors have been implicated, parents frequently seek relief by changing infant formulas. Although some calming benefit can be attributed to the sucrose[63,64] and fiber content,[65] controlled trials of cow milk and soy protein-based formulas have not demonstrated a significant benefit from soy.[66,67] The value of parental counseling as to the cause and duration of colic seems greater than the value of switching to soy formula.[68] Because most colicky behavior diminishes spontaneously between 4 and 6 months of age, any intervention at that time can be credited anecdotally.

SEVERE GASTROINTESTINAL REACTIONS TO SOY FORMULA

As with cow milk protein-based formula, severe gastrointestinal reactions to soy protein-based formula have been described for >40 years[69] and encompass the full gamut of disease: enteropathy, enterocolitis, and proctitis. Small-bowel injury, a reversible celiac-like villus injury that produces an enteropathy with malabsorption, hypoalbuminemia, and failure to thrive, has been documented in at least 4 studies.[70–73] In case series of infantile food protein-induced enterocolitis caused by cow milk protein, 30% to 64% of infants had concomitant soy-induced enterocolitis,[74–77] with enterocolitis manifested by bloody diarrhea, ulcerations, and histologic features of acute and chronic inflammatory bowel disease.[69,75,78–80] Afflicted infants have responded to replacing the soy protein-based formula with a hydrolyzed protein formula. It is theorized that the intestinal mucosa damaged by cow milk allows increased uptake and, therefore, increased immunologic response to the subsequent soy antigen. Eosinophilic proctocolitis, a more benign variant of enterocolitis, also has been reported in infants receiving soy protein-based formula.[81,82]

These dietary protein-induced syndromes of enteropathy and enterocolitis, although clearly immunologic in origin, are not immunoglobulin E (IgE)-mediated, reflecting instead an age-dependent transient soy protein hypersensitivity. Because of the reported high frequency of sensitivity to both cow milk and soy antigens in infants, soy protein-based formulas are not indicated in

the management of documented cow milk protein-induced enteropathy or enterocolitis. Hydrolyzed protein formulas should be used for these infants. Most, but not all children, can resume soy protein consumption safely after 5 years of age.

SOY PROTEIN-BASED FORMULAS AND PREVENTION OF ATOPIC DISEASE

Any ingested large molecular weight protein is a potential antigen to the intestinal immune system, including soy protein. In soy protein isolate, 90% of the pulp-derived protein resides in 2 major heat-stable globulins: β-conglycin, with a molecular weight of 180 000; and glycinin, with a molecular weight of 320 000.[83] After enteric digestion, the number of potential antigens generated at the mucosal surface is enormous.[84] As a result, the in vitro demonstration of antigen-specific antibody can be difficult. The antigenicity of soy protein, suspected since 1934,[85] was documented in low-risk infants by Eastham et al in 1982.[86] Intrauterine sensitization has been documented by demonstrating antigen-specific antibody in human amniotic fluid.[87]

Recognizing that soy protein is antigenic does not mean that soy protein is highly allergenic. In a prospective study of healthy infants fed human milk, cow milk formula, or soy protein-based formula, Halpern et al[88] documented true allergic responses in 0.5% and 1.8% of infants to soy formula and cow milk formula, respectively. This frequency is consistent with the summary by Fomon[89] that in 3 decades of study of soy protein-based formulas, <1% of soy formula-fed infants had adverse reactions. In a national survey of pediatric allergists, the occurrence of allergy to cow milk was reported at 3.4%, whereas allergy to soy protein was reported to be 1.1%.[90] Two large studies of infants with atopic dermatitis addressed the frequency with which a double-blind, placebo-controlled challenge with soy protein was positive. Sampson[91] documented a positive soy allergy in 5% of 204 patients, whereas Businco et al[92] implicated soy in 4% of 143 children.

In a recent meta-analysis of 5 randomized or quasi-randomized studies, the authors concluded that feeding with soy formula should not be recommended for the prevention of atopy in infants at high risk of developing allergy.[93] Furthermore, the use of soy protein-based formula during the first 3 months of age does not reduce the frequency of positive antibody responses to cow milk formula introduced later in infancy.[93] When human milk feeding is supplemented with soy formula in infants at high risk, the anticipated frequency of eczema by 2 years of age is not significantly reduced.[94,95] Interpretation of these data are obscured by multiple alterations in the maternal diet and by environmental stimuli. However, isolated soy protein-based formula has no advantage over cow milk-based formula for supplementing the diet of a breastfed infant.

Regarding soy proteins and other food allergies, in 1 partly prospective, partly retrospective study of the risk factors for the development of peanut allergy, feeding of soy milk or soy protein-based formula was associated with the development of peanut allergy (odds ratio: 2.6; 95% confidence interval: 1.3–5.2).[96] However, in a randomized trial of soy formula feeding in infants with cow milk allergy, there was no association between soy formula ingestion with the development of peanut allergy.[97] Thus, the evidence that soy formula feeding increases the risk of developing peanut allergy is contradictory, and additional study is warranted.

Sensitization to soy has been reported in 10% to 14% of infants with cow milk allergy.[98,99] One study documented similar adverse reactions to soy in IgE-associated and non-IgE-associated cow milk allergy (11% vs 9%).[99] A second study evaluated infants and children with IgE-associated cow milk allergy (ages 3–41 months), and 14% (95% confidence interval: 7.7–22.7) were determined to have soy allergy.[98] Thus, although most infants with IgE-mediated cow milk allergy will tolerate soy formula, because of the 10% to 14% crossover rate, the use of an extensively hydrolyzed protein formula rather than a soy formula may be considered in infants allergic to cow milk formula. Although reported in the literature, severe anaphylaxis after soy protein exposure is uncommon, especially in infants.[100,101]

SUMMARY

1. In term infants, although isolated soy protein-based formulas may be used to provide nutrition for normal growth and development, there are few indications for their use in place of cow milk-based formula. These indications include (*a*) for infants with galactosemia and hereditary lactase deficiency (rare) and (*b*) in situations in which a vegetarian diet is preferred.
2. For infants with documented cow milk protein allergy, extensively hydrolyzed protein formula should be considered, because 10% to 14% of these infants will also have a soy protein allergy.
3. Most previously well infants with acute gastroenteritis can be managed after rehydration with continued use of human milk or standard dilutions of cow milk-based formulas. Isolated soy protein-based formulas may be indicated when secondary lactose intolerance occurs.
4. Isolated soy protein-based formula has no advantage over cow milk protein-based formula as a supplement for the breastfed infant, unless the infant has 1 of the indications noted previously.
5. Soy protein-based formulas are not designed for or recommended for preterm infants.
6. The routine use of isolated soy protein-based formula has no proven value in the prevention or management of infantile colic or fussiness.
7. Infants with documented cow milk protein-induced enteropathy or enterocolitis frequently are as sensitive to soy protein and should not be given isolated soy protein-based formula. They should be provided formula derived from hydrolyzed protein or synthetic amino acids.

8. The routine use of isolated soy protein-based formula has no proven value in the prevention of atopic disease in healthy or high-risk infants.

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Use of Soy Protein-Based Formulas in Infant Feeding

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Pediatrics 2008;121;1062
DOI: 10.1542/peds.2008-0564

Position of the American Dietetic Association: Promoting and Supporting Breastfeeding

ABSTRACT

It is the position of the American Dietetic Association that exclusive breastfeeding provides optimal nutrition and health protection for the first 6 months of life and breastfeeding with complementary foods from 6 months until at least 12 months of age is the ideal feeding pattern for infants. Breastfeeding is an important public health strategy for improving infant and child morbidity and mortality, improving maternal morbidity, and helping to control health care costs. Breastfeeding is associated with a reduced risk of otitis media, gastroenteritis, respiratory illness, sudden infant death syndrome, necrotizing enterocolitis, obesity, and hypertension. Breastfeeding is also associated with improved maternal outcomes, including a reduced risk of breast and ovarian cancer, type 2 diabetes, and postpartum depression. These reductions in acute and chronic illness help to decrease health care-related expenses and productive time lost from work. Overall breastfeeding rates are increasing, yet disparities persist based on socioeconomic status, maternal age, country of origin, and geographic location. Factors such as hospital practices, knowledge, beliefs, and attitudes of mothers and their families, and access to breastfeeding support can influence initiation, duration, and exclusivity of breastfeeding. As experts in food and nutrition throughout the life cycle, it is the responsibility of registered dietitians and dietetic technicians, registered, to promote and support breastfeeding for its short-term and long-term health benefits for both mothers and infants.

J Am Diet Assoc. 2009;109: 1926-1942.

0002-8223/09/10911-0013$36.00/0
doi: 10.1016/j.jada.2009.09.018

This American Dietetic Association (ADA) position paper includes the authors' independent review of the literature in addition to systematic review conducted using ADA's Evidence Analysis Process and information from ADA's Evidence Analysis Library. Topics from the Evidence Analysis Library are clearly delineated. The use of an evidence-based approach provides important added benefits to earlier review methods. The major advantage of the approach is the more rigorous standardization of review criteria, which minimizes the likelihood of reviewer bias and increases the ease with which disparate articles may be compared. For a detailed description of the methods used in the Evidence Analysis Process, go to http://adaeal.com/eaprocess/.

Conclusion Statements are assigned a grade by an expert work group based on the systematic analysis and evaluation of the supporting research evidence. Grade I=Good; Grade II=Fair; Grade III=Limited; Grade IV=Expert Opinion Only; and Grade V=Not Assignable (because there is no evidence to support or refute the conclusion). Evidence-based information for this and other topics can be found at www.adaevidencelibrary.com and subscriptions for nonmembers are purchasable at www.adaevidencelibrary.com/store.cfm.

POSITION STATEMENT

It is the position of the American Dietetic Association that exclusive breastfeeding provides optimal nutrition and health protection for the first 6 months of life and breastfeeding with complementary foods from 6 months until at least 12 months of age is the ideal feeding pattern for infants. Breastfeeding is an important public health strategy for improving infant and child morbidity and mortality, and improving maternal morbidity, and helping to control health care costs.

With rare exceptions, breastfeeding, or lactation, is the optimal method for feeding and nurturing infants. Extensive research documents the significant advantages of breastfeeding for infants, mothers, families, and the environment. Breastfeeding involves primary and, to a lesser extent, secondary prevention of acute and chronic diseases. The benefits of breastfeeding include decreased infant and child morbidity and mortality, protection against common childhood infections, and decreased risk for certain acute and chronic diseases. Federal agencies and national professional associations in the United States recommend infants be exclusively breastfed for the first 6 months of life, and continue to breastfeed at least through the first year of life (1-6). In addition, the World Health Organization (WHO) and United Nations Children's Fund (UNICEF) recommend that every infant should be exclusively breastfed for the first 6 months of life, with breastfeeding continuing for up to 2 years of age or longer (7-9). Exclusive breastfeeding is defined as feeding the infant only breast milk, with no supplemental liquids or solids except for liquid medicine and vitamin/mineral supplements (9). The Bellagio Child Survival Study Group identified breastfeeding during the first year as one of the most important strategies for improving child survival (10-12). There also are extensive health benefits for breastfeeding mothers (7,8). The growth and development of breastfeeding infants is the standard by which all infants and children should be measured. New growth charts available from WHO

are based on breastfed infants as the normative growth model constituting good nutrition, health, and development (13). This is in contrast to the Centers for Disease Control and Prevention (CDC) growth charts that represent the growth patterns of breast- and formula-fed infants (14).

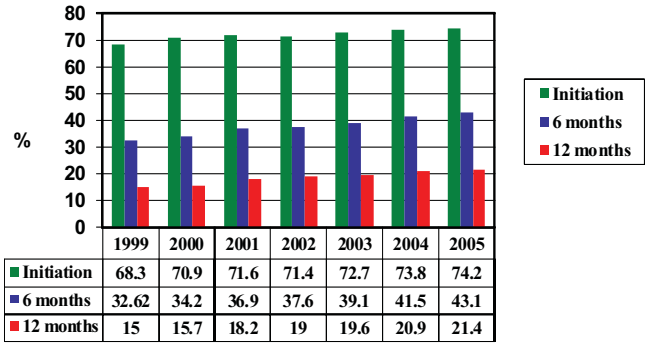
Portions of this position paper used the American Dietetic Association's (ADA's) Evidence Analysis Library (EAL) to address three questions:

- Which dietary factors would affect breast milk production, breast milk supply, or established lactation?
- What are the effects of an artificial nipple on the duration of breastfeeding?
- What are the effects of maternal diet or dietary supplements of n-3 fatty acids on breast milk composition and infant health outcomes?

For a detailed description of the methods used in the evidence analysis process, access ADA's Evidence Analysis Process information page at http://adaeal.com/eaprocess/.

BREASTFEEDING TRENDS IN THE UNITED STATES

Breastfeeding initiation and duration rates in the United States are lower than in most nations. Globally, about 79% of infants are breastfed for 12 months, compared to 21.4% in the United States (7,15,16). Currently, one out of three infants in the developing world is exclusively breastfed for the first 6 months of life, compared to 11.9% in the United States (16,17). Almost all newborns in the United States were breastfed before 1880. In the 1880s, women began to supplement breastfeeding with cow's milk soon after giving birth and to wean their infants before they were 3 months old. Infants fed cow's milk died at much higher rates than breastfed infants until the 1920s when pasteurization made cow's milk safe and readily available for infant feeding. Breastfeeding rates declined sharply because of the widespread belief that pasteurized cow's milk eliminated the differences between human and cow's milk feeding (18). The decline continued when other milk substitutes such as evaporated cow's milk and infant formula became widely available. These were promoted as being more convenient for the mothers and being more nutritious than human milk. Breastfeeding rates reached an all-time low in the United States in 1971 with only 24% of mothers initiating breastfeeding (19).



	1999	2000	2001	2002	2003	2004	2005
Initiation	68.3	70.9	71.6	71.4	72.7	73.8	74.2
6 months	32.62	34.2	36.9	37.6	39.1	41.5	43.1
12 months	15	15.7	18.2	19	19.6	20.9	21.4

Figure 1. Percentage of US children who were breastfed by birth year, 1999-2005. Data adapted from: National Immunization Survey, 2005 Births, Centers for Disease Control and Prevention, Department of Health and Human Services. http://www.cdc.gov/breastfeeding/data/NIS_data/. Accessed April 24, 2009.

The US Department of Health and Human Services (HHS) set goals for breastfeeding initiation and duration rates in the late 1970s, and the United States has since seen a steady increase in breastfeeding rates (1). Data from the 2007 National Immunization Survey (NIS) indicate that the rate of initiation and duration of breastfeeding are improving, but are still below the Healthy People 2010 goals (16). Breastfeeding initiation rates increased from a low of about 20% in the early 1970s to a high of 61.9% in 1982 (19,20). After a decline in breastfeeding rates through 1990, breastfeeding initiation rates in hospitals have increased yearly, exceeding 70% from 2000. The 2007 NIS data indicate a high of 74.2% in 2005 (16) (see Figure 1). Breastfeeding rates are expected to continue increasing as a result of several national efforts, including Healthy People 2010 (1) and Blueprint for Action on Breastfeeding (2), the US Department of Agriculture's Loving Support Makes Breastfeeding Work campaign (21), the US Breastfeeding Committee's Breastfeeding in the United States: A National Agenda (22), and the HHS's The Business Case for Breastfeeding: Steps for Creating a Breastfeeding Friendly Worksite (23). The US Breastfeeding Committee's strategic plan is supported by the HHS and more than 20 professional and public health organizations.

According to provisional 2007 NIS data for infants born in 2005, 23 states achieved the national Healthy People 2010 objectives of 75% of mothers initiating breastfeeding. In addition, 10 states achieved the objective of 50% of mothers breastfeeding at 6 months, 12 states achieved the objective of 25% of mothers breastfeeding at 12 months, and eight states achieved all three initiation and duration objectives (16). It should be noted that many of the mothers counted as "breastfeeding" were supplementing their infants with formula or other products and the degree of breastfeeding was not actually measured.

Breastfeeding initiation rates paint a much more positive picture of breastfeeding practices in the United States than do breastfeeding exclusivity rates. Although data about breastfeeding exclusivity are limited, the available data provide important insight. In 2007, Healthy People 2010 objectives were updated to include two new objectives that address exclusive breastfeeding (ie, feeding an infant only breast milk, with no additional liquids or solids) (9,24). These two new objectives are to increase the proportion of women who exclusively breastfeed their infants for 3 months to 40%, and to increase the proportion of mothers who exclusively breastfeed their infants for 6 months to 17% (24). The national rates for exclusive breastfeeding at 3 and 6 months for infants born in 2005 were 31.5% and 11.9%, respectively. These rates are significantly lower than the targets set by Healthy People 2010. More detailed information can be found on the CDC Web site (16). Furthermore, 10 states met the objective of 40% exclu-

Table. Provisional breastfeeding (BF) rates by sociodemographic factors among children born in 2005 (percent±half 95% confidence interval), n=15,014 (exclusive), n=15,269 (any)[a]

Demographic factor	Ever BF	BF at 6 months	BF at 12 months	Exclusive BF[b] at 3 months	Exclusive BF[b] at 6 months
US national	74.2±1.2	43.1±1.3	21.4±1.1	31.5±1.3	11.9±0.9
Marital status					
Married	79.6±1.2	49.8±1.5	25.1±1.4	36.9±1.5	14.0±1.1
Not married	62.4±2.6	28.0±2.5	13.3±2.0	19.5±2.2	7.1±1.5
Age					
<20	51.2±8.3	18.6±6.9	9.2±5.1	14.9±5.8	7.4±5.2
20-29 y	70.6±2.0	36.0±2.2	15.5±1.6	26.7±2.0	10.8±1.5
>30 y	78.5±1.4	49.9±1.7	26.6±1.6	36.1±1.7	12.9±1.2
Education					
< High school	65.7±3.4	37.1±3.7	20.4±3.2	23.9±3.5	8.6±2.4
High school	67.8±2.5	33.6±2.8	15.5±2.1	25.2±2.6	10.2±1.9
Some college	75.2±2.1	39.7±2.5	18.7±2.1	31.5±2.4	11.3±1.7
College grad	85.9±1.3	58.8±1.9	29.9±1.8	43±1.9	16.2±1.3
Race/ethnicity					
American Indian or Alaskan Native	65.5±8.5	42.3±6.9	24.3±5.8	25.7±5.7	7.9±2.8
Asian or Pacific Islander	83.6±4.9	51.8±4.4	29.1±3.9	34.5±5.9	13.4±3.7
Native Hawaiian and other	87.5±7.4	43.7±12.7	26.5±10.8	35.6±11.4	12.1±7.0
Black/African American	61.4±3.2	29.3±2.5	13.4±1.8	19.2±2.4	6.5±1.5
White	76.8±1.3	43.2±1.3	21.9±1.1	33.9±1.5	12.9±1.1
Hispanic/Latino	80.6±2.3	45.1±2.5	24.1±2.2	32.6±3.1	12.6±2.3
Receiving WIC[c]					
Yes	67.8±1.9	34.2±1.6	16.9±1.6	23.8±1.8	8.2±1.3
No, but eligible	76.2±5.2	56.4±6.5	32.9±6.8	40.6±7.2	16.1±4.5
No, ineligible	82.3±1.5	52.7±1.9	25.7±1.7	40.4±1.8	15.9±1.4
Poverty Income Ratio[d]					
<100%	67.0±2.9	36.2±3.1	19.3±2.7	25.8±3.0	8.9±2.0
100% to <185%	71.4±3.1	38.8±3.7	20.0±3.0	27.2±3.4	10.2±2.4
185% to <350%	74.9±2.4	43.3±2.6	21.5±2.0	32.6±2.4	12.7±1.8
350% or higher	82.8±1.7	52.1±2.2	24.5±2.0	40.1±2.2	15.1±1.6
Residence					
MSA[e], Central City	76.2±1.8	45.4±2.1	23.8±1.8	31.7±2.0	12.3±1.4
MSA, Non-Central City	75.8±1.8	44.4±2.2	21.4±1.8	32.7±2.0	12.3±1.5
Non-MSA	64.6±2.9	33.1±2.7	15.3±1.9	27.5±2.6	9.4±1.7

[a]Source: National Immunization Survey, Centers for Disease Control and Prevention, Department of Health and Human Services. http://www.cdc.gov/breastfeeding/data/NIS_data/2005/socio-demographic_any.htm. Accessed April 26, 2009.
[b]Exclusive breastfeeding is defined as only breast milk—no solids, no water, and no other liquids.
[c]WIC=Special Supplemental Nutrition Program for Women, Infants, and Children.
[d]Ratio of self-reported family income to the federal poverty threshold value.
[e]MSA=Metropolitan Statistical Area; defined by the US Census Bureau.

sively breastfeeding through 3 months of age and eight states met the objective of 17% of mothers who exclusively breastfeeding through 6 months (16). Achieving all of the Healthy People 2010 objectives for breastfeeding could lead to a significant decrease in pediatric health care costs in the United States (25).

Breastfeeding initiation rates and exclusive breastfeeding at 3 and 6 months are highest among women who are white or non-Hispanic, college educated, married, living in urban areas, older than 30 years, employed part-time, have higher incomes, or living in the Mountain or Pacific regions of the country (15,16) (see the Table). Among women eligible for the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC), those not receiving WIC benefits have higher initiation and duration rates, and twice as many are exclusively breastfeeding at 6 months (15). Whereas all demographic groups reported increases in breastfeeding initiation since 1990, the largest increases occurred among mothers who have historically been less likely to breastfeed—women who are African American, Hispanic, less educated, employed full-time, younger than 24 years old, living in the South Atlantic region, participating in WIC, and mothers with low-birth-weight infants (15,16).

BENEFITS OF BREASTFEEDING FOR INFANTS

According to the American Academy of Pediatrics, breastfed infants are the reference against which all alternative feeding methods must be measured with regard to growth, health, development, and other outcomes (4). Human milk has many beneficial effects on the health of infants, especially premature and low birth weight

1. Which dietary factors would affect breast milk production (or breast milk supply, established lactation)?

EAL Conclusion Statement: Current available evidence shows no significant effects or relationships between any of the following dietary factors and breast milk production in healthy, adult, lactating women (mean±standard deviation body mass index ranged from 21.4±0.9 to 25.2±4.2): short periods (<10 weeks) of reduced energy intake (25% to 35% energy deficit), increased or decreased fluid intake (±25% to 50%), increased protein intake (1.5 g/kg/d), three types of nutrition supplement (ie, *Coleus amboinicus* soup, Fenugreek seed capsules; sugar-coated Moloco+B-12 tablets), and calcium intake (*Evidence Grade II=Fair*).

2. What are the effects of artificial nipple on the duration of breastfeeding?

EAL Conclusion Statement: Overall, evidence suggests a negative influence of artificial nipple on the duration of all types of breastfeeding (from partial to exclusive). Observational evidence consistently showed an association between use of pacifier before 3 months of age and shorter breastfeeding duration in healthy term or full-term infants, after controlling for potential confounding. Data are insufficient to determine whether increasing frequencies of pacifier use or introduction of pacifier use beyond 3 months of age has differential influences on breastfeeding duration. Well-designed randomized control tests with blinded assessments of breastfeeding outcomes are needed to further support the validity of the findings from the observational studies concerning negative influence of pacifier use on the duration of breastfeeding. Data are insufficient to make a conclusion regarding the effects of artificial nipple on the duration of breastfeeding among preterm infants (*Evidence Grade II=Fair*).

Supplemental feeding in term or full-term Infants
Data from both randomized control trials and observational studies also consistently suggested that supplemental feedings to term infants, regardless of method (bottle or cup), had a detrimental effect on breastfeeding duration, compared to no supplemental feeding.

Preterm Infants
Data are insufficient to make a conclusion regarding the effects of artificial nipple on the duration of breastfeeding among preterm infants.

3. What are the effects of maternal diet or dietary supplements of n-3 fatty acids on the breast milk composition and infant health outcomes?

EAL Conclusion Statement: Consistent results from randomized control trials have shown that n-3 fatty acid supplementation (fish oil, cod liver oil, or docosahexaenoic acid [DHA]-rich oil) to pregnant women or breastfeeding mothers can increase n-3 FA levels in both breast milk and infants' plasma phospholipids. There is a dose-response relationship between doses of DHA supplementation and breast milk DHA levels, but the saturation dose remains unclear. Currently there is no study directly examining the dose-response relationship for other types of n-3 fatty acid supplementation.

These positive changes in breast milk n-3 fatty acid compositions, however, do not always show a positive affect on children's visual acuity and cognitive development at long-term follow-up. (*Evidence Grade=Good*).

Figure 2. American Dietetic Association Evidence Analysis Library (EAL) conclusion statements for dietary effects on lactation and the effects of artificial nipples on duration of breastfeeding.

infants and young children. These benefits are magnified with exclusive breastfeeding and breastfeeding beyond 6 months of age (9,10).

Optimal Nutrient Composition

Human milk is uniquely tailored to meet the nutrition needs of human infants. It has the appropriate balance of nutrients provided in easily digestible and bioavailable forms (7,26,27). The milk changes its composition—from colostrum for newborns to mature milk for older infants—to meet the nutrient needs of growing infants. It provides adequate amounts of carbohydrates, essential fatty acids, saturated fatty acids, medium-chain triglycerides, long-chain polyunsaturated fatty acids, and cholesterol. An EAL report indicates that there is consistent evidence to show that n-3 fatty acids supplementation to pregnant and breastfeeding women can increase n-3 fatty acid levels in breast milk and infant plasma phospholipids. However, there do not appear to be any long-term clinical benefits in children (**Evidence Grade I=Good**). See Figure 2 for the EAL conclusion statement.

The relatively low protein content of human milk presents a relatively modest nitrogen load to immature kidneys. The protein is largely alpha-lactalbumin—a whey protein that forms a soft, easily digestible curd. There are more than 100 major milk oligosaccharides in human milk that are thought to have protective properties against respiratory and enteric diseases. These oligosaccharides pass through the infant undigested, concentrate in feces, and are thought to interfere with pathogens binding to host cell receptors (28). Human milk has a relatively low sodium content, allowing the fluid requirements of exclusively breastfed infants to be met while keeping the renal solute load low. Minerals in breast milk are largely protein bound and balanced to enhance bioavailability. The 2:1 ratio of calcium to phosphorus is ideal for the absorption of calcium and both of these minerals, and, along with magnesium, are present in appropriate amounts for growth and development. The limited amount of iron and zinc is highly absorbable (26). Given the nutrient content of human milk, supplements are not necessary, with the exception of vitamin D and possibly fluoride (1,4,8). Due to insufficient levels of vitamin D in human milk and decreased exposure to sunlight, a

Benefits for infants	Benefits for mothers
• Optimal nutrition for infant • Strong bonding with mother • Safe, fresh milk • Enhanced immune system • Reduced risk for acute otitis media, nonspecific gastroenteritis, severe lower respiratory tract infections, and asthma • Protection against allergies and intolerances • Promotion of correct development of jaw and teeth • Association with higher intelligence quotient and school performance through adolescence • Reduced risk for chronic disease such as obesity, type 1 and 2 diabetes, heart disease, hypertension, hypercholesterolemia, and childhood leukemia • Reduced risk for sudden infant death syndrome • Reduced risk for infant morbidity and mortality	• Strong bonding with infant • Increased energy expenditure, which may lead to faster return to prepregnancy weight • Faster shrinking of the uterus • Reduced postpartum bleeding and delays the menstrual cycle • Decreased risk for chronic diseases such as type 2 diabetes, breast, and ovarian cancer • Improved bone density and decreased risk for hip fracture • Decreased risk for postpartum depression • Enhances self-esteem in the maternal role • Time saved from preparing and mixing formula • Money saved from not buying formula and increased medical expenses associated with formula feeding

Figure 3. Potential benefits of breastfeeding for infants and mothers. Data adapted from references 1-3, 6, 7, 9, 26, 27, 33, and 42.

vitamin D supplement is recommended. The American Academy of Pediatrics recommends that all healthy infants and children have at least 400 IU of vitamin D daily. Supplementation should be given to breastfeeding infants within the first few days of life and continued throughout childhood regardless of whether or not the child is receiving supplemental formula as it is unlikely that a breastfed infant would consume 1 L formula, the amount needed to supply 400 IU vitamin D (29). Breastfed infants who are aged 6 months and older may need a fluoride supplement if the total amount of fluoride from the local water supply or other sources available to the infant is inadequate (30).

Reduction in Infant Morbidity and Mortality

Breastfeeding, especially exclusive breastfeeding, during the first 6 months of life is an important factor for reducing infant and childhood morbidity and mortality (12). Breastfeeding is associated with a reduction in postneonatal deaths from all causes other than congenital anomalies and malignancies (31) and exclusive breastfeeding is associated with lower rates of hospitalization from infections in the first year of life (32). Evidence suggests that breastfeeding may reduce the risk for a large number of acute and chronic diseases (see Figure 3). A report by the Agency for Healthcare Research and Quality (AHRQ) provides an extensive summary of meta-analyses, randomized and nonrandomized comparative trials, prospective cohort, and case-control studies to examine the effects of breastfeeding on certain infant and maternal health outcomes (33). Evidence suggests a significant reduction in the risk of acute otitis media, nonspecific gastroenteritis, childhood leukemia, and in hospitalizations from lower respiratory tract disease for breastfed infants compared to their formula-fed counterparts (33). Compared to infants who are exclusively formula-fed, there is a 23% reduction in the risk of otitis media in infants ever breastfed and a 50% reduction in infants exclusively breastfed for at least 3 months (33). Breastfeeding may decrease morbidity from respiratory tract infections and infants exclusively breastfed 4 months or longer have a 72% reduction in hospitalization for a lower respiratory tract infection during the first year of life than infants who are formula-fed (32). In addition, breastfeeding may reduce the risk of nonspecific gastroenteritis by 64% when compared to infants who are not breastfed (33).

Breastfeeding for at least 6 months is associated with a 15% to 19% reduction in the risk of developing childhood leukemia (33,34). Exclusive breastfeeding has a positive effect on the development of the oral cavity by improving shaping of the hard palate resulting in proper alignment of the teeth and fewer problems with malocclusions (35). For families with a history of atopic dermatitis, breastfeeding for at least 3 months is associated with a 42% reduction in the condition (33). Studies on the effects of breastfeeding on the development of asthma are less clear. Some studies have shown a moderate protective effect whereas other studies demonstrate conflicting results including an increased risk associated with breastfeeding. Children without a family history of asthma who breastfeed at least 3 months have been shown to have a 27% reduction in the risk for asthma compared to children who do not breastfeed (33). For those with a family history of asthma, there is a 40% reduction in the risk of asthma in children younger than 10 years old if they are breastfed for at least 3 months (33). However, it is not clear if there is a reduction in older children and adolescents (33).

Breastfeeding is associated with a reduced risk of sudden infant death syndrome (SIDS). According to the AHRQ report, a meta-analysis of case-control studies found that receiving breast milk is associated with a 36% reduction in the risk of SIDS compared to infants who never breastfed (33). A German case-control study compared 333 infants who died as a result of SIDS to 998 age-matched controls and found that exclusively breastfeed infants at 1 month of age had half the risk, and that both partial and exclusive breastfeeding were associated with a reduced risk of SIDS (36).

Breast milk feedings for premature infants may reduce the incidence of necrotizing enterocolitis (NEC). Studies show an absolute risk difference of

Disease	AHRQ	WHO
Obesity	Three meta-analyses of good and moderate methodological quality report an association of breastfeeding and a reduction in the risk of obesity in adolescence and adult life compared with those not breastfed.	Updated meta-analyses concluded that the evidence suggests that breastfeeding may have a small protective effect on the prevalence of obesity.
Blood pressure	Two moderate quality meta-analyses concluded there was a small reduction in systolic and diastolic pressure in adults who were breastfed compared to those formula-fed.	Updated meta-analyses showed a small but significant protective effect of breastfeeding on systolic and diastolic blood pressure.

Figure 4. Findings of the *Agency for Healthcare Research and Quality (AHRQ)* and the World Health Organization (WHO) analyses of breastfeeding and obesity and blood pressure. Data adapted from references 13 and 33.

5% in the risk of NEC between preterm infants receiving human milk and formula. This is considered a meaningful clinical difference due to the high case-fatality rate of NEC (33,37,38). The value of human milk in reducing the incidence of NEC has influenced the growing use of pasteurized donor human milk for infants at high risk for NEC (37-41). When mother's milk is not available, providing pasteurized donor milk from appropriately screened donors from an approved milk bank offers immunoprotection and bioactive factors not found in infant formula and is the next best option particularly for ill or preterm infants (4,39,41). Only human milk from facilities that screen and approve donors and pasteurize the milk should be used because there is risk of disease transmission to the recipient from donors who are not screened and from the use of unpasteurized milk.

Long-Term Outcomes

In addition to a significant reduction in acute illnesses, breastfeeding can affect the development of chronic diseases later in life. WHO conducted systematic reviews of 33 observational and randomized studies to assess the long-term consequences of breastfeeding on blood pressure, obesity/overweight, total cholesterol, type 2 diabetes, and intellectual performance (42). Nearly all the studies were conducted in countries with high income and in predominantly white populations. The systematic review found a small but significant protective effect of breastfeeding on systolic and diastolic blood pressure and a reduction in cholesterol levels among adults who were breastfed in infancy (42). Breastfeeding has been found to have long-term effects on the reduction of blood pressure possibly due to the lower sodium content of breast milk compared to infant formula, the long-chain polyunsaturated fatty acid content of breast milk, and the reduced incidence of obesity, which is a risk factor for hypertension (42).

Studies have suggested that adults who were breastfed are more likely to have lower serum cholesterol than their formula-fed counterparts. However, the AHRQ reports that a meta-analysis of cohort and case-control studies included studies with serious methodological flaws and that the relationship between breastfeeding and cholesterol levels cannot be determined at this time (33). Nonetheless, a meta-analysis published by WHO reports that the evidence suggests that the association between breastfeeding and total cholesterol varies by age, with significant effects in adults who were breastfed, but not among children or adolescents who were breastfed. The study also concluded that the association was not due to publication bias or residual confounding (42) (see Figure 4).

Breastfed infants are less likely to become overweight or obese as adults (42-44). Some studies have found an association of breastfeeding and a reduction in the risk of obesity in adolescence and adulthood compared with those who were not breastfed. Breastfeeding may reduce the risk of overweight or obesity in adolescence and adulthood by 7% to 24% (43,44). Another study found a 4% reduction in the risk of being overweight in adulthood for each additional month of breastfeeding in infancy (44). Overall, there is an association between a history of breastfeeding and a reduction in the risk of being overweight or obese in adolescence and adulthood (44). Bottle-fed full-term infants who are appropriate for gestational age have a 3.2 times greater risk of rapid weight gain between ages 2 and 6 years when compared to breastfed infants (45). This effect may be related to factors such as the higher protein intake of formula-fed infants, greater insulin response to formula resulting in fat deposition, or an easier transition among breastfed infants to some new foods such as vegetables, which may lead to a more healthful diet in later life (42).

Breastfeeding is also associated with a decreased risk of type 2 diabetes later in life after adjusting for birth weight, parental diabetes, socioeconomic status, and body size (42). Studies report that formula-fed infants have higher glucose concentrations and higher basal and post-prandial concentrations of insulin and neurotensin when compared to breastfed infants (42,46). Children and adults who were not breastfed have higher serum insulin levels. WHO and AHRQ identified studies that found breastfed infants were less likely to present with type 2 diabetes later in life compared to formula-fed infants, but also report other studies that failed to show an association (33,42). WHO and AHRQ concluded that it is not currently possible to draw conclusions about the long-term effects of breastfeeding on the risk of type 2 diabetes. (33,42).

Although evaluating the effect of breastfeeding on cognitive development is problematic, as it is difficult to control for factors such as maternal intelligence, maternal education, the home environment, and socioeconomic status, a WHO meta-analysis report indicated that infants who were breastfed for at least 1 month

performed higher on intelligence tests than their formula-fed counterparts. Furthermore, infants who are exclusively formula-fed have an average intelligence quotient that is 4.9 points lower than infants who breastfeed at least 1 month, even when studies control for the home environment. Breastfeeding for less than 6 months is associated with decreased test scores and impaired school performance when compared to infants who breastfeed for a longer duration. The report also suggests that breastfeeding is associated with increased cognitive development in childhood. However, the practical significance is unknown. The report also reviewed a few studies that examined school performance and found higher educational achievement in late adolescence and young adulthood among those who were breastfed compared to their formula-fed counterparts (42). In addition, AHRQ reviewed one well-performed sibling analysis and three prospective cohort studies conducted in developed countries with term infants that were adjusted for maternal intelligence and found little or no evidence of a relationship between breastfeeding and cognitive performance (33).

A high concentration of long-chain polyunsaturated fatty acids in breast milk and enhanced maternal-child bonding may be responsible for improved cognitive development (27,30) and researchers are still trying to understand which of them is the deciding factor. However, the results from one large randomized trial suggest that the nutritional properties of breast milk have a positive independent effect (47). The EAL reports that although maternal supplementation with n-3 fatty acids increases plasma phospholipids in infants there is an apparent dose-response relationship. Furthermore, the increases in breast milk n-3 fatty acid compositions do not always show a positive influence on children's visual acuity and cognitive development at long-term follow-up, indicating that other factors are involved. (**Evidence Grade I=Good**). See Figure 2 for the EAL conclusion statement.

Although there is limited research, breastfeeding may also help to protect against maternal neglect and maltreatment. An Australian longitudinal cohort study spanning 15 years found that in children with substantiated maternal neglect, the odds were nearly four times greater for nonbreastfed infants compared to infants breastfed more than 4 months, after adjustment for confounding variables (48).

BENEFITS OF BREASTFEEDING FOR WOMEN

In addition to the numerous benefits of breastfeeding for the infant, there are many benefits for the mother (see Figure 3). The degree to which some of these health benefits may be realized depends on breastfeeding duration, breastfeeding frequency, breastfeeding exclusivity, and other personal factors (49). Women choosing to breastfeed can feel confident that their choice of infant feeding improves not only the health of their child but also their own long-term health and well-being.

Family Planning

Women who exclusively breastfeed their infants are more likely to be amenorrheic, which conserves iron stores and decreases the risk for iron deficiency, at 6 months postpartum (50). Extended breastfeeding also suppresses ovulation, which delays the menstrual cycle and in turn may increase spacing between pregnancies. The lactational amenorrhea method (LAM) has been promoted for more than two decades by family planning advocates, especially in developing countries that have difficulty obtaining contraceptive (50-53). LAM advocates purport that the method provides more than 98% protection from pregnancy in the first 6 months postpartum. A Cochrane Database of Systematic Review of LAM also concluded that exclusively breastfeeding women who stay amenorrheic (regardless of whether they used LAM) have a very small risk of getting pregnant (54). LAM can be implemented with minimal counseling or follow-up and is an effective family planning method with a high level of user satisfaction that can be used in a variety of cultures and health care settings (55). However, this method is not promoted by US federal agencies and national professional assocations (54).

Reduction in Disease

Several studies have found that breastfeeding is associated with a decreased risk for breast cancer that is magnified with a lifetime breastfeeding of more than 12 months (56-58). Women with breast cancer are less likely to have ever breastfed and their average lifetime duration of breastfeeding is shorter (9.8 vs 15.6 months) compared to women without breast cancer. For each year a woman breastfeeds in her lifetime there is a 4.3% reduction in the risk of breast cancer (56). Women who have breastfed three or more children have a decreased risk for breast cancer (57), and for each 6-month increase in breastfeeding there is further reduction in breast cancer risk (58). Breastfeeding has been also found to be effective in reducing ovarian cancer risk. This protection is attributed to the partial inhibition of ovulation in lactating women (59). One systematic review of 31 studies found that there was no emerging consensus regarding breastfeeding and protection against breast cancer for either ever vs never breastfeeding or for the duration of breastfeeding as only about half of the studies reviewed found a significant protective effect (60).

A longer duration of lifetime breastfeeding is also associated with a decreased risk for developing type 2 diabetes among women with no history of gestational diabetes, although for women with a history of gestational diabetes the increased risk of developing type 2 diabetes is not ameliorated by lactation (33,46). Breastfeeding may be associated with a reduced risk of hip fractures in postmenopausal women (61) and improve bone mineral density during young adulthood in adolescent mothers (62). However, others report there is little evidence to show an association between lifetime breastfeeding and a reduced risk of fractures due to osteoporosis (33). There also is a decreased risk for developing rheumatoid arthritis, especially if a mother breastfeeds for more than 12 months (63).

Weight Loss

The studies on breastfeeding and weight loss have produced mixed findings. Studies estimating postpartum weight changes are less likely to detect weight or fat loss than studies directly measuring postpartum weight changes (64). In the short term, breastfeeding women experience greater weight and fat loss than non-breastfeeding women. Furthermore, women who breastfeed for longer than 6 months and those who

do so exclusively are more likely to achieve greater weight loss (65-68). Some studies report that lactation may be associated with increased weight gain, or that any observed weight difference may not be sustained past 18 months (69). It should be noted that weight loss and body composition changes are highly variable among postpartum women (69). In addition, prepregnancy weight, total pregnancy weight change, and parity all greatly impact postpartum weight loss (69,70).

Maternal Well-Being

An unexpected benefit of exclusive breastfeeding is improved sleeping at night. Mothers who supplement with formula at night even when the father takes over the nighttime feedings to allow the mother to get more sleep have been found to sleep 40 to 45 minutes less and to have more sleep disturbances than mothers who exclusively breastfeed their infants, including overnight feedings (71). Breastfeeding also lowers blood pressure in breastfeeding mothers before, during, and after breastfeeding sessions. Oxytocin release during breastfeeding is thought to be responsible for this effect (72).

Consistently studies have shown that breastfeeding is associated with a decrease in depressive symptoms in the postpartum period and some studies have reported lower mean depression scores in breastfeeding mothers compared to those who bottle-feed (73). A shorter duration or no breastfeeding is associated with increased rates of postpartum depression although it is difficult to determine whether depression leads to a reduced duration of breastfeeding as opposed to breastfeeding reducing the risk for the development of depression. These outcomes might occur concurrently (33).

ECONOMIC BENEFITS OF BREASTFEEDING

Breastfeeding provides significant economic benefits to the family and society, such as reduced health care-related expenses and reduced time off from work and loss of income to take care of a sick infant or child (74-76). The US Department of Agriculture estimates that at least $3.6 billion could be saved in health care costs if breastfeeding rates were increased from current levels to those recommended by the US Surgeon General (74). These savings could be much higher since this figure only represents cost savings from the treatment of three childhood illnesses: otitis media, gastroenteritis, and necrotizing enterocolitis (74). It also is estimated that $30 million would be saved if all women participating in WIC breastfed for one month. An additional $48 million could be saved if 75% of the mothers in the WIC program breastfed for 3 months (74-76). Changes to the WIC food packages have recently been tailored to better promote and support the establishment of successful long-term breastfeeding (77). In addition to the savings in direct medical costs, data are emerging that document the economic benefits of breastfeeding support to employers, including lower maternal absenteeism due to infant illness, increased employee loyalty, improved productivity, lower insurance premiums and enhanced public image (74,78,79). Health care payers or insurers would reap benefits from savings in physician fees, emergency room visits, prescriptions, and laboratory procedures with increased breastfeeding rates (78). Costs that are equally important but more difficult to measure are long-term health concerns such as chronic diseases, a reduction in adult productivity due to decreased cognitive development and increases in chronic illnesses leading to higher health insurance rates related to not breastfeeding (78).

FACTORS THAT AFFECT INITIATION, DURATION, AND EXCLUSIVITY OF BREASTFEEDING

Despite an abundance of reasons to breastfeed, a large number of women still choose not to initiate breastfeeding, to only partially breastfeed, or to breastfeed for a short duration. Although the factors that determine whether a mother will choose breastfeeding or formula feeding for her newborn are numerous, unsupportive hospital practices, lack of knowledge, personal beliefs, and family attitudes are likely to influence the mother's decision (80,81). Popular mother-related reasons for breastfeeding include: the low cost, convenience, enjoyment, and not wanting to prepare formula and sterilize bottles (80). Women who do not initiate breastfeeding or who do so for less than 3 months report barriers such as: unsure if the infant is getting enough milk, perception of not producing enough milk, nipple or breast problems, mother or infant not liking breastfeeding, maternal fatigue, embarrassed to breastfeed in public, going back to work, concern about weight loss or dietary restrictions, and being the only one who can feed the infant (81-85). In a study of WIC participants who did not initiate breastfeeding, African American and white mothers were more likely to report perceptions of pain and Hispanic mothers were more likely to report perceptions of infant breast rejection (82).

Support, Education, and Cultural Influences

The support that a mother receives can influence her success with breastfeeding. Mothers rate social support as more important than health service support due to a lack of availability of health professionals, promotion of unhelpful practices, and conflicting advice (84). They also report dissatisfaction with their breastfeeding experience when they do not receive adequate help from their health professionals (84). Adolescent mothers report that they are not informed by physicians or nurses about the health benefits of breastfeeding and that it is ideally suited for infants (86). Many mothers who intend to exclusively breastfeed often give formula earlier than anticipated either because of difficulty with breastfeeding or because formula was given at the hospital (87,88). Often mothers believe that breastfeeding is beneficial for their infants, but also believe that early introduction of formula and solid food is necessary and often unavoidable, especially if the infant is fussy, does not sleep well, or if formula supplementation was started in the hospital (87,89). Although WIC is seen as supportive of breastfeeding, it is also seen as supportive of formula supplementation for breastfeeding mothers, which discourages mothers from exclusive breastfeeding (87). Whereas many mothers exclusively breastfeed initially, this number drops dramatically over time. Early introduction of formula (1 week after hospital discharge) by breastfeeding women is influenced by the hospital of delivery,

previous breastfeeding experience, and residing with a smoker (90).

The decision to breastfeed an infant is usually made before a woman discovers she is pregnant. Women with a positive intention to breastfeed usually initiate breastfeeding, but they do not necessarily have plans to breastfeed for a longer duration (91). Attending a prenatal breastfeeding class offered at the birth hospital has been shown to increase breastfeeding rates and improve exclusive breastfeeding for longer periods of time (92). Classroom education on infant feeding has been shown to increase knowledge and improve attitudes of adolescents towards breastfeeding and result in greater intention to breastfeed their children in the future (93).

The intention to breastfeed can also be influenced by country of origin. Foreign-born women living in the United States are more likely to intend to breastfeed when compared to women born in the United States (94). On the other hand, the influence of family members not born to the United States can have a negative influence on exclusive breastfeeding. It may be accepted within some cultures or groups of people to supplement breastfeeding with formula feeding. A study of Puerto Rican women in Hartford, CT, suggests that mothers are less likely to exclusively breastfeed when the maternal grandmother resides in the United States (95). The grandmothers may be discouraging exclusive breastfeeding in favor of mixed feedings of breast milk and formula (96). Researchers in Denver, CO, found that it is not uncommon for Latina mothers to initiate breastfeeding with combination feedings of breast and formula known as "Los Dos," or "best of both," a practice that inevitably leads to a low milk supply and eventual refusal of the infant to latch on to the breast (96). Mothers may believe that giving both breast milk and formula will assure that the infant is getting the health benefits of breast milk along with the vitamins in the formula (96). Other studies have shown that Hispanic mothers have high rates of partial breastfeeding at both discharge from the hospital and at 1 month postpartum (16,88,95). Some breastfeeding mothers may seek to enhance the quality and quantity of their milk production by using dietary supplements or eating certain foods. However, the EAL found limited evidence to suggest that there are specific dietary components that can boost a woman's breast milk production (**Evidence Grade II=Fair**). See Figure 2 for the EAL conclusion statement.

Hospital Practices

Hospitals provide a unique and critical link between the breastfeeding support provided before and after delivery. Hospital practices can influence not only the success of breastfeeding during the hospital stay but also the exclusivity and duration of breastfeeding. The CDC conducted the Maternity Practices in Infant Nutrition and Care Survey to determine if hospital and birth practices were supportive of breastfeeding during a critical time when lactation is being established (97). The study found that most hospitals offer breastfeeding assistance and instruct mothers on breastfeeding technique. Women who deliver in a hospital that employs board-certified lactation consultants have increased breastfeeding success at hospital discharge, especially women at high risk for not breastfeeding such as Medicaid recipients, adolescent mothers, and mothers of preterm or low birth weight babies (98). Support after hospital discharge is also important. Adolescent mothers believe that more support and phone contact with nurses would have helped them overcome breastfeeding difficulties after they are discharged from the hospital (86). Several hospital practices were found not to be supportive of breastfeeding. Some hospitals advise women to limit the duration of suckling at each breast and pacifiers are routinely given to more than half of all healthy, full-term breastfed infants (97).

Most observational studies report an association between pacifier use and shortened duration of breastfeeding (99). The EAL concludes that there is a negative impact of artificial nipple on breastfeeding duration (**Evidence Grade II=Fair**). See Figure 2 for the EAL conclusion statement. Observational studies show an association between pacifier use before 3 months of age and a shorter duration of breastfeeding in healthy term infants. However, the EAL reports that there are insufficient data to determine if increasing the frequency of pacifier use or introducing a pacifier after 3 months of age has differential effects on breastfeeding duration. The EAL did conclude that there are insufficient data regarding the influence of pacifier and breastfeeding duration among preterm infants (**Evidence Grade II=Fair**). See Figure 2 for the EAL conclusion statement and grade. However, in a systematic review of the literature from 1950-2006, results from four randomized controlled trials do not support an adverse relationship between pacifier use and breastfeeding duration or exclusivity. The researchers assert that the association between shortened duration of breastfeeding and pacifier use in observational studies likely reflects several factors such as breastfeeding difficulties or intent to wean (99).

Formula supplemental feedings to breastfed infants occur frequently in hospitals. As a general practice, 24% of facilities give supplements to more than half of all healthy, full-term breastfeeding infants, 30% offer glucose water, and 15% offer water (97). In 17% of the facilities, healthy full-term breastfeeding infants born in uncomplicated cesarean births are fed something other than breast milk for their first feeding. Discharge packs containing infant formula are distributed to breastfeeding mothers in 70% of facilities, giving the mother mixed messages about the value of exclusive breastfeeding (97). The CDC recommends that these practices be discontinued to provide more positive support for breastfeeding initiation and duration (97). The EAL concludes that there is consistent evidence to suggest that supplemental feedings to term infants, regardless of method (bottle or cup), had a detrimental effect on breastfeeding duration, compared to no supplemental feeding (**Evidence Grade II=Fair**). See Figure 2 for the EAL conclusion statement.

The Baby-Friendly Hospital Initiative (BFHI) is a global program sponsored by WHO and UNICEF to encourage hospitals and birthing centers that offer an optimal level of care for lactation. There are 10 steps to becoming a "baby-friendly" facility and those that accomplish them are officially designated as such. The BFHI assists hospi-

tals in giving breastfeeding mothers information, confidence, and skills needed to successfully initiate and continue breastfeeding infants and gives special recognition to hospitals that follow "baby-friendly" pratices (100). A mother's perception of the hospital's compliance with the Ten Steps of the BFHI influences the rate of exclusive breastfeeding during the hospital stay. Mothers are more likely to exclusively breastfeed when they feel that the hospital is compliant with the BFHI (101). Having a written breastfeeding policy (Step 1) that is communicated to all staff improves breastfeeding rates 2 weeks after delivery (101). Training of perinatal and neonatal nurses and medical staff in breastfeeding guidance (Step 2) can have a significant influence on breastfeeding initiation, duration, and exclusivity as well as improving satisfaction with lactation support (102). Mothers who experience "baby-friendly" hospital practices are also more likely to continue breastfeeding beyond 6 weeks (103).

Hospital practices found to have a positive effect on breastfeeding duration include breastfeeding in the first hour after birth, feeding only breast milk in the hospital, infant rooming-in, providing a phone number for breastfeeding help after discharge, and not using a pacifier (103,104). Mothers who experience these hospital practices are less likely to wean due to difficulties establishing breastfeeding such as insufficient milk supply, an unsatisfied infant, and difficulties with latching (104). Mothers who breastfeed within 120 minutes of birth are 2.5 times more likely to be exclusively breastfeeding at 4 months than mothers who breastfeed for the first time at more than 120 minutes (105). Mothers who hold their infants skin to skin are more likely to initiate breastfeeding sooner after birth (105). In-hospital feeding of newborns can influence the modality of infant feeding at one month of age. Of the mothers who are exclusively breastfeeding in the hospital, 50.9% continue to exclusively breastfeed during the first month compared to 20.3% of women who partially breastfeed and 4.2% of mothers who do not breastfeed before hospital discharge (82). Mothers are more likely to fulfill their intention to exclusively breastfeed when the hospital staff does not supplement with formula and the mother is assisted with breastfeeding (103).

Formula Marketing

Formula company marketing is a common institutional practice in public health clinics, physician offices, and hospitals that reduces the rates of breastfeeding initiation, duration, and exclusivity. Marketing of formula is evident in the provision of formula company-produced infant feeding literature and free formula offers at prenatal care visits, free formula provided at hospital discharge, and when hospitals feed breastfed infants formula when it is not medically indicated (106). Concerned about the effects of formula marketing on breastfeeding rates, the New York City Department of Health and Mental Hygiene and its partners collaborated to change hospital and health professionals' practices and to educate professionals and the public that breastfeeding is the normative and accepted method of infant feeding (107).

Peer Counselors

Ongoing support is essential to assure breastfeeding success. Peer counselor programs are an effective strategy to improve breastfeeding rates among WIC participants and empower both the peer counselor and the client (108-113). Counselors are capable of identifying and discussing barriers to breastfeeding, recognizing situations that require referrals to a health professional, and are able to increase a woman's self-confidence in her ability to breastfeed. Proactive interactions are important as it is known that few mothers will call for help even when provided with a referral contact number upon discharge from the birth hospital (109). Counselors manage client's questions through telephone counseling and individual clinic visits, and many also visit clients in their homes. Fathers are also an important source of support for breastfeeding women. A "peer dad" program can offer fathers an opportunity to serve as role models and to share information and support with other new fathers. WIC sites where peer dads are available have increased breastfeeding initiation rates (114).

Maternal Employment

Even with sufficient family and community support, many women discontinue or reduce breastfeeding when they return to employment outside the home. Evidence suggests that return to employment does not necessarily reduce initiation of breastfeeding except for those mothers returning to work within the first 6 weeks after delivery (115,116). However, there is evidence to suggest that breastfeeding duration is significantly reduced when the mother returns to work in less than 12 weeks (117). It has been suggested that offering paid maternity leave may encourage more women to extend the duration of breastfeeding (115). Studies suggest that paid leave may result in more positive health outcomes for both mother and infant (118).

Paid maternity leave is not required by federal law in the United States, and industrialized nations with exemplary paid maternity coverage include: Norway, with 42 weeks at 100% of salary or 52 weeks at 80% of salary; France, with 16 weeks at 100% of salary; Germany, with 14 weeks at 100% of salary; Italy, with 5 months at 80% of salary; and Ireland, with 18 weeks at 70% of salary (119). The only law related to maternity leave in the United States is the Family and Medical Leave Act of 1993, and it provides 12 weeks of unpaid leave annually, allows for continued health insurance, and guarantees a return to the same, or an equivalent job (120). Five states (California, Hawaii, New Jersey, New York, and Rhode Island) and Puerto Rico have gone beyond the Family and Medical Leave Act and offer postpartum women temporary disability insurance. The insurance is funded by the employee, employer, or both and the weeks covered vary by state (121). The HHS offers guidelines for employers to create a supportive work environment for breastfeeding employees (23).

Four components have been shown to provide the greatest financial return for employer investments: privacy for milk expression, flexible breaks and work options, breastfeeding education, and support (121). The International Lactation Consultant Association recommends three strategies for protection of breastfeeding in the workplace. First, arrange-

ments should be considered to keep mother and infant together such as working from home, bringing the infant to the workplace and extended maternity leave. If that is not feasible then intermittent contact to allow for breastfeeding breaks by having the mother visit her child or having the child brought to the workplace will allow breastfeeding to continue while the mother is at work. If mother and infant must be separated, protection of breastfeeding can be provided by offering the mother adequate breaks and appropriate facilities to express and store her breast milk for later use while the child is at the child care provider (122). Legislation protecting the rights of breastfeeding mothers to breastfeed in public and in the workplace has been enacted in many states and is an important strategy to extend the duration of breastfeeding.

SPECIAL CONSIDERATIONS

The advantages of breastfeeding and the use of human milk are particularly salient for premature infants and low birth weight infants. If these infants are unable to feed directly at the breast, the mother's milk can be administered through various feeding routes (27). Human milk has also been successfully used with infants with cleft palate; cystic fibrosis (with pancreatic enzyme replacement); Down syndrome; congenital heart disease; and inborn errors of metabolism, especially phenylketonuria (with supplementation of low-phenylalanine formula) (27). In each of these situations, the major challenge remains the achievement and maintenance of an adequate milk supply. Health professionals should provide anticipatory support and be alert to early signs or symptoms of feeding difficulties so effective early intervention can be initiated. Mothers who desire to breastfeed and are unable to produce a sufficient milk supply can augment the milk the infant receives from the breast with the assistance of a supplemental feeding device, allowing them to experience the closeness of breastfeeding while providing adequate supplemental nutrition (123). Mothers may have concerns about the long-term effects of offering their preterm infants feedings by bottle on breastfeeding success. The EAL found insufficient evidence to make a conclusion about the effects of artificial nipple on the duration of breastfeeding among preterm infants. (**Evidence Grade II=Fair**). See Figure 2 for the EAL conclusion statement and grade.

Despite the many benefits of breastfeeding, there are some situations in which the infant should not be breastfed. These include an infant with galactosemia (4), and an infant whose mother uses illegal drugs (4), has active tuberculosis (4,124), is infected with the human immunodeficiency virus (HIV), has acquired immunodeficiency syndrome (AIDS), or other diseases where the immune system is compromised (4,124). In countries with high prevalence of HIV/AIDS, the infant mortality risks associated with not breastfeeding may outweigh the possible risks of acquiring HIV (125). Breastfeeding is not contraindicated when the mother has hepatitis, is febrile, has been exposed to low-level environmental agents, or is positive for cytomegalovirus (4). Women who smoke cigarettes or are exposed to cigarette smoke should attempt to quit and avoid smoke exposure, but for breastfeeding women with tobacco smoke exposure, breastfeeding is still the best and preferred feeding method (4).

A mother's physical and mental health status can affect her ability to successfully breastfeed her infant. Maternal obesity is linked to lower rates of breastfeeding initiation (126). Women with obesity who initiate lactation are less likely to maintain a full supply and are more likely to have infants with slower weight gain who require supplementation. Mothers with obesity face more breastfeeding challenges, yet are less likely to seek support (127). Depression in the early postpartum period has been shown to be linked to lower breastfeeding rates. The observation that depressed women who stop breastfeeding by 6 weeks have greater improvement in their symptoms than women who continue to breastfeed leads to speculation that unresolved nipple pain or soreness may be a factor in depression (127). Medical advances have improved the health outcomes of many pregnant women with chronic diseases. The key to successful breastfeeding for these women is appropriate choice of medications, treatments, and lactation support from the early prenatal to postpartum period (27).

Most prescribed and over-the-counter medications are safe for the breastfed infant and resources are available to assist in evaluating the safety of drug use in lactation (27,128). However, there are a few medications that are not compatible with breastfeeding. They include radioactive isotopes, antimetabolites, cancer chemotherapy agents, lithium, ergotamine, and a small number of other medications (4). Breastfeeding mothers should be encouraged to discuss any use of prescription drugs, over-the-counter drugs, and herbal medications with their primary care health professional. Although herbal products are widely used in the United States, data are lacking about the safety of their use during lactation.

With the exception of maternal chemical poisoning, human milk remains a safe feeding method for infants and young children. Contamination of breast milk with environmental pollutants is a concern when mothers have had specific exposure to heavy metals or insecticides (129,130). In situations where maternal exposure and probability of transfer in breast milk lipids are determined to be significant, analysis of milk is recommended with decisions regarding safety made from estimated average intake. Environmental contaminants get into human milk when mothers have had geographical, occupational, or accidental exposure. Dioxins produced during industrial processes, organochlorine pesticides, polybrominated diphenyl ethers and polychlorinated biphenyls are of greatest concern due to their long half-lives and bioaccumulative nature in human tissues of mothers and infants (129,131). Studies have shown that even when levels of environmental chemicals are high, beneficial effects of breastfeeding have been observed (131). Research shows that the greatest risk period for adverse effects from exposure is prenatally (132).

Breastfeeding mothers should be encouraged to reduce their exposure to known chemical contaminants. For example, women who may become pregnant, who are pregnant, or who are breastfeeding should reduce their exposure to methylmercury (133). Large bottom-dwelling fish are the

most common food source of methylmercury so the US Food and Drug Administration and the US Environmental Protection Agency recommend the following guidelines for eating fish: avoid shark, swordfish, mackerel, and tilefish; eat up to 12 oz of other kinds of fish every week with a maximum of 6 oz albacore tuna per week; and check local advisories about eating locally caught fish. If no advice is posted, limit intake of locally caught fish to 6 oz per week and consume no other fish in that same week (133).

ROLES AND RESPONSIBILITIES OF FOOD AND NUTRITION PROFESSIONALS REGARDING PROMOTING AND SUPPORTING BREASTFEEDING

As experts in food and nutrition throughout the life cycle, it is the responsibility of registered dietitians (RDs) and dietetic technicians, registered (DTRs) to promote and support breastfeeding for its short- and long-term health benefits for both mother and infants. ADA emphasizes the essential role of RDs and DTRs in promoting and supporting breastfeeding by providing up-to-date, practical information to pregnant and postpartum women, involving family and friends in breastfeeding education and counseling, advocating for the removal of institutional barriers to breastfeeding, collaborating with community organizations and others who promote and support breastfeeding, and advocating for policies that position breastfeeding as the norm for infant feeding. ADA recommends the following strategies to promote and support breastfeeding:

Counsel and Educate Pregnant and Postpartum Women

- Counsel clients enthusiastically about the benefits of breastfeeding, with emphasis that breastfeeding is more than a lifestyle choice.
- Recognize and respect that breastfeeding is an individual and personal decision. Effective educational strategies that strike a balance of support, respect, and education result in informed decisions about infant feeding.
- Discuss the challenges of breastfeeding and suggest ways to minimize or eliminate.
- Provide pregnant women and their families with practical information about breastfeeding that addresses their specific questions and concerns. A family-centered approach may help identify potential breastfeeding problems early and prevent unnecessary or premature weaning.
- Limit or discontinue the use of educational materials provided by formula companies, because they often contain subtle messages that may discourage breastfeeding.
- Target women who are less likely to breastfeed (eg, ethnic minority groups, low education, and adolescents) and counsel in a culturally relevant and sensitive manner.
- Identify women who are at risk for early cessation. The first 6 weeks are especially crucial. Predictors of early cessation include education level, working intentions, workplace support, social support, and previous breastfeeding experience (134).
- Encourage breastfeeding mothers with overweight and obesity to achieve a healthful weight. These women may have a lower prolactin response, which may result in decreased milk production and early cessation of breastfeeding (135).
- Refer new mothers to a woman-to-woman breastfeeding support group. Women who are members of these peer networks act as volunteer counselors and receive specific training on supporting and encouraging new mothers. Peer support may represent a cost-effective method to promote and support breastfeeding, especially where lactation consultants or professional breastfeeding support is not widely available.
- Encourage women who are returning to work or school to explore their options for continuing to breastfeed. Discuss on-site arrangements to pump and store milk safely for later use. For women who cannot pump on-site, discuss how to supplement breastfeeding with formula while apart and continuing to breastfeed when with their infant.
- Discuss appropriate weaning foods, and clean and safe feeding of breast milk substitutes when indicated.
- Provide appropriate and timely information on weaning. The decision to wean should be based on the desires and needs of each breastfeeding dyad. Ideally, weaning should be gradual and solid foods should be offered based on the age and developmental stage of the child. Evaluate client education materials and service delivery sites for product bias. Changes should be made to the counseling environment to clearly communicate that breastfeeding is the norm for infant feeding.

Involve Family and Friends

- Identify support networks as early in pregnancy as possible and develop programs and materials aimed at specific groups such as adolescent mothers, partners, and grandmothers.
- Include fathers in breastfeeding education and counseling sessions. Support from a woman's partner and her mother significantly increase her chances of breastfeeding and continuing to breastfeed. Fathers need to learn how to be part of a successful breastfeeding family and adolescents need to hear that breastfeeding strengthens the bond with their infants. Mothers and grandmothers of pregnant adolescent mothers should also be included if possible.
- Encourage women to identify and enlist help and support of women in their family or community who have previously breastfed successfully.
- Compile a list of resources to give to clients such as breast pump rentals, breastfeeding-friendly places in the community, and contact information for lactation consultants and breastfeeding support groups and agencies.

Enhance Professional Development

- Be familiar with and comply with all aspects of the International Code of Marketing of Breast-milk Substitutes in particular as it applies to health professionals (136).
- Participate in continuing education activities to keep up-to-date with the art and science of lactation. Intensive courses in lactation training and education are available through various organizations.
- Consider obtaining the professional

credential, International Board Certified Lactation Consultant, through the International Board of Lactation Consultant Examiners (137,138).
- Participate in continuing education programs that sharpen skills in counseling and brief motivational interviewing.
- Participate in continuing education programs on cultural competence. Cultural, ethnic, linguistic, and economic differences impact how individuals access and use health, education, and social services. These differences also present barriers to effective education and health care interventions (139,140). The low prevalence of breastfeeding among racial/ethnic minority groups demands ongoing training in cultural competence. Ask questions and invite dialogue to identify and understand the specific barriers for a group, then design or refine services and messages to address those barriers. Focusing on hands-on interventions, skill building and problem-solving can begin the process of social change.
- Conduct critical internal review of undergraduate and graduate dietetic training programs to ensure that lactation physiology, breastfeeding management, and cultural competence are incorporated into curriculums.

Initiate Institutional Change

- Encourage hospitals and birthing centers to adopt the "Ten Steps to Successful Breastfeeding" as outlined by UNICEF/WHO (100).
- Initiate and create institutional and organizational policies to reduce or eliminate institutional bias in hospitals and clinics for infant formula and incorporate appropriate lactation promotion and support policies in their place. Food and nutrition professionals must present the breastfed infant as the standard against which infants fed human milk substitutes are compared.
- Encourage public health agencies and health professionals to use the WHO reference standards for growth assessment of all infants and children.
- Promote the use of pasteurized donor milk from a milk bank for sick or preterm infants when mother's own milk is not available.
- Encourage lactating mothers to consider donating surplus milk to a milk bank.
- Advocate for hospitals and clinics to provide training for all health care staff, including physicians.
- Encourage hospitals to have lactation consultants available.
- Ensure that commercial infant formula and feeding products are not inadvertently being promoted through the display of formula company logos on lanyards, badge holders, pens, and note pads.
- Support the removal of discharge packs in hospitals provided by formula companies to breastfeeding mothers.
- Advocate for the use of nurse home-visitation programs that promote and support breastfeeding among low-income pregnant and postpartum women.

Collaborate with Others Who Promote Breastfeeding

- Participate in professional and volunteer activities with other health professionals and community-based agencies. Collaborative opportunities exist for ADA members to work with the International Lactation Consultant Association; La Leche League International; Nursing Mothers' Counsel; Healthy Mothers Healthy Babies coalitions; WIC; home visitation programs such as the Nurse-Family Partnership Program, the Community Health Workers Program, and the Healthy Families Program; the African American Breastfeeding Alliance; and breastfeeding task forces at all levels to promote and support breastfeeding.
- Work with other health professionals to recruit and train successful breastfeeding women to be members of woman-to-woman breastfeeding peer support groups.

Initiate and Support Breastfeeding Campaigns

- Work with pro-breastfeeding organizations to promote breastfeeding as the social norm.
- Support extending the reach of breastfeeding promotion campaigns to adolescent mothers, men, and grandmothers.
- Initiate and support campaigns that promote breastfeeding exclusivity for the first 6 months of life and continued breastfeeding beyond 6 months. Emphasize that breastfeeding is more than meeting the nutrition needs of young infants. It offers health, physical, and psychological benefits to infants that influence health outcomes later in life.
- Initiate campaigns that promote breastfeeding as part of a broader strategy to eliminate health disparities among vulnerable groups.
- Organize and participate in World Breastfeeding Week activities annually in the first week of August.

Advocate for Policy Change

- Support legislation to eliminate barriers to breastfeeding. More than half of the states have enacted legislation to address breastfeeding in public, on the job, and on jury duty (141).
- Advocate for other policy changes affecting a woman's ability to continue breastfeeding including longer family leave, paid family leave, facilities for child care and breastfeeding at the worksite or nearby in the community, paid nursing breaks, lactation rooms for milk expression, flexible work arrangements, breastfeeding support personnel/lactation consultation, and third party reimbursement for lactation consultation and management services.
- Encourage school boards to review their curriculums to ensure that breastfeeding is presented as the norm in texts, other resources, and classroom discussion at elementary and secondary schools. Volunteer to work with curriculum committees; science fair committees; and guest lecture in classes such as social studies, life management, and science.

Conduct Empirical Research

- Initiate or partner with researchers in the conduct of empirical research. Research is needed on topics such as breastfeeding older children, cultural

influences on infant feeding, milk banking, social marketing of breastfeeding, breastfeeding in the workplace, media portrayal of infant feeding, effectiveness of breastfeeding promotion programs, cost-effectiveness of breastfeeding, hospital/clinic use rates, oral health and breastfeeding, eliminating barriers to extended breastfeeding, and nutrient needs for women and children with special needs. In addition, research should be theory-based and have policy implications.

- Encourage all public and private funding sources to target breastfeeding as an important topic in grant funding.
- Develop and/or advocate for a consistent definition of breastfeeding in research studies to include frequency and duration of breastfeeding as well as timing of introduction of solid foods to improve the understanding of the benefits of exclusive breastfeeding.
- Submit applications for training grants to promote and support breastfeeding at the local level. These grants could focus on activities such as developing woman-to-woman breastfeeding network, providing stipends for women in the woman-to-woman network, developing culturally relevant breastfeeding materials, providing workshop training for health professionals, and establishing telephone hotlines.
- Support a national policy to track breastfeeding trends using nonproprietary data. Policies are also needed to centralize national infant and child morbidity and mortality data.

CONCLUSIONS

Human milk has many beneficial effects on the health of infants, especially premature and low birth weight infants and young children. These benefits are magnified with exclusive breastfeeding and breastfeeding beyond 6 months of age (7,12). Breastfeeding also provides several health benefits for the breastfeeding woman. ADA recognizes the various factors that influence women and their families to choose a particular infant feeding method, but ADA supports and advocates the position that breastfeeding is the optimal feeding method for the infant. RDs and DTRs have an important role in promoting and supporting breastfeeding for its short- and long-term health benefits for both mother and infants. RDs and DTRs also have an important role in conducting empirical research on breastfeeding-related topics. Research is especially needed on the effectiveness of breastfeeding promotion campaigns.

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We thank the reviewers for their many constructive comments and suggestions. The reviewers were not asked to endorse this position or the supporting paper.

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Effects of Early Nutritional Interventions on the Development of Atopic Disease in Infants and Children: The Role of Maternal Dietary Restriction, Breastfeeding, Timing of Introduction of Complementary Foods, and Hydrolyzed Formulas

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Pediatrics 2008;121;183
DOI: 10.1542/peds.2007-3022

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CLINICAL REPORT

Effects of Early Nutritional Interventions on the Development of Atopic Disease in Infants and Children: The Role of Maternal Dietary Restriction, Breastfeeding, Timing of Introduction of Complementary Foods, and Hydrolyzed Formulas

Guidance for the Clinician in Rendering Pediatric Care

Frank R. Greer, MD, Scott H. Sicherer, MD, A. Wesley Burks, MD, and the Committee on Nutrition and Section on Allergy and Immunology

ABSTRACT

This clinical report reviews the nutritional options during pregnancy, lactation, and the first year of life that may affect the development of atopic disease (atopic dermatitis, asthma, food allergy) in early life. It replaces an earlier policy statement from the American Academy of Pediatrics that addressed the use of hypoallergenic infant formulas and included provisional recommendations for dietary management for the prevention of atopic disease. The documented benefits of nutritional intervention that may prevent or delay the onset of atopic disease are largely limited to infants at high risk of developing allergy (ie, infants with at least 1 first-degree relative [parent or sibling] with allergic disease). Current evidence does not support a major role for maternal dietary restrictions during pregnancy or lactation. There is evidence that breastfeeding for at least 4 months, compared with feeding formula made with intact cow milk protein, prevents or delays the occurrence of atopic dermatitis, cow milk allergy, and wheezing in early childhood. In studies of infants at high risk of atopy and who are not exclusively breastfed for 4 to 6 months, there is modest evidence that the onset of atopic disease may be delayed or prevented by the use of hydrolyzed formulas compared with formula made with intact cow milk protein, particularly for atopic dermatitis. Comparative studies of the various hydrolyzed formulas also indicate that not all formulas have the same protective benefit. There is also little evidence that delaying the timing of the introduction of complementary foods beyond 4 to 6 months of age prevents the occurrence of atopic disease. At present, there are insufficient data to document a protective effect of any dietary intervention beyond 4 to 6 months of age for the development of atopic disease.

INTRODUCTION

Over the past several decades, the incidence of atopic diseases such as asthma, atopic dermatitis, and food allergies has increased dramatically. Among children up to 4 years of age, the incidence of asthma has increased 160%, and the incidence of atopic dermatitis has increased twofold to threefold.[1] The incidence of peanut allergy has also doubled in the past decade.[2] Thus, atopic diseases increasingly are a problem for clinicians who provide health care to children.

It has been recognized that early childhood events, including diet, are likely to be important in the development of both childhood and adult diseases. This clinical report will review the nutritional options during pregnancy, lactation, and the first year of life that may or may not affect the development of atopic disease. Although

www.pediatrics.org/cgi/doi/10.1542/peds.2007-3022

doi:10.1542/peds.2007-3022

All clinical reports from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

The guidance in this report does not indicate an exclusive course of treatment or serve as a standard of medical care. Variations, taking into account individual circumstances, may be appropriate.

Key Words
atopy, food allergies, breastfeeding, complementary foods, hydrolyzed formula, atopic dermatitis, asthma

Abbreviations
AAP—American Academy of Pediatrics
IgE—immunoglobulin E
OR—odds ratio
CI—confidence interval

atopic diseases have a clear genetic basis, environmental factors, including early infant nutrition, may have an important influence on their development and, thus, present an opportunity to prevent or delay the onset of the disease. This clinical report replaces an earlier policy statement[3] from the American Academy of Pediatrics (AAP) that addressed the use of hypoallergenic infant formulas and included provisional recommendations for dietary management for the prevention of atopic disease. This report is not directed at the treatment of atopic disease once an infant or child has developed specific atopic symptoms.

DEFINITIONS

The following definitions are used throughout this clinical report (adapted from work by Muraro et al[4]):

Allergy: A hypersensitivity reaction initiated by immunologic mechanisms.

Atopy: A personal or familial tendency to produce immunoglobulin E (IgE) antibodies in response to low-dose allergens, confirmed by a positive skin-prick test result.

Atopic disease: Clinical disease characterized by atopy; typically refers to atopic dermatitis, asthma, allergic rhinitis, and food allergy. This report will be limited to the discussion of conditions for which substantial information is available in the medical literature.

Atopic dermatitis (eczema): A pruritic, chronic inflammatory skin disease that commonly presents during early childhood and is often associated with a personal or family history of other atopic diseases.

Asthma: An allergic-mediated response in the bronchial airways that is verified by the variation in lung function (measured by spirometry) either spontaneously or after bronchodilating drugs.

Cow milk allergy: An immunologically mediated hypersensitivity reaction to cow milk, including IgE-mediated and/or non—IgE-mediated allergic reactions.

Food allergy: An immunologically mediated hypersensitivity reaction to any food, including IgE-mediated and/or non—IgE-mediated allergic reactions.

Hypoallergenic: Reduced allergenicity or reduced ability to stimulate an IgE response and induce IgE-mediated reactions.

Infants at high risk of developing allergy: Infants with at least 1 first-degree relative (parent or sibling) with documented allergic disease.

The following definitions are from various industry sources:

Partially hydrolyzed (PH) formula: Contains reduced oligopeptides that have a molecular weight of generally less than 5000 d (Table 1).

Extensively hydrolyzed (EH) formula: Contains only peptides that have a molecular weight of less than 3000 d (Table 1).

Free amino acid—based formula: Peptide-free formula that contains mixtures of essential and nonessential amino acids (Table 1).

TABLE 1 **Examples of Hydrolyzed Protein and Amino Acid–Based Infant Formulas Available in the United States**

Extensively hydrolyzed casein (cow milk protein)
Enfamil Nutramigen Lipil (Mead Johnson Nutritionals, Evansville, IN)
Enfamil Pregestimil (Mead Johnson Nutritionals)
Similac Alimentum Advance (Ross Products, Columbus, OH)
Partially hydrolyzed whey (cow milk protein)[a]
Good Start Supreme (Nestlé USA, Glendale, CA)
Partially hydrolyzed whey/casein (cow milk protein)[a]
Enfamil Gentlease Lipil (Mead Johnson Nutritionals)
Partially Hydrolyzed Soy (Soy Protein)
Good Start Supreme Soy (Nestlé USA)
Free amino acid–based
Neocate (and Neocate 1+ for children >12 mo) (Nutricia North America, Gaithersburg, MD)
EleCare (Ross Pediatrics)

[a] For infants with known cows milk allergy, the residual milk protein peptides in these formulas may cause an allergic reaction.

DIETARY RESTRICTIONS FOR PREGNANT AND LACTATING WOMEN

The earliest possible nutritional influence on atopic disease in an infant is the diet of the pregnant woman. However, studies generally have not supported a protective effect of a maternal exclusion diet (including the exclusion of cow milk and eggs) during pregnancy on the development of atopic disease in infants, as summarized in a 2006 Cochrane review.[5–10] Although previous AAP publications have suggested that pregnant women avoid peanuts,[3,11] a more recent study has reported that there is no association between the maternal consumption of peanuts during pregnancy and childhood peanut allergy.[12] Previous AAP publications have advised lactating mothers with infants at high risk of developing allergy to avoid peanuts and tree nuts and to consider eliminating eggs, cow milk, and fish from their diets while nursing.[3,11] Dietary food allergens can be detected in breast milk, including peanuts, cow milk protein, and egg.[13–15] Two studies found a preventive effect of maternal dietary exclusion of milk, egg, and fish while breastfeeding on the development of atopic dermatitis in the infant.[16,17] Other studies found no association between the development of atopic diseases and a maternal exclusion diet.[8,18,19] A 2003 study found no association between breastfeeding and peanut allergy, and there was no difference in peanut intake during lactation between mothers with and without children with peanut allergy.[12] Dietary food allergens in human milk may interact with the mucosal immune system[20] and induce allergic reactions in infants who are known to be clinically allergic to the antigen. Rare cases of anaphylaxis to cow milk protein present in human milk have been described even in exclusively breastfed infants.[21]

Consideration of a large number of studies on maternal diet, not all of which were randomized or included dietary restriction during lactation, demonstrated no impact on various outcomes among the majority of the studies, particularly when follow-up was beyond 4 years, and led one recent group of reviewers to conclude that there is no convincing evidence for a long-term preventive effect of maternal diet during lactation on

atopic disease in childhood.[22] A 2006 Cochrane review also concluded that there was insufficient evidence that antigen avoidance during lactation was beneficial in preventing atopic disease in the breastfed infant, with the exception of atopic dermatitis.[5] Because the available published trials have had methodologic shortcomings, more data are necessary to conclude that the avoidance of antigens during lactation prevents atopic dermatitis in infants.[5]

ROLE OF HUMAN MILK AND EXCLUSIVE BREASTFEEDING ON THE DEVELOPMENT OF ATOPIC DISEASE

Since the 1930s, many studies have examined the benefits of breastfeeding on the development of atopic disease. In general, these have been nonrandomized, retrospective, or observational in design and, thus, inconclusive.[22,23] Of course, it is not possible to truly randomize breastfeeding, which is always a confounding variable in these studies. Acknowledging this difficulty, Kramer[23] proposed 12 criteria to apply to studies designed to assess the relationship between atopic disease and breastfeeding. These criteria included nonreliance on late maternal recall of breastfeeding, sufficient duration of exclusive breastfeeding, strict diagnostic criteria for atopic outcomes, assessment of effects of children at high risk of atopic outcomes, and adequate statistical power. Unfortunately, no studies to date have completely fulfilled these criteria.

Atopic Dermatitis

A 2001 meta-analysis of 18 prospective studies compared the incidence of atopic dermatitis in infants who were breastfed versus infants who were fed cow milk formula.[24] Overall, there was a protective effect of exclusive breastfeeding for 3 months (odds ratio [OR]: 0.68; 95% confidence interval [CI]: 0.52–0.88), the stronger effect having been shown for infants with a family history of allergy (OR: 0.58; 95% CI: 0.4–0.92). No protective effect of breastfeeding was seen in children who were not at risk of developing allergy (OR: 1.43; 95% CI: 0.72–2.86).[24] A 2005 study published from Sweden[25] found no effect of exclusive breastfeeding for ≤4 months on the incidence of atopic dermatitis in the first year of life with or without a family history of atopic disease. On the other hand, another 2005 study from Sweden[26] found that exclusive breastfeeding for more than 4 months reduced the risk of atopic dermatitis at 4 years of age (OR: 0.78; 95% CI: 0.63–0.96) with or without a family history of allergy. In their review, Kramer and Kakuma[27] also found no benefit of exclusive breastfeeding beyond 3 months of age on the incidence of atopic dermatitis in studies in which parents were not selected for risk of allergy.

A series of recent reports from the German Infant Nutritional Intervention Program[28–30] also found that breastfeeding reduces the incidence of atopic dermatitis, supporting the results of the meta-analysis.[24] In the interventional arm of this study, 1834 newborn infants identified as being at high risk of developing atopic disease were enrolled in a 3-year longitudinal, prospective study. Breastfeeding infants at risk for atopic disease were enrolled in the study before 14 days of life and, at that time, were exclusively breastfed and had no history of formula supplementation. Infants were randomly assigned at the time of entry to receive supplements of 1 of 3 hydrolyzed formulas (2 extensively hydrolyzed formulas and 1 partially hydrolyzed formula) or a cow milk formula, if formula supplementation had begun. Eight hundred eighty-nine mothers exclusively breastfed for 4 months and did not use any of the formula supplements they were randomly assigned to use. Nine hundred forty-five infants were introduced to the randomly assigned formula before 4 months and, thus, were not exclusively breastfed. Of these, 689 infants were randomly assigned to receive one of the hydrolyzed formulas, and 256 were randomly assigned to receive cow milk formula. The incidence of atopic dermatitis in infants who were exclusively breastfed, breastfed with supplemental hydrolyzed formula, and breastfed with supplemental cow milk formula was 9.5%, 9.8%, and 14.8%, respectively, at the 1-year follow-up.[28–30] Thus, exclusive breastfeeding for 4 months showed a positive effect compared with breastfeeding with supplemental cow milk formula in these infants at high risk of developing allergy. Breastfeeding with supplemental hydrolyzed formula (both partially and extensively hydrolyzed) also showed a positive effect compared with breastfeeding with supplemental cow milk formula; however, breastfeeding with supplements of hydrolyzed formulas showed no advantage compared with exclusive breastfeeding. Both groups showed a one-third decrease in the risk of atopic dermatitis compared with the risk of breastfeeding with supplements of cow milk formula. Thus, exclusive breastfeeding or breastfeeding with hydrolyzed formula is not enough to prevent the majority of cases of atopic dermatitis.

The advantages of breastfeeding are less clear for infants who are not selected for high risk of developing atopic disease, as shown in the noninterventional arm of the German Infant Nutritional Intervention Program.[28] In this arm, mothers unselected for a history of atopy who either formula fed or partially breastfed their infants were free to select cow milk–based or hydrolyzed formulas. No differences in the incidence of atopic dermatitis occurred among the 3 groups of infants (exclusively breastfed for 4 months, cow milk formula fed with or without breastfeeding, and hydrolyzed formula fed with or without breastfeeding). This lack of effect has been attributed to reverse causation; thus, mothers who knew that their infants were at risk of developing allergy were more likely not only to breastfeed but also to breastfeed for a longer period of time. Alternatively, mothers who were not going to breastfeed or were going to supplement with formula were more likely to choose hydrolyzed formula if they believed that their children were at risk of developing atopy. This reverse causation effect may explain why some studies have found an increased incidence of atopic dermatitis in breastfed infants.[31–33]

In summary, for infants at high risk of developing atopy, there is evidence that exclusive breastfeeding for at least 4 months or breastfeeding with supplements of

hydrolyzed infant formulas decreases the risk of atopic dermatitis compared with breastfeeding with supplements of standard cow milk–based formulas. On the basis of currently available evidence, this is less likely to apply to infants who are not at risk of developing atopy, and exclusive breastfeeding beyond 3 to 4 months does not seem to lead to any additional benefit in the incidence of atopic eczema.[27]

Asthma

The evidence for the protective effects of human milk on the development of asthma is more controversial. A 2001 meta-analysis of 12 prospective studies that met preestablished criteria found that exclusive breastfeeding for at least 3 months was protective against the development of asthma between 2 and 5 years of age (OR: 0.70; 95% CI: 0.60–0.81).[34] The effect of breastfeeding was even stronger when the analysis was limited to children from families with a history of atopic disease (OR: 0.52; 95% CI: 0.35–0.79). No benefit was seen in children from families without a history of atopic disease (OR: 0.99; 95% CI: 0.48–2.03).[34] Two more studies[35,36] not included in this meta-analysis supported these results. On the other hand, a 2002 Cochrane review found no benefit of exclusive breastfeeding beyond 3 months on the incidence of asthma in families not preselected for a history of atopic disease.[27]

Two additional reports in the literature with a more accurate definition of asthma[37,38] made a distinction between the wheezy bronchitis associated with viral infections in younger children and that of the allergic disease seen in older children associated with respiratory spirometric changes. In the first of these studies, a cohort of 1246 children in Tucson, Arizona, was followed from birth to 13 years of age.[37] The study found that an association between breastfeeding and asthma at 13 years of age depended on the presence of maternal asthma in children with atopic disease. Infants whose mothers had asthma were at greatest risk of developing asthma by 13 years of age if they had been breastfed exclusively for ≥4 months (OR: 8.7; 95% CI: 3.4–22.2). When infants with atopic disease whose mothers had asthma were exclusively breastfed for any length of time (either greater than or less than 4 months), the risk of developing asthma between 6 and 13 years of age was also increased (OR: 5.7; 95% CI: 2.3–14.1). An increased risk of developing asthma was not found in breastfed children of mothers without asthma. However, in this same study during the first 2 years of life, exclusive breastfeeding was associated with significantly lower rates of recurrent wheezing of infancy (OR: 0.45; 95% CI: 0.2–0.9), similar to results from a recent study performed in Perth, Australia.[35]

In the second of these studies, a long-term longitudinal study from New Zealand,[38] 1037 children from a general population (not selected for risk of allergic disease) were followed from 3 to 26 years of age. Five hundred four infants were breastfed for 4 weeks or more, and 533 infants were formula fed from the time of birth or breastfed for less than 4 weeks. Breastfeeding for more than 4 weeks significantly increased the risk of developing asthma at 9 years (OR: 2.40; 95% CI: 1.36–4.6) and at 21 years (OR: 1.83; 95% CI: 1.35–2.47). This increased risk was not related to the presence of maternal atopic disease, unlike in the Tucson study. The study has been criticized for retrospective determination of breastfeeding and unclear definitions of atopic heredity.[22] There was also no evidence of a "dose-response" effect of breastfeeding on the incidence of atopy or asthma.

In summary, at the present time, it is not possible to conclude that exclusive breastfeeding protects young infants who are at risk of atopic disease from developing asthma in the long term (>6 years of age), and it may even have a detrimental effect.[37,38] On the other hand, breastfeeding seems to decrease the wheezing episodes seen in younger children (<4 years of age) that are often associated with respiratory infections.[35,36]

Food Allergy

Food allergy, similar to atopic dermatitis and asthma, is more likely to occur in infants with a family history of atopic disease. In a prospective study of infants born to families with a history of atopic disease, it was determined that 25% will develop food allergy between birth and 7 years of age.[39] Because both atopic dermatitis and asthma are closely associated with the development of food allergy, it is difficult to sort out the effect of breastfeeding on the development of food allergy. As reviewed above, maternal dietary exposure during pregnancy and lactation is unlikely to contribute significantly to the development of food allergy in the infant, although many food antigens can be found in human milk. In theory, human milk should inhibit food antigen absorption; however, prospective studies have failed to show a protective effect of human milk–specific antibodies to cow milk on infant sensitization.[40] Investigations of the role of breastfeeding on the outcomes of allergies to specific foods have been few, and the results may have been influenced by additional dietary variables such as length and degree of breastfeeding exclusivity. In reviewing the available studies, Muraro et al[22] concluded that exclusively breastfeeding for at least 4 months in infants who are at risk of developing atopic diseases is associated with a lower cumulative incidence of cow milk allergy until 18 months of age. A Cochrane review included only 1 study with a blinded challenge (using the double-blind, placebo-controlled food-challenge technique) and concluded that at least 4 months of exclusive breastfeeding did not protect against food allergy at 1 year of age.[27] Overall, firm conclusions about the role of breastfeeding in either preventing or delaying the onset of specific food allergies are not possible at this time.

ROLE OF HYDROLYZED FORMULA ON THE DEVELOPMENT OF ATOPIC DISEASE

The role of partially hydrolyzed and extensively hydrolyzed formulas for the prevention of atopic disease has been the subject of many studies in both formula-fed and breastfed infants in the last 15 years. Most studies with published results have been of infants at high risk of developing allergy.

Approximately 100 studies in the literature have examined the role of hydrolyzed formulas on the development of atopic disease. However, using the criteria of a 2006 Cochrane review,[41] only 14 randomized or quasi-randomized (eg, using alternation) trials in term infants compared the use of partially or extensively hydrolyzed formula with the use of human milk or an adapted cow milk formula.[42–55] All of these trials have followed up with at least 80% of study participants. It is important to note that none of these studies reported any adverse effects, including any adverse effect on infant growth. No long-term studies have compared partially or extensively hydrolyzed formula to exclusive breastfeeding. Thus, there is no evidence that the use of these formulas is any better than human milk in the prevention of atopic disease.

Three studies of 251 infants examined the effect of partially hydrolyzed formula on reduction of the occurrence of any allergy compared with cow milk formula in infants at high risk of developing allergy.[49,51,52] Two of these studies found no significant effect,[51,52] and a third study found an OR of 0.45 (95% CI: 0.22–0.94) for partially hydrolyzed formula versus cow milk formula.[49] Three more studies[53–55] examined prolonged feeding of extensively hydrolyzed formula compared with partially hydrolyzed formula in 411 infants at high risk of developing allergy. None of these studies found a significant difference in the incidence of atopic dermatitis between the 2 feeding groups. Two of these studies[53,55] of 352 infants also examined other manifestations of atopic disease and did not show a significant difference in the occurrence of food allergy, cow milk allergy, or asthma between the groups of infants who were fed extensively or partially hydrolyzed formula.

A very large published study from the German Infant Nutritional Intervention Program[30] raised additional issues. In the interventional arm of this study, 945 newborn infants were identified as being at high risk of developing atopic disease and were enrolled in a longitudinal, prospective study through 12 months of age. Although the majority of infants were breastfed initially, formula was introduced in the first 4 weeks to most infants. The infants were randomly assigned to receive 1 of 3 hydrolyzed formulas ($n = 689$) or cow milk formula ($n = 256$). The 3 hydrolyzed formulas were a partially hydrolyzed whey-based formula, an extensively hydrolyzed whey-based formula, and an extensively hydrolyzed casein-based formula. The incidence of atopic dermatitis was significantly reduced in those using the extensively hydrolyzed casein-based formula (OR: 0.42; 95% CI: 0.22–0.79; $P < .007$) and the partially hydrolyzed whey-based formula (OR: 0.56; 95% CI: 0.32–0.99; $P < .046$) but not the extensively hydrolyzed whey-based formula (OR: 0.81; 95% CI: 0.48–1.4; $P < .44$), compared with the incidence in those in the cow milk formula group. However, the overall results for prevention of allergic disease (atopic dermatitis, urticaria, and food allergy) for the 3 hydrolyzed formulas compared with cow milk formula were less impressive (extensively hydrolyzed whey-based: OR: 0.86; 95% CI: 0.52–1.4; partially hydrolyzed whey-based: OR: 0.65; 95% CI: 0.38–1.1; and extensively hydrolyzed casein-based: OR: 0.51; 95% CI: 0.28–0.92; $P < .025$). Thus, this study indicated that different hydrolysates have different effects on atopic disease, and there may be an advantage for the extensively hydrolyzed casein-based formula. However, as the study demonstrated, it is difficult to show that partially hydrolyzed formulas have a very large effect on the reduction of atopic disease in infants who are fed formula or mixed feedings of human milk and formula, even if they are at high risk of developing allergic disease. If atopic disease associated with cow milk allergy has occurred, partially hydrolyzed formula is not recommended, because it contains potentially allergic cow milk peptides.

More studies are needed to determine if any of the hydrolyzed formulas have any effect on the incidence of atopic disease later in childhood and adolescence and whether the modest effects of the use of extensively or partially hydrolyzed formulas in early childhood can be confirmed and are sustained. Such studies should also include a cost/benefit analysis of the use of the more expensive hydrolyzed formulas. It should be noted that the potential benefit of these formulas has only been documented in infants at risk of developing atopic disease. Additional studies are needed among unselected infants or infants at low risk.

The use of amino acid–based formulas for prevention of atopic disease has not been studied. Soy formulas, on the other hand, have a long history of use for atopic disease in infants. In a recent meta-analysis of 5 randomized or quasi-randomized studies, the authors concluded that feeding with soy formula should not be recommended for the prevention of atopy in infants at high risk of developing allergy.[56]

ROLE OF INTRODUCTION OF COMPLEMENTARY FOODS ON ATOPIC DISEASE

Many studies have examined the duration of breastfeeding and its effect on atopic disease. However, few studies have examined the timing of the introduction of complementary foods as an independent risk factor for atopic disease in breastfed or formula-fed infants. An expert panel from the European Academy of Allergology and Clinical Immunology has recommended delayed introduction of solid foods for 4 to 6 months in breastfed or formula-fed infants.[22] The AAP has also recommended that solid foods be delayed until 4 to 6 months of age and that whole cow milk be delayed until 12 months of age.[11] Before publication of this clinical report, AAP recommendations for infants who are at risk of developing atopic disease were to avoid eggs until 2 years of age and avoid peanuts, tree nuts, and fish until 3 years of age.[3,11] These guidelines for solid food introduction and avoidance of specific allergens were based on the evidence of a few studies with various limitations.[39,57–59] Three newer studies have reported mixed results regarding the timing of the introduction of solid foods and development of childhood atopic disease.[60–62]

In a prospective (nonrandomized) study of infants at risk of developing atopic disease by Kajosaari[57], atopic dermatitis and history of food allergy were reduced at 1

year of age if the introduction of solid foods was delayed until 6 months compared with at 3 months of age. However, in a 5-year follow-up study, no difference was seen in the incidence of atopic dermatitis or symptoms of food allergy.[57] In a second prospective study of a birth cohort of 1210 unselected children between 2 and 4 years of age, there was more atopic dermatitis but not asthma in infants who were fed 4 or more solid foods compared with no solid foods before 4 months of age.[58] This difference was maintained in a 10-year follow-up study in 85% of the original study infants.[59]

In a study of 257 preterm infants (34.4 weeks' gestational age; birth weight: 2.3–2.4 kg), the introduction of 4 or more, compared with fewer than 4, solid foods before 17 weeks after term was associated with a higher risk of atopic dermatitis (unconfirmed by skin-prick testing) at 12 months after term (OR: 3.49; 95% CI: 1.51–8.05).[60] Also in this study, the introduction of solid foods before 10 weeks of age or atopic disease in either parent increased the risk of atopic dermatitis in infants (OR: 2.94; 95% CI: 1.57–5.52). In a more recent prospective, longitudinal cohort study in which atopic dermatitis was confirmed by skin testing, 642 infants were followed until 5.5 years of age.[61] The history of the introduction of solid foods was carefully recorded during the first year of life. Most children had at least 1 parent with a positive skin-prick test result. Rice cereal was introduced at a median age of 3 months, milk was introduced at a median age of 6 months, and egg was introduced at a median age of 8 months. However, the later introduction of solids had no effect on the prevalence of asthma or atopic dermatitis (confirmed by skin-prick testing), although there was an increased risk of atopic dermatitis in relation to the late (6–8 months) rather than the earlier introduction of eggs (OR: 1.6; 95% CI: 1.1–2.4) or milk (OR: 1.7; 95% CI: 1.1–2.5).[61]

Finally, an ongoing prospective, cohort study[62] of 2612 infants (without a risk of developing atopic disease) found no evidence to support delayed introduction of solid foods beyond 6 months of age for prevention of atopic disease. However, in the same study, the effect of delayed introduction of solid foods for the first 4 months of life was less clear. Another study has even suggested that children exposed to cereal grains before 6 months of age (as opposed to after 6 months of age) are protected from the development of wheat-specific IgE.[63]

In summary, the evidence from these conflicting studies, in balance, does not allow one to conclude that there is a strong relationship between the timing of the introduction of complementary foods and development of atopic disease. This raises serious questions about the benefit of delaying the introduction of solid foods that are thought to be highly allergic (cow milk, fish, eggs, and peanut-containing foods) beyond 4 to 6 months of age; additional studies are needed.

SUMMARY

It is evident that inadequate study design and/or a paucity of data currently limit the ability to draw firm conclusions about certain aspects of atopy prevention through dietary interventions. In some circumstances in which there are insufficient studies (pregnancy and lactation avoidance diets, timing of introduction of specific complementary foods), the lack of proven efficacy does not indicate that the approach is disproved. Rather, more studies would be needed to clarify whether there is a positive or negative effect on atopy outcomes. The following statements summarize the current evidence within the context of these limitations.

1. At the present time, there is lack of evidence that maternal dietary restrictions during pregnancy play a significant role in the prevention of atopic disease in infants. Similarly, antigen avoidance during lactation does not prevent atopic disease, with the possible exception of atopic eczema, although more data are needed to substantiate this conclusion.
2. For infants at high risk of developing atopic disease, there is evidence that exclusive breastfeeding for at least 4 months compared with feeding intact cow milk protein formula decreases the cumulative incidence of atopic dermatitis and cow milk allergy in the first 2 years of life.
3. There is evidence that exclusive breastfeeding for at least 3 months protects against wheezing in early life. However, in infants at risk of developing atopic disease, the current evidence that exclusive breastfeeding protects against allergic asthma occurring beyond 6 years of age is not convincing.
4. In studies of infants at high risk of developing atopic disease who are not breastfed exclusively for 4 to 6 months or are formula fed, there is modest evidence that atopic dermatitis may be delayed or prevented by the use of extensively or partially hydrolyzed formulas, compared with cow milk formula, in early childhood. Comparative studies of the various hydrolyzed formulas have also indicated that not all formulas have the same protective benefit. Extensively hydrolyzed formulas may be more effective than partially hydrolyzed in the prevention of atopic disease. In addition, more research is needed to determine whether these benefits extend into late childhood and adolescence. The higher cost of the hydrolyzed formulas must be considered in any decision-making process for their use. To date, the use of amino acid–based formulas for atopy prevention has not been studied.
5. There is no convincing evidence for the use of soy-based infant formula for the purpose of allergy prevention.
6. Although solid foods should not be introduced before 4 to 6 months of age, there is no current convincing evidence that delaying their introduction beyond this period has a significant protective effect on the development of atopic disease regardless of whether infants are fed cow milk protein formula or human milk. This includes delaying the introduction of foods that are considered to be highly allergic, such as fish, eggs, and foods containing peanut protein.

7. For infants after 4 to 6 months of age, there are insufficient data to support a protective effect of any dietary intervention for the development of atopic disease.
8. Additional studies are needed to document the long-term effect of dietary interventions in infancy to prevent atopic disease, especially in children older than 4 years and in adults.
9. This document describes means to prevent or delay atopic diseases through dietary changes. For a child who has developed an atopic disease that may be precipitated or exacerbated by ingested proteins (via human milk, infant formula, or specific complementary foods), treatment may require specific identification and restriction of causal food proteins. This topic was not reviewed in this document.

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Effects of Early Nutritional Interventions on the Development of Atopic Disease in Infants and Children: The Role of Maternal Dietary Restriction, Breastfeeding, Timing of Introduction of Complementary Foods, and Hydrolyzed Formulas

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Pediatrics 2008;121;183
DOI: 10.1542/peds.2007-3022

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Prevention of Invasive *Cronobacter* Infections in Young Infants Fed Powdered Infant Formulas

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Pediatrics 2012;130;e1076; originally published online October 8, 2012;
DOI: 10.1542/peds.2011-3855

Prevention of Invasive *Cronobacter* Infections in Young Infants Fed Powdered Infant Formulas

WHAT'S KNOWN ON THIS SUBJECT: Invasive *Cronobacter* infection is a rare but devastating disease known to affect hospitalized premature or immunocompromised infants fed powdered infant formulas (PIFs). PIF labels imply that powdered formulas are safe for healthy, term infants if the label instructions are followed.

WHAT THIS STUDY ADDS: *Cronobacter* can also infect healthy, term infants in the first months of life, even if PIF label instructions are followed. Invasive Cronobacter infection is extremely rare in exclusively breastfed infants or those fed commercially sterile, ready-to-feed formulas.

abstract

BACKGROUND: Invasive *Cronobacter* infection is rare, devastating, and epidemiologically/microbiologically linked to powdered infant formulas (PIFs). In 2002–2004, the US Food and Drug Administration advised health care professionals to minimize PIF and powdered human milk fortifier (HMF)'s preparation, feeding, and storage times and avoid feeding them to hospitalized premature or immunocompromised neonates. Labels for PIF used at home imply PIF is safe for healthy, term infants if label instructions are followed.

METHODS: 1) Medical, public health, Centers for Disease Control and Prevention, US Food and Drug Administration, and World Health Organization records, publications, and personal communications were used to compare 68 (1958–2003) and 30 (2004–2010) cases of invasive *Cronobacter* disease in children without underlying disorders. 2) The costs of PIFs and ready-to-feed formulas (RTFs) were compared.

RESULTS: Ninety-nine percent (95/96) of all infected infants were <2 months old. In 2004–2010, 59% (17/29) were term, versus 24% (15/63) in 1958–2003; 52% (15/29) became symptomatic at home, versus 21% (13/61). Of all infected infants, 26% (22/83) had received breast milk (BM), 23% (19/82) RTF, and 90% (76/84) PIF or HMF. Eight percent received BM and not PIF/HMF; 5%, RTF without PIF/HMF. For at least 10 PIF-fed infants, label instructions were reportedly followed. Twenty-four ounces of milk-based RTF cost $0.84 more than milk-based PIF; 24 ounces of soy-based RTF cost $0.24 less than soy-based PIF.

CONCLUSIONS: *Cronobacter* can infect healthy, term (not just hospitalized preterm) young infants. Invasive *Cronobacter* infection is extremely unusual in infants not fed PIF/HMF. RTFs are commercially sterile, require minimal preparation, and are competitively priced. The exclusive use of BM and/or RTF for infants <2 months old should be encouraged. *Pediatrics* 2012;130:e1076–e1084

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KEY WORDS

Cronobacter, *sakazakii*, infant formula, neonatal infection

ABBREVIATIONS

AAP—American Academy of Pediatrics
BM—breast milk
CDC—Centers for Disease Control and Prevention
Cronobacter—*Cronobacter* multispecies complex, formerly *Enterobacter sakazakii*
EBF—exclusively breastfed
FDA—US Food and Drug Administration
HMF—human milk fortifier
PFGE—pulse field electrophoresis
PIF—powdered infant formula
RTF—ready-to-feed formula
WHO—World Health Organization
WIC—Supplemental Nutrition Program for Women, Infants, and Children

www.pediatrics.org/cgi/doi/10.1542/peds.2011-3855

doi:10.1542/peds.2011-3855

Accepted for publication Jun 18, 2012

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PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

FINANCIAL DISCLOSURE: *The author has acted as an expert witness in legal cases related to* Cronobacter *infection; therefore, if this study leads to preventive action, it is, in a practical sense, contrary to her personal financial interests.*

FUNDING: No external funding.

Cronobacter multispecies complex, formerly classified as *Enterobacter sakazakii* (*Cronobacter*), are pathogenic, Gram-negative, non–spore-forming, coliform enteric bacteria.[1,2] Invasive *Cronobacter* infection was first reported in 1961 and is now recognized as a rare, often devastating, infection predominantly affecting infants.[3–6] *Cronobacter* infection appears to have a low infectious dose and short incubation period[6–9] and (R. Mittal, PhD, personal communication, 2011). Liquefying meningitis is a frequent complication, and severe neurologic impairment or death is common.[6] In the United States, only 1 state, Minnesota, requires *Cronobacter* reporting. These infections are likely underrecorded, as evidenced by recent events. In late 2011, single reports of *Cronobacter* illness in infants in Missouri and Illinois caused the Centers for Disease Control and Prevention (CDC) to ask public health officials around the country to look for other cases of *Cronobacter* infection among infants. This generated reports of 2 additional cases, 1 in Oklahoma and 1 in Florida, bringing the 2011 US case total to 13.[10,11]

Ten NICU *Cronobacter* outbreaks have been reported.[6]* In 8, nutritional sources were evaluated; all affected infants had received some specific powdered infant formula (PIF). In 3 outbreaks, epidemiological and microbiologic studies were done. There was no evidence of infant-to-infant or environmental transmission and the implicated PIF yielded *Cronobacter*.[12–14] These findings, nonoutbreak cases, and a 2002 US Food and Drug Administration (FDA) study isolating *Cronobacter* from 23% of sampled PIFs[15] prompted the World Health Organization (WHO) to state[16]: "Contaminated powdered infant formula has been convincingly shown, both epidemiologically and microbiologically, to be the vehicle and source of infection in infants."

A 2002 FDA Letter to Health Care Professionals[17] and subsequent cautionary material from formula manufacturers and the International Formula Council (see, for example, references 18 and 19)† warned that premature infants and infants with underlying medical conditions could become infected with *Cronobacter*, recommended PIF be avoided in NICUs unless there was no alternative, and suggested the chance of infection could be decreased by (1) reconstituting only a small amount of formula at a time, (2) minimizing "holding time" between preparation and feeding, (3) refrigerating and using formula within 24 hours after preparation, and (4) not exceeding 4 hours "hang time" for continuous enteral feeding. Parents did not receive similar information but formula companies gradually changed PIF instructions and labels for at-home use to indicate that PIF should not be fed to premature or immunocompromised infants and, for infants' safety, caretakers should (1) feed PIF immediately or refrigerate and use it within 24 hours and (2) use warmed formula within 1 hour or discard it. (see, for example, references 20–22) Since 2004–2005, PIF labels have stated that PIF is not sterile but, in a 2005–2006 US national survey, when mothers of 2-month-old infants were asked if various formulas were "likely to contain germs," only 29.5% responded affirmatively for PIF, whereas 31.1% did so for commercially sterile, ready-to-feed formula (RTF), and 35.0%, for commercially sterile concentrates.[23]

In an August 28th, 2003 letter to the FDA, the American Academy of Pediatrics (AAP) wrote, "While sampling large batches of product can be problematic, and product sterility cannot be absolutely assured, all powdered formula should be E. sakazakii free. The AAP also recommends that the standards regarding powdered formula be the same for premature as well as term infants. The AAP sees no reason that they should be different, as the absolute risk, even to term infants, is not zero."

This study analyzes all obtainable 1958–2010 reports of invasive pediatric *Cronobacter* infection occurring worldwide in children without underlying disorders, to examine if the frequency, place of occurrence, or characteristics changed after warnings were disseminated to health care professionals. In addition, the costs of PIF, RTF, and concentrates were compared to determine if the latter 2 might be economically viable home-use alternatives to PIF for young infants who are not exclusively breastfed (EBF).

METHODS

Reviewed material included (1) CDC and FDA files obtained through Freedom of Information Act requests, (2) published cases and literature reviews,[4–6,24] (3) all cases reported by WHO as of July 15 to 18, 2008,[25] (4) personal communications with publication authors, and (5) nonconfidential information from parents, medical records, and legal documents. Children were not included in these analyses if their infections were noninvasive or they had underlying birth defects, medical conditions, or signs of immunodeficiency. Other exclusion criteria are provided in Supplemental Information 1. Of note, all children meeting these criteria were ≤87 days of age at symptom onset.

Definitions for terms used herein include the following: healthy, no recorded evidence of a preexisting immunodeficiency, underlying disorder, or birth

*United Kingdom (1961), Netherlands (1983), Greece (1987), Iceland (1989), United States (1989 and 2002), Belgium (2001), Israel (2001), France (2004), and New Zealand (2004).

†The International Formula Council is an international association of manufacturers and marketers of formulated nutrition products (eg, infant formulas and adult nutritionals) whose members are predominantly based in North America. It was formed in 1998 through the consolidation of the Infant Formula Council (founded in 1970) and the Enteral Nutrition Council (founded in 1983).

defect; neonatal, in the first month of life; premature, gestational age <37 weeks at birth; and low birth weight, <2500 g. Nutritional intake was based on the best obtainable information. The estimated general population rate of newly diagnosed primary immunodeficiency, underlying disorders, and birth defects in newborns (ie, <5%) was based on data from a large, local US population[26] and Birth Defects OMNI-Net.[27] US rates of prematurity (13% in 2005), low birth weight births (8%), and breastfeeding of 1-month-olds (46% EBF and an additional 23% fed breast milk [BM] in combination with other foods) were based on CDC data.[28,29] The proportion of US newborns remaining in the hospital because of clinical problems/complicating diagnoses (29% in 2000) was based on US Agency for Healthcare Research and Quality data.[30] Comparisons excluded unknowns and were made by using 2-tailed Fisher exact tests and the Freeman-Halton extension of the Fisher exact tests for 2×3 and 2×4 tables.

Cost data for PIF, RTF, and concentrate formulations of 3 milk-based and 3 soy-based products marketed for US neonates were obtained in September 2011 from 5 Web sites with free-shipping options: www.amazon.com, www.babiesrus.com, www.cvs.com, www.diapers.com, and www.walmart.com.

RESULTS

The proportion of invasively infected infants with a preexisting disorder/immunodeficiency did not change significantly between 1958–2003 and 2004–2010 (9/77, 12% vs 6/36, 17%) and was higher than the general population rate (<5%). The worldwide average annual number of reported invasive *Cronobacter* infections in infants without preexisting conditions, that is, those examined further herein, was 1.5 in 1958–2003 (68 cases in 46 years) and 4.3 in 2004–2010 (30 cases in 7 years).

The proportion of infected infants who were neonates (83%) was stable (Table 1). Only 1 infant was >2 months old at symptom onset. During both time periods, the proportions of *Cronobacter*-infected infants who were premature and/or of low birth weight were higher than in the general population (prematurity, 13%; low birth weight, 8%); however, the proportions of cases involving term and normal birth weight infants were significantly higher in 2004–2010, compared with 1958–2003. Similarly, the proportion of invasive *Cronobacter* infections occurring in a hospital exceeded the proportion of US infants requiring prolonged postnatal hospitalization (29%), but the majority of 2004–2010 infections occurred at home, even though 2 infants who became symptomatic at home on the day of postnatal discharge were placed into the "hospital" category for this analysis. Consistent with these findings, the proportion of reported invasive *Cronobacter* infections involving necrotizing enterocolitis was lower in 2004–2010 than in 1958–2003. In both time periods, most reported *Cronobacter*-infected infants had meningitis.

Nutritional information (Table 2) was wholly absent for 19% of cases in 1958–2003 and no case in 2004–2010. Ninety percent of invasively infected infants had received a powdered product, that is, PIF or human milk fortifier (HMF). This proportion did not differ significantly between time periods, but in 2004–2010 proportionately more infants received multiple types of nutrition. Nineteen infants received RTF; where timing was specified, RTF was initiated before postnatal discharge; at least 9 infants were not receiving it on the day they became symptomatic. The proportions EBF (1/53 in 1958–2003 and 2/29 in 2004–2010) were much lower than the rate for all US neonates

TABLE 1 Characteristics of All Reported Infants Without Underlying Disorders, Invasively Infected With *Cronobacter*, by Time Period

Characteristic[a]	1958–2003	2004–2010	Total	*P*[b]
<1 mo old at onset of symptoms	53/66 (80%)	27/30 (90%)	80/96 (83%)	NS
Premature	48/63 (76%)	12/29 (41%)	60/92 (65%)	
Term	15/63 (24%)	17/29 (59%)	32/92 (35%)	.002
BW <2500 g	44/55 (80%)	10/24 (42%)	54/79 (68%)	
BW ≥2500 g	11/55 (20%)	14/24 (58%)	25/79 (32%)	.001
Premature, BW <2500 g	42/54 (78%)	8/24 (33%)	50/78 (64%)	
Term, BW ≥2500 g	6/54 (11%)	14/24 (58%)	20/78 (26%)	<.0001
Other[c]	6/54 (11%)	2/24 (8%)	8/78 (10%)	
Place of symptom onset				
Hospital	48/61 (79%)	14/29 (48%)[d]	62/90 (69%)	
Home	13/61 (21%)	15/29 (52%)	28/90 (31%)	0.007
Diagnoses[e]				
Meningitis	38/68 (56%)	22/30 (73%)	60/98 (61%)	NS
Bacteremia	21/68 (31%)	14/30 (47%)	35/98 (36%)	NS
NEC	22/68 (32%)	1/30 (3%)	23/98 (23%)	0.001
UTI	1/68 (2%)	0/30 (0%)	1/98 (1%)	NS

See Methods section and Supplemental Information 1 for details concerning data sources and selection criteria. BW, birth weight; NEC, necrotizing enterocolitis; NS, not significant; UTI, urinary tract infection.

[a] An infant was considered term if the records indicated that was the case and/or the gestational age was specified as being at least 37 weeks. An infant was considered premature if the records indicated that was the case and/or the gestational age was <37 weeks. Table excludes patients for whom the specified data are unknown; there were a total of 68 infants in 1958–2003 and 30 in 2004–2010.

[b] Fisher exact tests and Freeman-Halton extension of the Fisher exact probability test for a 2 × 3 table. Not significant if $P \geq .05$. Totals percents may not equal 100 because of rounding.

[c] Term, BW <2500 g or premature, BW ≥2500 g. When "other" category is excluded, *P* remains <.0001.

[d] This category includes 1 infant who became ill 12 hours after leaving the hospital and another who was noted to be ill on the day of hospital discharge and was reportedly symptomatic while in the hospital.

[e] Some patients had >1 diagnosis. Specifically, 18 patients with meningitis also had proven bacteremia and 2 also had NEC. One patient with bacteremia also had NEC and one also had a UTI. *P* values are for proportion with each individual diagnosis.

TABLE 2 Number and Proportion of Reported Infants Without Underlying Disorders, Invasively Infected With *Cronobacter*, by Time Period and Nutrition Source

Nutrition Source[a,b]	1958–2003	2004–2010	Total	*P* Value[c]
Noted[d]	55/68 (81%)	30/30 (100%)	84/98 (86%)	.020
Not indicated	13/68 (19%)	0/30 (0%)	13/98 (13%)	
PIF, no BM[b]	43/53 (81%)	17/30 (57%)	60/83 (72%)	.022
BM & PIF	4/53 (7%)	6/30 (20%)	10/83 (12%)	NS
BM & HMF	3/53 (6%)	2/30 (7%)	5/83 (6%)	NS
BM, no PIF/HMF[b]	3/53 (6%)	4/29[d] (14%)	7/82 (8%)	NS
Any PIF or HMF[e]	51/54[d] (94%)	25/30[d] (83%)	76/84 (90%)	NS
Any BM[e]	10/54[d] (18%)	12/29[d] (41%)	22/83 (26%)	.036
Any RTF[e]	6/53[d] (9%)	13/29[d] (45%)	19/82 (23%)	.003
Any concentrate[e]	1/53[d] (2%)	2/29[d] (7%)	3/82 (4%)	NS

See Methods section and Supplemental Information 1 for details on data sources and selection criteria. Pertinent details on individual cases are provided in the Supplemental Information, but not all previously published details concerning outbreak-associated cases are provided therein. NS, not significant.

[a] Documented nutrition at any time before onset of symptoms, based on the best available information, including from medical records, CDC files, parent report, publications, and communications with publication authors. Total percents may not equal 100 because of rounding. Denominators include only those for whom data were known.

[b] The "PIF, no BM" category includes 9 infants who were also fed RTF, 7 of whom were not receiving RTF at the time of symptom onset and 2 of whom also received concentrate. One of these 2 was receiving only concentrate on the day of symptom onset. The "BM & PIF" category includes 4 infants who also received RTF, one of whom additionally received concentrate. The "BM, no PIF/HMF" category includes 4 infants who were also fed RTF, one of whom may also have been fed his twin's PIF (see Supplemental Information 2 for details).

[c] Fisher's exact tests. Not considered significant if $P \geq .05$.

[d] This category includes 1 infant who received formula that was likely but not definitely PIF and definitely did not receive BM (J. Burdette, MD, personal communication, 2011). This infant is included in the denominator for "any BM" and not in any numerators. The category also includes an infant who definitely received a recalled, contaminated lot of PIF but I could not determine if he received BM or other formulas as well (Belgium 2002). This infant is included in the numerator and denominator for "any PIF." A third infant in this category is a term newborn recorded on a CDC line list as not having received PIF but without information concerning what, if any, enteral feeding she did receive (AZ 2009). This infant is included in the denominator of "Any PIF or HMF" and is not included in "Any BM," "Any RTF," and "Any concentrate."

[e] Categories are not mutually exclusive; therefore, total percent is >100. Numbers are for those who had the specified nutrition noted.

(46%), but the proportions who had been fed BM and other nutrition were not (9/54 = 17% and 10/29 = 34%, vs 23%).[29] The EBF-infected infants lived in Brazil (2003), India (2006), and Slovania (2006). One US neonate diagnosed on the day of his postnatal discharge (2007) and 3 hospitalized infants (United States 1998–2001, United States 2003, Spain 2007) were fed only BM and RTF. Supplemental Information 2 provides the available case-specific clinical, epidemiological, and microbiologic testing details, broken down by nutrition received.

BM was cultured and negative in 5 cases, breast pumps in 2, and pump tubing in 1. Water samples were tested and negative in 10 PIF-related incidents involving 29 patients. One or more PIF product samples of some sort were *Cronobacter* tested in 29 incidents involving 62 patients and positive in 12 of the incidents (41%), involving 44 of the patients (71%). Investigators considered a *Cronobacter* isolate indistinguishable from the patient(s)' isolate(s) in 9 (75% of positive) incidents involving 35 patients. Environmental testing was never described in detail but was noted to have been done in 17 incidents involving 28 patients, with something positive in 6 (35%) incidents involving 16 (57%) patients. These involved formula preparation areas (sink, splash area, counter, water storage area, dish drawer); 2 were considered indistinguishable from patient isolates. FDA records for 1 case indicate that a bottle nipple was positive for *Cronobacter*, in another, a pacifier. (See Supplemental Information 3 for summaries of available microbiologic information, including the techniques used by investigators to compare isolates.)

Records for 4 hospital and 11 at-home US cases unrelated to outbreaks contained comments concerning the caretakers' PIF or HMF feeding and storage techniques (15/35, 43%). For 1 hospitalized infant, it was noted that BM/HMF feedings were given over 30 minutes; for another, that 6 hours-worth of PIF was mixed at a time, refrigerated for <24 hours, and warmed immediately before feeding. For the remaining 2, BM and HMF were mixed immediately before feeding, hang time was <4 hours, and BM was either stored frozen or refrigerated for <6 hours. Records of 8 infants who became symptomatic at home specified that PIF was mixed immediately before each feeding and never stored; another infant's parent made 2 bottles at a time, fed 1 immediately, and stored the other in the refrigerator just until the next feeding; another parent usually mixed formula for each feeding, occasionally made 1 or 2 extra bottles, stored these in the refrigerator, and used them within the day. In addition, 7 records specifically noted that unfinished remainders of feedings were always discarded; 5, that hands and/or preparation areas were washed before PIF preparation; and 6, that bottles, caps, and nipples were sterilized. Of note, these data were not collected systematically by case investigators and absence of information from a record does not indicate that a guideline was not followed. To summarize, for at least 2 infected, hospitalized infants, FDA guidelines reportedly were followed; for at least 10 infants infected at home, label instructions reportedly were followed.

Table 3 provides September 2011 online-shopping costs and relative costs for 6 formulas commonly used from birth to 6 or 12 months of age. These products are all available in PIF, RTF, and concentrate formulations. Prices varied relatively widely within and among brands, products, formulations, and stores. Approximate daily (4 ounces of formula every 4 hours) costs of feeding a neonate the least expensive

TABLE 3 Per Ounce Prices and Price Differences, by Brands and Forms of Infant Formulas

Type of Infant Formula	Price Range[a]	Mean (Median) Cost Differences Compared With Powdered	
		%	Absolute[a]
Within-brand differences[b]			
Milk-based			
Powdered	0.121–0.192	NA	NA
RTF	0.156–0.417	26–60 (31–42)	0.040–0.103 (0.047–0.071)
Concentrate	0.137–0.193	11–15 (13–15)	0.017–0.024 (0.020–0.024)
Soy-based			
Powdered	0.140–0.198	NA	NA
RTF	0.130–0.451	6–82 (6–55)	0.011–0.134 (0.010–0.087)
Concentrate	0.140–0.399	30–36 (15–35)	0.050–0.062 (0.026–0.055)
Prices for all brands[c]	Mean (Median)		
Milk-based formulas			
Powdered	0.160 (0.162)	NA	NA
RTF	0.237 (0.206)	48 (27)	0.077 (0.044)
Concentrate	0.180 (0.184)	12 (14)	0.020 (0.022)
Soy-based formulas			
Powdered	0.170 (0.171)	NA	NA
RTF	0.232 (0.203)	36 (19)	0.062 (0.032)
Concentrate	0.224 (0.212)	32 (24)	0.054 (0.041)
Both milk- & soy-based combined			
Powdered	0.165 (0.169)	NA	NA
RTF	0.235 (0.203)	42 (20)	0.070 (0.034)
Concentrate	0.202 (0.192)	22 (14)	0.037 (0.023)
Least-expensive available products[d]	Actual cost/ounce	Actual Cost Differences Compared With Powdered	
Milk-based formula			
Powdered	0.121	NA	NA
RTF	0.156	29	0.035
Concentrate	0.137	13	0.016
Soy-based formula			
Powdered	0.140	NA	NA
RTF	0.130	−7	−0.010
Concentrate	0.140	0	0

Costs were determined for 6 formulas available for neonates and young infants (and for use by a premature or immunocompromised infant as/if recommended by that infant's pediatrician): Enfamil (milk-based) (5 stores for PIF and RTF, 2 stores for concentrate); ProSobee LIPIL (soy-based) (5 stores for PIF, 3 stores for RTF, and 2 stores for concentrate); Good Start with iron, Gentle or Gentle plus (milk-based) (5 stores for PIF, 4 stores for RTF, and 3 stores for concentrate); Good Start soy, Supreme or Supreme Plus (4 stores for PIF, 3 stores for RTF, and 2 stores for concentrate); Similac Advance (milk-based) (5 stores for PIF, RTF, and concentrate); and Isomil (soy-based) (5 stores for PIF, 4 for RTF and concentrate). Prices were obtained in September 2011, for the least expensive packaging options, from the following Internet sites: Amazon.com, Babies-R-Us, CVS, Diapers.com, and Walmart. Not all sites carried all brands of each product, but all sites carried at least 1 brand each of a powdered, RTF, and concentrate product. Price ranges are for any of the assessed brands at any of the assessed Internet sites. NA, non applicable.

[a] In dollars per fluid ounce of prepared formula.

[b] Brand-specific ranges for differences in mean and median costs of each product type (RTF and Concentrate), compared with PIF, by using prices from all stores carrying the specific product type. Median values are in parentheses.

[c] All brands of specified product type are included in analyses. Medians are provided in parentheses.

[d] Lowest priced product of any brand, at any store. Numbers reflect actual costs and cost differences for those products.

formula of each type were compared. Milk-based RTF cost 84 cents more a day than milk-based PIF and milk-based concentrate cost 38 cents more than milk-based PIF. Soy-based concentrate cost no more than soy-based PIF and soy-based RTF, 24 cents less a day than soy-based PIF.

DISCUSSION

The major findings in this study are that the majority of reported invasive pediatric *Cronobacter* infections now occur in nonhospitalized and term infants, 99% were <3 months old, and 90% had received PIF. These findings raise a number of issues, including study limitations, potential sources of *Cronobacter* infection other than PIF and related to PIF, and implications in terms of parent education and infant feeding, taking into consideration that approximately half of US parents (those living at or below 185% of the federal poverty level) receive nutrition assistance through the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC).

This study has at least 5 limitations. First, these data span a wide time period, during which NICU care, infant-feeding practices, and formula processing have changed in ways that cannot be fully addressed in these analyses. Second, I could examine only available records from known cases of invasive *Cronobacter* infections. Europe has a surveillance system for product contamination (European Rapid Alert System for Food and Feed), but few countries have active surveillance for clinical *Cronobacter* infections. Current automated bacterial identification systems can accurately identify *Cronobacter* but several cases' medical records suggest that not all health care providers recognize that *Cronobacter* is an unusual pathogen. Cases reported after a public health alert[10,11] support that health authorities are not proactively informed of all *Cronobacter* infections. Third, reporting may be biased in regard to case characteristics and information collected. For example, most neonatologists are likely aware of *Cronobacter* infection in premature infants. This might lead to better reporting from NICUs and a relative underestimation of infections in healthy, nonhospitalized infants. Also, infections in breastfed infants are disproportionately represented in published case

reports, even though these provide no or minimal epidemiological or environmental microbiologic data, whereas infections in PIF-fed infants dominate CDC records, review articles, and footnotes in published microbiologic studies. Fourth, information concerning feeding preparation and storage techniques was not provided in response to standardized questionnaires and therefore is incomplete and varies between records. Fifth, I could not document data validity. Much information was obtained by public health investigators at the time of the illness, but some preparation and storage information was obtained in subsequent years. Parental recall may have been inaccurate or influenced by grief, stress, and/or a sense of guilt.

For 3 cases involving PIF-fed infants at home, *Cronobacter* was isolated from kitchen surfaces; for another, from a pacifier; and, for a fifth, from a bottle nipple. Epidemiological investigations could not determine whether these were contaminated by PIF or reflected an extrinsic source of PIF contamination or infection. *Cronobacter* has been found in a number of food substances, some used in PIF and some commonly present in household kitchens.[31,32] In a recent study, it was recovered from environmental sampling in 21 of 78 kitchens of recruited, predominantly low-income, middle Tennessee households.[33] These findings, the seven reported cases of invasive infection in non-PIF-fed infants, and occasional *Cronobacter* infection or colonization of immunocompromised, hospitalized adults,[34] indicate that *Cronobacter* infections are sometimes related to non-PIF sources. However, epidemiological and microbiologic data strongly implicate PIF as a source of pediatric *Cronobacter* infections. Furthermore, *Cronobacter* has been isolated repeatedly from PIF, including as recently as 2010.[9,15,31,35–39] *Cronobacter* (and *Enterobacteriaceae*) are established and ubiquitous in PIF dry processing environments; eradication is not considered possible.[16,40] PIF, RTF, and concentrate manufacturing begin with nonsterile nutritional components being put into solution, homogenized, and then pasteurized, resulting in commercial sterility. PIF is then dried in a nonsterile environment and nonsterile components often are added after pasteurization.[40] Drying- and dry-processing areas can be kept free of *Salmonella* through environmental, component, and end-product surveillance and microbiologic testing; however, 6 PIF-associated salmonellosis outbreaks have been reported since 1995, in Canada, France, Korea, Spain, the United Kingdom, and the United States. The most recent, in 2005, involved 141 French infants.[41]

One of the statistical assumptions in the FDA's *Cronobacter* end-product testing protocol is that *Cronobacter* contamination in PIF is not clustered or clumped[42]; however, *Cronobacter* has been described as tending to form clumps that are "sort of stuck together."[43] A recent study provided evidence of this. A 22 000 kg, released-to-market lot (ie, batch) of PIF was recalled because postmarket testing by authorities found 1 package to be positive for *Cronobacter*.[39] Examination of the retrieved material showed that contamination varied among production-time-specific samples. Most samples were below detectable limits but 3- to 560-cell clusters occurred sporadically in 8 of 2290 1-g samples. The 2 largest clusters, of 123 and 560 cells, originated from just 2 product bags. Of note, the investigated lot contained >1 contaminated product bag, but that does not preclude the possibility of more confined, even single-bag, contamination occurring in other lots of PIF.

Cronobacter has never been isolated from BM, unopened bottled water, treated US municipal drinking water, unopened RTF, or unopened concentrates. Only 7 reported, invasively infected infants were not fed PIF. PIF labels imply the product is safe if label feeding and storage instructions are followed. AAP and WHO PIF guidelines recommend cleaning hands and preparation areas, cleaning and sterilizing equipment, discarding unfed warmed, prepared formula after 2 hours, and storing prepared formula in a refrigerator and for no more than 24 hours.[44,45] Cases of invasive *Cronobacter* infections have occurred when these preparation and feeding guidelines, as well as label directions, reportedly were followed or exceeded (in that formula was always prepared as individual servings immediately before feeding and never stored).

WHO guidelines also recommend that water be boiled and cooled for up to 30 minutes before being added to PIF to achieve a reconstitution temperature of 70°C, because WHO consultants determined this inactivated all tested *Cronobacter* strains.[45] Not all organizations agree with this recommendation.[45] In 2002, the FDA and the US Department of Agriculture reversed their own recommendations that health professionals use boiled water to reconstitute PIF, citing potential loss of heat-sensitive nutrients, changes in some formulas' physical characteristics, inadequate destruction of *Cronobacter*, and injury to personnel preparing formula.[17,45] The European Society for Pediatric Gastroenterology, Hepatology, and Nutrition Committee on Nutrition also disagreed with the WHO recommendation, because of possible adverse effects on nutrients.[45] AAP's current instructions do not recommend boiling water unless the safety of the water source is uncertain.[44] Two case records reviewed herein indicated that the *Cronobacter*-infected infants had received boiled water, but there was no indication it was done as recommended by WHO. Of note, in a recent report of two 2010 noninvasive

Cronobacter infections in Mexico, associated with a US-manufactured PIF, the authors determined that the health care providers had attempted to follow WHO guidelines. However, retrospective investigation suggested that the boiled water was likely 45°C, not 70°C, at the time of PIF reconstitution.[9]

The AAP recommends exclusive breastfeeding for the first 6 months of infancy.[46] The data herein suggest that invasive *Cronobacter* infection rarely occurs in EBF infants. However, the proportion of *Cronobacter*-infected infants who were partially breastfed was similar to the rate for all US 1-month-olds. In a 2007 survey of breastfeeding-related maternity practices at US hospitals and birth centers, 70% of facilities reported providing breastfeeding mothers with discharge packs containing formula samples.[47] It might be helpful to discontinue these samples or limit them to RTF, which is commercially sterile, requires minimal, albeit careful, handling, and is comparably priced to PIF if parents are willing and able to comparison shop.

Comparison shopping is not a primary option for families on WIC. WIC has instituted policies to encourage breastfeeding, with some apparent success; in 1 non-nationally representative, US survey, 47% of WIC neonates were EBF in the previous week, compared with 26% of non-WIC neonates.[23] Infant formula is purchased by WIC at a discount, through a state-by-state exclusive contract bidding process, and provided to nonbreastfeeding or BM-supplementing mothers. RTF is available through WIC, but PIF is the predominant type of formula currently used by the program. The options for parents on WIC could be improved if WIC could provide RTF for infants in the first 2 months of life.

CONCLUSIONS

Premature and immunocompromised PIF-fed neonates continue to be disproportionately represented in reports of invasive *Cronobacter* infection, relative to their proportion in the general population. However, the majority of cases now involve nonhospitalized and term, PIF-fed infants. Parents, like health care professionals, need education concerning the proper handling and storage of infant nutrition, as well as accurate information concerning the relative number of enteric infections, including *Cronobacter*, in EBF, RTF-fed, and PIF-fed infants, so they can make informed decisions about their infants' nutrition.

ACKNOWLEDGMENTS

The author would like to acknowledge Stephen Rathke's helpful discussions and encouragement and to thank the parents, authors, and other individuals who provided additional information, to ensure this study would be as complete and accurate as possible.

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Prevention of Invasive *Cronobacter* Infections in Young Infants Fed Powdered Infant Formulas

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Pediatrics 2012;130;e1076; originally published online October 8, 2012;
DOI: 10.1542/peds.2011-3855

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Lactose Intolerance in Infants, Children, and Adolescents

Melvin B. Heyman

Pediatrics 2006;118;1279
DOI: 10.1542/peds.2006-1721

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CLINICAL REPORT

Lactose Intolerance in Infants, Children, and Adolescents

Guidance for the Clinician in Rendering Pediatric Care

Melvin B. Heyman, MD, MPH, for the Committee on Nutrition

ABSTRACT

The American Academy of Pediatrics Committee on Nutrition presents an updated review of lactose intolerance in infants, children, and adolescents. Differences between primary, secondary, congenital, and developmental lactase deficiency that may result in lactose intolerance are discussed. Children with suspected lactose intolerance can be assessed clinically by dietary lactose elimination or by tests including noninvasive hydrogen breath testing or invasive intestinal biopsy determination of lactase (and other disaccharidase) concentrations. Treatment consists of use of lactase-treated dairy products or oral lactase supplementation, limitation of lactose-containing foods, or dairy elimination. The American Academy of Pediatrics supports use of dairy foods as an important source of calcium for bone mineral health and of other nutrients that facilitate growth in children and adolescents. If dairy products are eliminated, other dietary sources of calcium or calcium supplements need to be provided.

INTRODUCTION

SIGNIFICANT CHANGES IN our knowledge and approach toward lactose intolerance have occurred over the past quarter century, since the first statement on lactose intolerance was published by the American Academy of Pediatrics Committee on Nutrition.[1] Lactose ingestion in certain susceptible individuals can cause abdominal symptoms that are variable and can be treated with dietary restriction or enzyme replacement, depending on the amount of lactose consumed and the degree of lactase deficiency. Pediatricians and other pediatric care providers should maintain awareness of the benefits and controversies related to the consumption of dietary milk products and milk-based infant formula. The lactose content of milk often influences, correctly or not, the ultimate decision about the use or continuation of milk in the diet. Milk and dairy-product avoidance has a negative effect on calcium and vitamin D intake in infants, children, and adolescents. Other nutrients such as protein make dairy products an important source of nutrition for growing children. This revised statement will update the initial statement of 1978 while incorporating changes from the 1990 supplement[2] and current state-of-the-art relating to lactose intolerance. Recommendations regarding dietary calcium have been updated recently.[3]

Lactose, a disaccharide that comprises the monosaccharides glucose and galactose, is the primary carbohydrate found exclusively in mammalian milk. Absorption of lactose requires lactase activity in the small intestinal brush border to split the bond linking the 2 monosaccharides. A β-galactosidase termed "lactase-phlorizin hydrolase" (lactase) accounts for most of the lactase activity in the intestinal

www.pediatrics.org/cgi/doi/10.1542/peds.2006-1721

doi:10.1542/peds.2006-1721

All clinical reports from the American Academy of Pediatrics automatically expire 5 years after publication unless reaffirmed, revised, or retired at or before that time.

Key Words
abdominal pain, breath tests, calcium, dietary, dairy products, diarrhea, flatulence, lactase, malabsorption, pediatric

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

mucosa.[4] Lactase is found in the small intestine and localized to the tips of the villi, a factor of clinical importance when considering the effect of diarrheal illness on the ability to tolerate milk.

Milk intolerance may be attributed to either the lactose or the protein content. Lactose intolerance can occur among infants and young children with acute diarrheal disease, although the clinical significance of this is limited except in more severely affected children. Symptoms of lactose intolerance are relatively common among older children and adolescents; however, associated intestinal injury is infrequently seen. Lactose intolerance is a distinct entity from cow milk–protein sensitivity, which involves the immune system and causes varying degrees of injury to the intestinal mucosal surface. Cow milk–protein intolerance is reported in 2% to 5% of infants within the first 1 to 3 months of life, typically resolves by 1 year of age, and is not the subject of this statement.[5,6]

DEFINITIONS

Following are definitions of terms used in the remainder of this statement:

- Lactose intolerance is a clinical syndrome of 1 or more of the following: abdominal pain, diarrhea, nausea, flatulence, and/or bloating after the ingestion of lactose or lactose-containing food substances. The amount of lactose that will cause symptoms varies from individual to individual, depending on the amount of lactose consumed, the degree of lactase deficiency, and the form of food substance in which the lactose is ingested.
- Lactose malabsorption is the physiologic problem that manifests as lactose intolerance and is attributable to an imbalance between the amount of ingested lactose and the capacity for lactase to hydrolyze the disaccharide.
- Primary lactase deficiency is attributable to relative or absolute absence of lactase that develops in childhood at various ages in different racial groups and is the most common cause of lactose malabsorption and lactose intolerance. Primary lactase deficiency is also referred to as adult-type hypolactasia, lactase nonpersistence, or hereditary lactase deficiency.
- Secondary lactase deficiency is lactase deficiency that results from small bowel injury, such as acute gastroenteritis, persistent diarrhea, small bowel overgrowth, cancer chemotherapy, or other causes of injury to the small intestinal mucosa, and can present at any age but is more common in infancy.
- Congenital lactase deficiency is extremely rare; teleologically, infants with congenital lactase deficiency would not be expected to survive before the 20th century, when no readily accessible and nutritionally adequate lactose-free human milk substitute was available.
- Developmental lactase deficiency is now defined as the relative lactase deficiency observed among preterm infants of less than 34 weeks' gestation.

Primary Lactase Deficiency

Approximately 70% of the world's population has primary lactase deficiency.[7,8] The percentage varies according to ethnicity and is related to the use of dairy products in the diet, resulting in genetic selection of individuals with the ability to digest lactose (Table 1). In populations with a predominance of dairy foods in the diet, particularly northern European people, as few as 2% of the population has primary lactase deficiency. In contrast, the prevalence of primary lactase deficiency is 50% to 80% in Hispanic people, 60% to 80% in black and Ashkenazi Jewish people, and almost 100% in Asian and American Indian people.[9–11] The age of onset and its prevalence differ among various populations. Approximately 20% of Hispanic, Asian, and black children younger than 5 years of age have evidence of lactase deficiency and lactose malabsorption,[12] whereas white children typically do not develop symptoms of lactose intolerance until after 4 or 5 years of age. Recent molecular studies of lactase-phlorizin hydrolase (lactase) have correlated the genetic polymorphism of messenger RNA expression with persistence of lactase activity, demonstrating early loss (at 1–2 years of age) of messenger RNA expression and enzyme activity in Thai children and late (10–20 years of age) loss of activity in Finnish children.[11,13] The clinical relevance of these observations is that children with clinical signs of lactose intolerance at an earlier age than is typical for a specific ethnic group may warrant an evaluation for an underlying cause, because primary lactase deficiency would otherwise be unusual at such a young age. Although primary lactase deficiency may present with a relatively acute onset of milk intolerance, its onset typically is subtle and progressive over many years. Most lactase-

TABLE 1 **Prevalence of Acquired Primary Lactase Deficiency[69]**

Examples of groups among whom lactase deficiency predominates (60%–100% lactase deficient)
Near East and Mediterranean: Arabs, Ashkenazi Jews, Greek Cypriots, Southern Italians
Asia: Thais, Indonesians, Chinese, Koreans
Africa: South Nigerians, Hausa, Bantu
North and South America: black Americans, Latinas, Eskimos, Canadian and American Indians, Chami Indians
Examples of groups among whom lactase persistence predominates (2%–30% lactase deficient)
Northern Europeans
Africa: Hima, Tussi, Nomadic Fulani
India: individuals from Punjab and New Delhi

deficient individuals experience onset of symptoms in late adolescence and adulthood.

Reports that focus on clinical symptoms of lactase deficiency are prone to subjectivity, confounding clinical diagnosis. For instance, when lactase-deficient adults were given 2 glasses of milk or 2 glasses of lactose-hydrolyzed milk per day in a double-blind, crossover study, no statistical differences in symptoms of lactose intolerance were found regardless of whether the individual described himself or herself as lactose intolerant.[14] Even lactose-intolerant adults may find that 1 glass of milk or a scoop of ice cream is tolerated, whereas an additional glass of milk or other milk product may produce symptoms. Because of the variation of dairy intake in each individual's diet and in the amount of lactose contained in different products, symptoms may vary and be modified by diet and by milk-containing foods (see "Management"). For these reasons, dietary history is an unreliable means to confirm or exclude the diagnosis of lactose intolerance.

Secondary Lactase Deficiency

Secondary lactase deficiency implies that an underlying pathophysiologic condition is responsible for the lactase deficiency and subsequent lactose malabsorption. Etiologies include acute infection (eg, rotavirus) causing small intestinal injury with loss of the lactase-containing epithelial cells from the tips of the villi. The immature epithelial cells that replace these are often lactase deficient, leading to secondary lactose deficiency and lactose malabsorption, although several reports indicate that lactose malabsorption in most children with acute gastroenteritis is not clinically important.[15] Several recent studies and a meta-analysis found that children with rotaviral (and other infectious) diarrheal illnesses who have no or only mild dehydration can safely continue human milk or standard (lactose-containing) formula without any significant effect on outcome, including hydration status, nutritional status, duration of illness, or success of therapy.[16–18] However, in the at-risk infant (eg, younger than 3 months or malnourished) who develops infectious diarrhea, lactose intolerance may be a significant factor that will influence the evolution of the illness. Giardiasis, cryptosporidiosis, and other parasites that infect the proximal small intestine often lead to lactose malabsorption from direct injury to the epithelial cells by the parasite. Secondary lactase deficiency with clinical signs of lactose intolerance can be seen in celiac disease, Crohn disease, and immune-related and other enteropathies and should be considered in these children. Diagnostic evaluation should be directed toward these entities when secondary lactase deficiency is suspected and an infectious etiology is not found.

Young infants with severe malnutrition develop small intestinal atrophy that also leads to secondary lactase deficiency.[19] Although uncommon in the United States, malnutrition is associated with lactose malabsorption and carbohydrate intolerance in developing countries.[20] Lactose malabsorption has also been associated with poor growth in these countries.[21] Most infants and children with malabsorption attributable to malnutrition are able to continue to tolerate dietary carbohydrates, including lactose.[22] However, the World Health Organization recommends avoidance of lactose-containing milks in children with persistent postinfectious diarrhea (diarrhea lasting more than 14 days) when they fail a dietary trial of milk or yogurt.[23]

Treatment of secondary lactase deficiency and lactose malabsorption attributable to an underlying condition generally does not require elimination of lactose from the diet but, rather, treatment of the underlying condition. Once the primary problem is resolved, lactose-containing products can often be consumed normally, and these excellent sources of calcium and other nutrients need not be unnecessarily excluded from the diet.

Developmental (Neonatal) Lactase Deficiency

In the immature gastrointestinal tract, lactase and other disaccharidases are deficient until at least 34 weeks' gestation.[24] One study in preterm infants reported benefit from use of lactase-supplemented feedings or lactose-reduced formulas,[25] and the use of lactose-containing formulas and human milk does not seem to have any short- or long-term deleterious effects in preterm infants.[26] Up to 20% of the dietary lactose may reach the colon in neonates and young infants. Bacterial metabolism of colonic lactose lowers the fecal pH (5.0–5.5 is normal), which has a beneficial effect, favoring certain organisms (eg, *Bifidobacterium* and *Lactobacillus* species) in lieu of potential pathogens (*Proteus* species, *Escherichia coli*, and *Klebsiella* species) in young infants. Antimicrobial agents may also affect this colonization.

Congenital Lactase Deficiency

Congenital lactase deficiency is a rare disorder that has been reported in only a few infants.[27,28] Affected newborn infants present with intractable diarrhea as soon as human milk or lactose-containing formula is introduced. Small intestinal biopsies reveal normal histologic characteristics but low or completely absent lactase concentrations.[29,30] Unless this is recognized and treated quickly, the condition is life-threatening because of dehydration and electrolyte losses. Treatment is simply removal and substitution of lactose from the diet with a commercial lactose-free formula.

DIAGNOSIS

Symptoms of lactose intolerance, including abdominal distention, flatulence, abdominal cramping, and (ultimately) diarrhea, are independent of the cause of lactose malabsorption and are directly related to the quantity of ingested lactose. These symptoms are not necessarily

correlated with the degree of intestinal lactase deficiency. Malabsorbed lactose generates an osmotic load that draws fluid and electrolytes into the intestinal lumen, leading to loose stool. The onset of diarrhea and other symptoms is related to the amount of lactose that is not absorbed. As little as 12 g of lactose (the amount of lactose in an 8-oz glass of milk) may be sufficient to cause symptoms in children with chronic abdominal pain.[31] In addition, unabsorbed lactose is a substrate for intestinal bacteria, especially in the colon. Bacteria metabolize lactose, producing volatile fatty acids and gases (methane, carbon dioxide, and hydrogen), leading to flatulence. The fatty acids lower the fecal pH, making the fecal pH test a nonspecific but sometimes helpful marker for lactose (or other carbohydrate) malabsorption. When sufficient intestinal gas is produced by the bacterial metabolic processes to cause stimulation of the intestinal nervous system by intestinal distention, visceral (abdominal) cramping results.

Initial studies using lactose hydrogen breath tests documented lactose malabsorption in up to 40% of children and adolescents presenting with abdominal pain.[32] However, recent studies suggest that the prevalence of abdominal symptoms related to lactose intolerance documented by hydrogen breath tests is variable and ranges from 2% in Finnish children to 24% in southern US children.[33,34]

A good clinical history often reveals a relationship between lactose ingestion and symptoms. When lactose intolerance is suspected, a lactose-free diet can be tried (Tables 2 and 3).[35] During a diagnostic lactose-free diet, it is important that all sources of lactose be eliminated, requiring the reading of food labels to identify "hidden" sources of lactose. Generally, a 2-week trial of a strict lactose-free diet with resolution of symptoms and subsequent reintroduction of dairy foods with recurrence of symptoms can be diagnostic. In more-subtle cases, the hydrogen breath test is the least invasive and most helpful test to diagnose lactose malabsorption. The test has been shown to be more reliable than history, because some patients think they are lactose intolerant when they prove not to be, and others prove to be lactose intolerant (lactose malabsorbers) when they think they are not.[36,37] The test is performed by administration of a standardized amount of lactose (2 g/kg, up to a maximum of 25 g, equivalent to the amount of lactose in 2 8-oz glasses of milk) after fasting overnight and then measuring the amount of hydrogen in expired air over a 2- to 3-hour period. An increase (>20 ppm) in the hydrogen expired after approximately 60 minutes is consistent with lactose malabsorption. Factors that may produce false-negative or false-positive results include conditions affecting the intestinal flora (eg, recent use of antimicrobial agents), lack of hydrogen-producing bacteria (10%–15% of the population), ingestion of high-fiber diets before the test, small intestinal bacterial overgrowth, or intestinal motility disorders. A pediatric gastroenterologist should be consulted to interpret the results of this test.

TABLE 2 **Lactose and Calcium Content of Common Foods[70,71]**

Dairy Products	Calcium Content, mg	Lactose Content, g
Yogurt, plain, low fat, 1 cup	448	8.4
Milk, whole (3.25% fat), 1 cup	276	12.8
Milk, reduced fat, 1 cup	285	12.2
Ice cream, vanilla, 1/2 cup	92	4.9
Cheddar cheese, 1 oz	204	0.07
Swiss cheese, 1 oz	224	0.02
Cottage cheese, creamed (small curd), 1 cup	135	1.4

TABLE 3 **Hidden Sources of Lactose[72]**

Bread and other baked goods
Processed breakfast cereals
Mixes for pancakes, biscuits, and cookies
Instant potatoes, soups, and breakfast drinks
Margarine
Nonkosher lunchmeats
Salad dressings
Candies and other snacks

The older lactose-tolerance test was previously relied on as the primary test of lactose malabsorption before the breath hydrogen test became available. Lactose intolerance was diagnosed by onset of symptoms and/or positive test results after ingestion of a standard lactose dose (2 g/kg of body weight or 50 g/m^2 of body surface area; maximum 50 g in a 20% water solution). If the maximum increase in blood glucose concentration was less than 26 mg/dL after a lactose-tolerance test dose, lactose malabsorption was diagnosed. The lactose-tolerance test is not sensitive enough to determine if a subject is malabsorbing some lactose. It is also often falsely positive because of lack of an increase of blood glucose concentration attributable to normal insulin response to the carbohydrate load. Given the high rate of false-negative and false-positive results, this test should not be used and has been replaced by the hydrogen breath test.

Other tests are available in consultation with a pediatric gastroenterologist to diagnose lactose intolerance. If an underlying cause for secondary lactose intolerance is suspected, testing for intestinal etiologies includes stool examination, particularly for parasites affecting the upper gastrointestinal tract such as *Giardia lamblia* and *Cryptosporidia* species, and blood tests for celiac disease (ie, total immunoglobulin A concentration and antitissue transglutaminase antibody[38,39]) or immunodeficiency (quantitative immunoglobulins). Intestinal biopsy may be needed to uncover an underlying gastrointestinal mucosal problem that is causing the lactose malabsorption. Biopsies can yield direct measurement of disaccharidase concentrations to document lactase deficiency directly and assess the status of the other

brush-border disaccharidases (sucrase, maltase, isomaltase), which may also be deficient under various circumstances. However, intestinal lactase concentrations do not seem to correlate well with symptoms of lactose intolerance.[40]

Newer tests may eventually yield additional detailed information pertaining to the prevalence and significance of lactose intolerance.[41] For example, the [^{13}C]lactose breath test is being considered as a test to augment the accuracy of the breath hydrogen test but is still primarily an investigational tool.[42,43]

In infants with diarrhea in whom lactose (or other carbohydrate) intolerance is suspected, stool can be screened for malabsorbed carbohydrate by testing fecal pH, which decreases with carbohydrate malabsorption as a result of the formation of volatile fatty acids. It should be remembered that fecal pH will normally be lower (5.0–5.5) in infants compared with older children and adolescents because of the physiologic overload of lactose in their diets, which in turn helps to favor growth of *Lactobacillus* species in the colon. Fecal reducing substances can also be measured and become positive by excretion of a reducing sugar in the stools. Reducing sugars include lactose, glucose, fructose, and galactose but not sucrose. Because some patients may only malabsorb enough carbohydrates, such as lactose, to lower the fecal pH but not increase excretion of carbohydrate in the stool, the pH test is a more sensitive test for carbohydrate malabsorption.

MANAGEMENT

When children are diagnosed with lactose intolerance, avoidance of milk and other dairy products will relieve symptoms. However, those with primary lactose intolerance have varying degrees of lactase deficiency and, correspondingly, often tolerate varying amounts of dietary lactose. Lactose-intolerant children (and their parents) should realize that ingestion of dairy products resulting in symptoms generally leads to transient symptoms without causing harm to the gastrointestinal tract (as compared with celiac disease or allergic reactions, including milk-protein intolerance, that can lead to ongoing inflammation and mucosal damage). Although lactose malabsorption does not predispose to calcium malabsorption,[44] avoidance of milk products to control symptoms may be problematic for optimal bone mineralization. Children who avoid milk have been documented to ingest less-than-recommended amounts of calcium needed for normal bone calcium accretion and bone mineralization.[45,46]

Lactose-free and lactose-reduced milks (and lactose-free whole milk for children younger than 2 years) are widely available in supermarkets and can be obtained with WIC (Special Supplemental Nutrition Program for Women, Infants, and Children) vouchers. Although lactose-free milk is more expensive than regular milk, some major chain stores sell less-expensive lactose-free milk under their own brand names.

Beyond infancy, substitutes for cow milk based on rice, soy, or other proteins are readily available and are generally free of lactose, although the nutrient content of most of these milks is not equivalent to cow milk. Other mammalian milks, including goat milk, are not free of lactose. Tolerance to milk products may be partial, so that dietary maneuvers alone may help avoid symptoms in some individuals. Small amounts of lactose in portions of 4 to 8 oz spaced throughout the day and consumed with other foods may be tolerated with no symptoms.[47–51] Some children are able to drink 1 to 2 glasses of milk each day without difficulty but cannot tolerate more without developing symptoms.[14] Many lactose-intolerant individuals who are intolerant of milk can tolerate milk chocolate[52] and/or yogurt (plain better than flavored), because the bacteria in the yogurt partially digest the lactose into glucose and galactose before consumption.[53,54] In addition, yogurt's semisolid state slows gastric emptying and gastrointestinal transit, resulting in fewer symptoms of lactose intolerance.[55] Furthermore, ingestion of other solid foods delays gastric emptying, providing additional time for endogenous lactase to digest dietary lactose. Aged cheeses tend to have lower lactose content than other cheeses and, thus, may also be better tolerated. Finally, oral lactase-replacement capsules or predigested milk or dairy products with lactase are readily available and will often permit a lactose-intolerant individual to be able to take some or all milk products freely.[56] Because the vitamin D content in milk-substitute products varies, labels must be checked to verify the vitamin D content of individual brands.

Even among population groups with significant lactose intolerance, the importance of dietary dairy products has been stressed. For example, the National Medical Association recently recommended that black people consume 3 to 4 servings per day of low-fat milk, cheese, and/or yogurt and that lactose-free milk be used as an alternative for those who are intolerant of these other products to help reduce the risk of nutrient-related chronic diseases such as hypertension and diabetes.[57]

Milk and dairy products are often well tolerated by many children with underlying inflammatory conditions of the intestines, including Crohn disease and ulcerative colitis, in whom the prevalence of lactose intolerance does not seem to be any greater than in the general population.[58–61]

Lactose-Free Formulas

In developed countries, even in the case of acute gastroenteritis, enough lactose digestion and absorption are preserved so that low-lactose and lactose-free formulas have no clinical advantages compared with standard lactose-containing formulas except in severely undernourished children, in whom lactose-containing formu-

las may worsen the diarrhea and lactose-free formulas may be advantageous.[62] Breastfed infants should be continued on human milk in all cases.[57] This has also been reviewed recently in the American Academy of Pediatrics' practice guideline for acute gastroenteritis.[63] The use of lactase in formulas for preterm infants has been noted above. Although lactose-free cow milk–protein-based formulas are readily available and popular, no studies have documented that these formulas have any clinical impact on infant outcome measures including colic, growth, or development.[64]

Lactose, Calcium Absorption, and Bone Mineral Content

Recent evidence indicates that dietary lactose enhances calcium absorption and, conversely, that lactose-free diets result in lower calcium absorption.[65] Thus, lactose intolerance (and lactose-free diets) theoretically may predispose to inadequate bone mineralization, a problem now recognized in many other disorders affecting pediatric patients.[45,46] The effects of lactose-free diets in childhood on long-term bone mineral content and risk of fractures and osteoporosis with aging remains to be clarified. Calcium homeostasis is also affected by protein intake, vitamin D status, salt intake, and genetic and other factors, making long-term studies essential to determine the risks of each or all of these to bone health. Recent studies suggest that in the future, genetic testing may be useful for identifying individuals at increased risk of lactase deficiency and consequent diminished bone mineral density,[66] potentially allowing early intervention with dietary manipulation or nutrient supplementation. Recent research has even suggested that gene-replacement therapies might someday be available for susceptible individuals.[67]

SUMMARY

Lactose intolerance has been recognized for many years as a common problem in many children and most adults throughout the world. Although rarely life-threatening, the symptoms of lactose intolerance can lead to significant discomfort, disrupted quality of life, and loss of school attendance, leisure and sports activities, and work time, all at a cost to individuals, families, and society. Treatment is relatively simple and aimed at reducing or eliminating the inciting substance, lactose, by eliminating it from the diet or by "predigesting" it with supplemental lactase-enzyme replacement. Calcium must be provided by alternate nondairy dietary sources or as a dietary supplement to individuals who avoid milk intake.

CONCLUSIONS

1. Lactose intolerance is a common cause of abdominal pain in older children and teenagers.
2. Lactose intolerance attributable to primary lactase deficiency is uncommon before 2 to 3 years of age in all populations; when lactose malabsorption becomes apparent before 2 to 3 years of age, other etiologies must be sought.
3. Evaluation for lactose intolerance can be achieved relatively easily by dietary elimination and challenge. More-formal testing is usually noninvasive, typically with fecal pH in the presence of watery diarrhea and hydrogen breath testing.
4. If lactose-free diets are used for treatment of lactose intolerance, the diets should include a good source of calcium and/or calcium supplementation to meet daily recommended intake levels.
5. Treatment of lactose intolerance by elimination of milk and other dairy products is not usually necessary given newer approaches to lactose intolerance, including the use of partially digested products (such as yogurts, cheeses, products containing *Lactobacillus acidophilus*, and pretreated milks[56,68]). Evidence that avoidance of dairy products may lead to inadequate calcium intake and consequent suboptimal bone mineralization makes these important as alternatives to milk. Dairy products remain principle sources of protein and other nutrients that are essential for growth in children.

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Pediatrics 2006;118;1279
DOI: 10.1542/peds.2006-1721

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Lipid Screening and Cardiovascular Health in Childhood

Stephen R. Daniels and Frank R. Greer

Pediatrics 2008;122;198
DOI: 10.1542/peds.2008-1349

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CLINICAL REPORT

Lipid Screening and Cardiovascular Health in Childhood

Guidance for the Clinician in Rendering Pediatric Care

Stephen R. Daniels, MD, PhD, Frank R. Greer, MD, and the Committee on Nutrition

ABSTRACT

This clinical report replaces the 1998 policy statement from the American Academy of Pediatrics on cholesterol in childhood, which has been retired. This report has taken on new urgency given the current epidemic of childhood obesity with the subsequent increasing risk of type 2 diabetes mellitus, hypertension, and cardiovascular disease in older children and adults. The approach to screening children and adolescents with a fasting lipid profile remains a targeted approach. Overweight children belong to a special risk category of children and are in need of cholesterol screening regardless of family history or other risk factors. This report reemphasizes the need for prevention of cardiovascular disease by following Dietary Guidelines for Americans and increasing physical activity and also includes a review of the pharmacologic agents and indications for treating dyslipidemia in children. *Pediatrics* 2008;122:198–208

www.pediatrics.org/cgi/doi/10.1542/peds.2008-1349

doi:10.1542/peds.2008-1349

Key Words
lipid screening, children, cardiovascular disease, cholesterol, lipid profile, dyslipidemia, obesity, familial hypercholesterolemia, statins

Abbreviations
CVD— cardiovascular disease
AAP—American Academy of Pediatrics
LDL—low-density lipoprotein
HDL— high-density lipoprotein
PDAY—Pathobiological Determinants of Atherosclerosis in Youth
IMT—intimal medial thickness
NHANES—National Health and Nutrition Examination Survey
NCEP—National Cholesterol Education Program
VLDL—very low-density lipoprotein

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of death and morbidity in the United States.[1] Most of the clinical burden of CVD occurs in adulthood. However, research over the last 40 years has increasingly indicated that the process of atherosclerotic CVD begins early in life and is progressive throughout the life span.[2] It has also become clear that there is an important genetic component to the disease process that produces susceptibility but that environmental factors, such as diet and physical activity, are equally important in determining the course of the disease process.

This statement replaces the outdated 1998 American Academy of Pediatrics (AAP) policy statement "Cholesterol in Childhood," which has been retired.[3] New data emphasize the negative effects of excess dietary intake of saturated and trans fats and cholesterol as well as the effect of carbohydrate intake, the obesity epidemic, the metabolic/insulin-resistance syndrome, and the decreased level of physical activity and fitness on the risk of adult-onset CVD. In addition, more data are now available on the safety and efficiency of pharmacologic agents used to treat dyslipidemia. Most of these data were not available at the time of the previous statement.

A number of studies have identified potential risk factors for adult CVD.[4] The strongest risk factors include a high concentration of low-density lipoprotein (LDL), a low concentration of high-density lipoprotein (HDL), elevated blood pressure, type 1 or 2 diabetes mellitus, cigarette smoking, and obesity. Research in children and adolescents has demonstrated that some of these risk factors may be present at a young age,[5] and pediatricians must initiate the lifelong approach to prevention of CVD in their patients. The focus of this report is on improving lipid and lipoprotein concentrations during childhood and adolescence to lower the lifelong risk of CVD. The current obesity epidemic among children has increased the need for pediatric health care professionals to be knowledgeable of the risk factors for CVD and to implement the changes recommended in this report in practice.

DEVELOPMENT OF ATHEROSCLEROSIS IN CHILDREN

Autopsy studies, such as the Pathobiological Determinants of Atherosclerosis in Youth (PDAY) study and the Bogalusa Heart Study, have demonstrated that the atherosclerotic process begins in childhood.[2,6–8] The earliest pathologic finding in atherosclerosis is thought to be the fatty streak. This is characterized by an accumulation of lipid-filled macrophages within the intima of an artery.[9] The progression of atherosclerosis is characterized by continued accumulation of lipid-filled macrophages and a proliferation of vascular smooth muscle cells. These

smooth muscle cells migrate into the arterial intima and form a lesion called a fibrous plaque.[9] This lesion is responsible for adverse clinical outcomes, such as myocardial infarction and ischemic stroke, by either obstructing the arterial lumen or rupture of the plaque with release of thrombogenic substances.

The PDAY study included people 15 to 34 years of age who died of accidental causes.[7,8] The PDAY investigators examined indicators of cardiovascular risk status, measured at the time of autopsy. These indicators included concentrations of cholesterol and vascular pathologic features indicative of hypertension. They evaluated the extent of fatty streaks and fibrous plaques in the aorta and coronary arteries and found that the presence of increased coverage of the arterial intimal surface, with fatty streaks and fibrous plaques, was associated with increased traditional risk factors, such as elevation of cholesterol levels and blood pressure.[7,8]

The Bogalusa Heart Study investigators followed a cohort of children who had their risk-factor status measured during examinations at school.[2,6] As this population became older, some people died of accidental causes. The investigators were able to obtain autopsies on these people and evaluate the presence and extent of atherosclerotic lesions.[6] They reported that the extent of the arterial intimal surface covered with fatty streaks and fibrous plaques increased with age. The prevalence was almost 70% in young adulthood. They also found that the extent to which the intimal surface was covered with atherosclerotic lesions was significantly associated with elevation of concentrations of total cholesterol, LDL, and triglycerides, as well as a lower concentration of HDL. Another important finding was that increased coverage of atherosclerotic lesions was positively correlated with the number of risk factors for CVD present, such as dyslipidemia, high blood pressure, and obesity.[6]

More recently, noninvasive methods of imaging have allowed for the study of atherosclerosis development. The Muscatine Study used ultrasonography of the carotid arteries to evaluate intimal medial thickness (IMT), which has been shown to be an indicator of the atherosclerotic process in adults.[10] Carotid ultrasonography in adults aged 33 to 42 years showed that increased carotid IMT was associated with increased total cholesterol concentration and other CVD risk factors, such as high blood pressure, in childhood.[10] A second study, the Cardiovascular Risk in Young Finns Study, also showed a positive relationship between adolescent risk factors and subclinical measures of atherosclerosis in adulthood.[11] In this study of >2000 young adults, CVD risk status in adolescence was predictive of increased carotid IMT in adulthood, independent of the risk factors for CVD present in adulthood.

From these studies, it is increasingly clear that cholesterol concentrations can be elevated during childhood and adolescence and that increased concentrations in childhood are associated with increased risk of atherosclerosis and CVD in adulthood.

CHOLESTEROL CONCENTRATIONS IN CHILDHOOD AND ADOLESCENCE

Data from the Lipid Research Clinics prevalence studies have shown that the concentration of serum lipids and lipoproteins increases during early childhood and reaches concentrations similar to those seen in young adults by approximately 2 years of age.[12] This knowledge is important when making recommendations regarding screening, because concentrations before 2 years of age may not reflect values in subsequent years of childhood or adult values. Population-based studies, including the National Health and Nutrition Examination Surveys (NHANESs), have provided useful data on the distribution and trends in lipids and lipoproteins during childhood and adolescence. Data from the 1988–1994 NHANES for ages 4 to 19 years showed that the mean total cholesterol concentration was 165 mg/dL.[13] Age-specific values for mean total cholesterol concentration actually peaked at 171 mg/dL at 9 to 11 years of age.[13] The values subsequently decreased during pubertal development and then increased thereafter. This has important implications for the timing of cholesterol screening and the cut points used, because lipid concentrations are age and maturation dependent.[14]

There are also differences in cholesterol concentrations related to gender. In the 1988–1994 NHANES, females had higher total cholesterol and LDL concentrations than did males. Females also tended to have higher HDL concentrations than did males after pubertal development had occurred. Investigators for the Project HeartBeat! study reported that lipid and lipoprotein concentrations changed in different ways for males and females during development.[15] These developmental patterns of puberty are complicated by ethnicity, with black girls having the earliest onset of puberty.

There are also differences in cholesterol and triglyceride concentrations according to ethnic group. In the 1988–1994 NHANES, black children had higher HDL and lower triglyceride concentrations than did children of non-Hispanic white and Hispanic descent.[13] In the Cardiovascular Health in Children Study of 8- to 10-year-olds in North Carolina, black children had the highest prevalence of having a total serum cholesterol concentration of >200 mg/dL: 18.7%, compared with 11% in white children.[16] The overall prevalence in all ethnic groups of having a total cholesterol level of >200 mg/dL was 12.6%.

As observed in adults,[17] there have been changes over time in lipid and lipoprotein concentrations in children and adolescents. Ford et al[18] compared values from the 1988–1994 and 1999–2000 NHANESs. They found that, over this 12-year time period, triglyceride concentrations decreased approximately 8.8 mg/dL in adolescents aged 12 to 17 years, and total cholesterol, LDL, and HDL concentrations remained relatively stable. Hickman et al[13] compared data from the 1966–1970 NHANES with those from the 1988–1994 NHANES in children and adolescents aged 4 to 19 years and reported a decrease in mean total cholesterol concentration of approximately 7 mg/dL during this time. The reasons for these changes are not completely understood, but they may be related

to the increased efforts to alter diet and prevent CVD that have been in effect since the 1950s.

A substantial proportion of children and adolescents have elevated concentrations of lipids and lipoproteins. In the Child and Adolescent Trial for Cardiovascular Health, 13.3% of children in the 4th grade had total cholesterol concentrations of >200 mg/dL. The prevalence of total cholesterol concentrations of >200 mg/dL was 15.6% in girls and 11.1% in boys.[5] In the 1988–1994 NHANES, approximately 10% of adolescents had total cholesterol concentrations of >200 mg/dL, which is a level of concern in adults.[13]

An important epidemiologic aspect of cardiovascular risk in children is the tracking of lipid and lipoprotein concentrations over time. Tracking indicates the likelihood that children will maintain their percentile ranking over time. Such tracking has been demonstrated in a number of studies, most notably the Muscatine Study and Bogalusa Heart Study.[19–21] In the Muscatine Study, 75% of school-aged children who had total cholesterol concentrations greater than the 90th percentile at baseline had total cholesterol concentrations of >200 mg/dL in their early 20s. In the Bogalusa Heart Study, approximately 70% of the children with elevated cholesterol levels continued to have cholesterol elevations in young adulthood. The Muscatine investigators also evaluated other factors beyond childhood cholesterol concentrations that predicted cholesterol level elevation in adulthood.[19] They found that onset of obesity in adolescence and young adulthood, cigarette smoking, and use of oral contraceptives by women may have deleterious effects on adult concentrations of lipids and lipoproteins.

CLINICAL EVALUATION

A recommendation regarding a targeted approach to cholesterol screening for children from the National Cholesterol Education Program (NCEP) of the National Heart, Lung, and Blood Institute was published in 1992 and subsequently adopted by the AAP.[22] This approach recommends screening children with a family history of premature CVD or high blood concentrations of cholesterol. They also recommend screening pediatric patients for whom family history is not known or those who had other risk factors for CVD such as obesity, hypertension, and diabetes mellitus. Since publication of that guideline, research has focused on optimizing the approach to screening children and adolescents for cholesterol elevation and the subsequent treatment of cholesterol abnormalities. However, the results of this research have not led to consensus on pediatric screening, and many continue to advocate for screening on the basis of a positive family history. Some have maintained that the evidence is insufficient to recommend for or against routine screening for lipid disorders in childhood.[23] Others have suggested that a universal screening strategy similar to that recommended for adults be used for children and adolescents, although no pediatric organizations have recommended universal screening.[23]

The optimal screening program would identify children and adolescents with progressive atherosclerosis who are most at risk of CVD in adulthood. One problem is that, currently, no noninvasive clinically applicable tools are available to adequately assess the progression of atherosclerosis in children without familial hypercholesterolemia. This means that investigators and clinicians have often relied on cholesterol concentrations as a surrogate marker for this risk. In adults, this approach is well accepted and has led to the NCEP adopting the Framingham risk score to evaluate which patients are at highest 10-year risk of CVD and would benefit from more aggressive treatment.[24] Unfortunately, no similar risk score is available for children. Also, data supporting a particular level of childhood cholesterol that predicts risk of adult CVD do not exist, which makes the prospect of a firm evidence-based recommendation for cholesterol screening for children elusive.

There are problems with the targeted approach to screening on the basis of a family history of CVD or of cholesterol level elevation.[25] The assumption for this recommendation is that the family history will provide additional information regarding the genetic predisposition and shared environmental factors that may increase risk. Unfortunately, family history may not be known, and if it is known, it may be incomplete or inaccurate. It also presumes that adult family members have had their cholesterol level measured, will know their results, and understand the significance of those results. Unfortunately, this is often not the case.

Since the NCEP recommended targeted screening, investigators have attempted to evaluate its effectiveness. Generally, studies of the targeted approach have found that 35% to 46% of children and adolescents have had their cholesterol levels measured on the basis of a positive family history of CVD or elevated cholesterol concentration.[25–29] The reasons for this variability may be that populations may differ in adult prevalence of CVD or in the implementation of the default screening strategies for children and adolescents when family history is unknown or when other risk factors, including obesity and blood pressure elevation, are present. With the prevalence of obesity increasing[30] and the possibility that the prevalence of high blood pressure is also increasing,[31] this would lead to an increase in the percentage of children and adolescents who would qualify for having their cholesterol concentration determined. The studies of screening have also shown that although it is useful for identifying children with a cholesterol level elevation, 30% to 60% of children and adolescents with high cholesterol levels will be missed by the targeted strategy.[26,32,33] An important but unanswered question is whether the lack of identification and treatment of those children leads to increased risk of CVD development.

ABNORMAL CHOLESTEROL CONCENTRATIONS

The NCEP pediatric report recommended the cut points presented in Table 1 be used to identify children and adolescents with abnormal lipid and lipoprotein concentrations.[22] It is worth noting that the same values are used for all children, from 2 to 18 years of age. After 18 years of age, the concentrations presented in the NCEP report for adults would be used. As discussed previously, cholesterol concentrations change with age in children

TABLE 1 **Cut Points for Total Cholesterol and LDL Concentrations in Children and Adolescents**

Category	Percentile	Total Cholesterol, mg/dL	LDL, mg/dL
Acceptable	<75th	<170	<110
Borderline	75th–95th	170–199	110–129
Elevated	>95th	>200	>130

Adapted from NCEP guidelines for children and adolescents.[22]

and adolescents and are particularly variable during puberty. The sensitivity and specificity of these cut-point concentrations for predicting adult lipid status may vary widely according to age and sexual maturation of the pediatric patient. Friedman et al[14] showed that the lowest sensitivity occurred at 14 to 16 years of age, when cholesterol values are generally lower, whereas the highest sensitivity occurred at 5 to 10 and 17 to 19 years of age. Of interest is that the results were similar regardless of whether the population was restricted to children with a positive parental history of CVD. It is also worth noting that the NCEP did not provide pediatric cut points for concentrations of triglycerides or HDL. Measurement of these variables has become more important, because they are part of the clustering of risk factors associated with obesity and often called the metabolic syndrome. The American Heart Association has recommended that triglyceride concentrations of >150 mg/dL and HDL concentrations of <35 mg/dL be considered abnormal for children and adolescents.[34] Again, a single cut point for all pediatric age groups may be limited by the known age, sexual, and ethnic differences in the concentrations of triglycerides and HDL.

Given the concerns for using the same cut points for all children, percentile values for concentrations of total cholesterol, triglycerides, LDL, and HDL according to age and gender are presented in Table 2. These values are from the 1981 prevalence study of the Lipid Research Clinics and were measured before the increase in prevalence of obesity.[12] These percentile values could be used in a similar fashion to those for blood pressure and BMI. In this case, LDL concentrations greater than the 95th percentile (or less than the 5th percentile for HDL concentration) would be considered abnormal, particularly if the abnormality was persistent over several office visits. LDL concentrations between the 90th and 95th percentiles (5th–10th for HDL concentration) would be considered borderline. Use of these tables and percentiles would reduce the clinical effects of natural changes in lipid and lipoprotein concentrations with age.

METABOLIC SYNDROME

The metabolic syndrome is a clustering of risk factors for CVD and diabetes mellitus that seems to be related to obesity and insulin resistance. The NCEP definition of the metabolic syndrome for adults is presented in Table 3. Currently, there is no accepted definition of the metabolic syndrome for children and adolescents. However,

TABLE 2 **Lipid and Lipoprotein Distributions in Subjects Aged 5 to 19 Years**

	Males			Females		
	5–9 y	10–14 y	15–19 y	5–9 y	10–14 y	15–19 y
Total cholesterol, mg/dL						
50th percentile	153	161	152	164	159	157
75th percentile	168	173	168	177	171	176
90th percentile	183	191	183	189	191	198
95th percentile	186	201	191	197	205	208
Triglyceride, mg/dL						
50th percentile	48	58	68	57	68	64
75th percentile	58	74	88	74	85	85
90th percentile	70	94	125	103	104	112
95th percentile	85	111	143	120	120	126
LDL, mg/dL						
50th percentile	90	94	93	98	94	93
75th percentile	103	109	109	115	110	110
90th percentile	117	123	123	125	126	129
95th percentile	129	133	130	140	136	137
HDL, mg/dL						
5th percentile	38	37	30	36	37	35
10th percentile	43	40	34	38	40	38
25th percentile	49	46	39	48	45	43
50th percentile	55	55	46	52	52	51

Adapted from the Lipid Research Clinic Pediatric Prevalence Study.[12]

several definitions have been proposed using the same factors but using percentile values for the cut points.[35–37]

Prevalence of the metabolic syndrome in any group depends on the variables and cut points chosen. Nevertheless, it does seem that the metabolic syndrome, regardless of the cutoffs used for various risk factors, is more prevalent in overweight children and adolescents. It also seems that the prevalence of the metabolic syndrome has increased in children and adolescents, reflecting the increased prevalence of obesity, prediabetes, and type 2 diabetes mellitus.[38,39] In addition, pathology studies such as the Bogalusa Heart Study have clearly shown that the presence of an increasing number of risk factors (as seen in the metabolic syndrome) is associated with increased risk of fatty streaks and fibrous plaques in the aorta and coronary arteries.[6] Generally, the approach to treatment of the metabolic syndrome is focused on decreasing the BMI percentile of obese children, which is usually accomplished via lifestyle changes in diet and physical activity. Kirk et al[40] demonstrated that the components of the metabolic syndrome can be improved by effective weight management. A relatively small de-

TABLE 3 **Definition of Metabolic Syndrome for Adults[25]**

Clinical Measure	Any 3 of the Following 5 Features
Waist circumference, cm	≥102 (men) or ≥88 (women)
Lipid levels	
Triglycerides, mg/dL	≥150
HDL, mg/dL	<40 (men) or <50 (women)
Blood pressure, mm Hg	≥130/85
Fasting glucose level (includes diabetes), mg/dL	>100

Note that there is no currently accepted definition of metabolic syndrome in children.

crease in BMI percentile can be effective. In adults, a weight loss of only 5% to 7% was shown to be successful in prevention of diabetes mellitus in the Diabetes Prevention Program.[41] These results indicate that for some overweight children, maintenance of weight during growth in height can be beneficial.

CLINICAL APPROACH FOR TREATMENT OF ABNORMALITIES IN LIPID AND LIPOPROTEIN CONCENTRATIONS

The 1992 guidelines for children and adolescents published by the NCEP recommended 2 broad approaches to lowering or minimizing cholesterol levels in young people. One is a population-based approach that focuses on lifestyle issues for all children. The second is an individual approach focusing on children and adolescents at high risk.[22] This comprehensive, 2-pronged approach was adopted previously by the AAP.[3]

Population Approach

The population approach addresses the diet and levels of physical activity that are appropriate for all children and adolescents. The AAP has also addressed these issues in its policy statement on active healthy living for children.[42] The emphasis on a healthy lifestyle is key in the prevention of the development of abnormal lipid and lipoprotein concentrations. Although changes in individuals are modest, implementation of this approach can result in substantially fewer people in the higher-risk range for CVD.[43]

Dietary changes using the population approach are not recommended for children younger than 2 years, because younger children are thought to require a relatively high intake of total fat to support rapid growth and development.[22] However, some studies have examined dietary intervention at a younger age. The ongoing Special Turku Risk Intervention Program was a randomized dietary intervention study beginning at approximately 7 months of age with weaning. Children in the intervention group were maintained on a diet with total fat of <30% of calories, saturated fat of <10% of calories, and cholesterol intake of <200 mg/day, using 1.5% cow milk after 12 months of age.[44] Outcomes in this study included both growth and neurologic function. No adverse effects of the intervention diet were observed on growth or neurologic outcomes. Other significant observations included lowering the LDL concentrations of boys and decreasing the prevalence of obesity in girls in the intervention groups, compared with controls.[45]

Most studies of dietary intervention have been performed on older children aged 8 to 11 years.[46] In the Dietary Intervention Study in Children, the lower saturated fat intervention diet was safe and resulted in significantly lower LDL concentrations in the dietary intervention group. It is encouraging that in both the Special Turku Risk Intervention Program and the Dietary Intervention Study in Children, children who received the dietary intervention were more likely to select healthier foods.[44,46] The results of these studies indicate that there is no harm associated with prudent diet changes, even when they are instituted in children soon after weaning.

TABLE 4 **Daily Estimated Calories and Recommended Servings for Grains, Fruits, Vegetables, and Milk/Dairy According to Age and Gender**

	1 y	2–3 y	4–8 y	9–13 y	14–18 y
Energy, kcal[a]	900	1000	—	—	—
Female	—	—	1200	1600	1800
Male	—	—	1400	1800	2200
Fat, % kcal	30–40	30–35	25–35	25–35	25–35
Milk/dairy, cups[b]	2[c]	2	2	3	3
Lean meat/beans, oz	1 1/2	2	—	5	—
Female	—	—	3	—	5
Male	—	—	4	—	6
Fruits, cups[d]	1	1	1 1/2	1 1/2	—
Female	—	—	—	—	1 1/2
Male	—	—	—	—	2
Vegetables, cups[d]	3/4	1	—	—	—
Female	—	—	1	2	2 1/2
Male	—	—	1 1/2	2 1/2	3
Grains, oz[e]	2	3	—	—	—
Female	—	—	4	5	6
Male	—	—	5	6	7

Calorie estimates are based on sedentary lifestyle. Increased physical activity will require additional calories (0–200 kcal/day if moderately physically active and 200–400 kcal/day if very physically active [1 kcal = 4.2 kJ]). — indicates data not applicable.

[a] For youth 2 years and older; adapted from Table 2, Table 3, and Appendix A-2 of the 2005 *Dietary Guidelines for Americans*. (www.healthierus.gov/dietaryguidelines). Nutrient and energy contributions from each group are calculated according to the nutrient-dense forms of food in each group (eg, lean meats and fat-free milk).

[b] Milk listed is fat free (except for children younger than 2 years). If 1%, 2%, or whole-fat milk is substituted, this will use, for each cup, respectively, 19, 39, or 63 kcal of discretionary calories and add 2.6, 5.1, or 9.0 g of total fat, of which 1.3, 2.6, or 4.6 g are saturated fat.

[c] For 1-year-old children, 2% fat milk is included. If 2 cups of whole milk are substituted, 48 kcal of discretionary calories will be used.

[d] Serving sizes are > 1/4 > cup for 1 year of age, > 1/3 > cup for 2 to 3 years of age, and > 1/2 > cup for ≥4 years of age. A variety of vegetables should be selected from each subgroup over the week.

[e] Half of all grains should be whole grains.

Adapted with permission from American Heart Association. Table: dietary recommendations for children. Available at: www.americanheart.org/presenter.jhtml?identifier=3033999.

This includes use of reduced-fat milk in children after 12 months of age.

The American Heart Association recently provided updated dietary recommendations based on the new US Department of Agriculture dietary guidelines for children (older than 2 years) and adolescents (Table 4), which have been endorsed by the AAP.[47,48] These guidelines include recommendations that children and adolescents have a balanced caloric intake with sufficient physical activity to achieve an appropriate weight and consume more fruits, vegetables, fish, whole grains, and low-fat dairy products. It is also recommended that the intake of fruit juice, sugar-sweetened beverages and foods, and salt be reduced.

At the time of the earlier NCEP recommendations, there was less concern about trans fatty acids in processed and preprepared foods. Trans fatty acids in the diet tend to increase LDL concentration and do not raise HDL concentration.[49] Therefore, the new guidelines recommend that intake of trans fatty acids be limited to <1% of total calories.[47,48] This is easier for families to implement, because the fat content, including total grams of trans fatty acids, is now required on all food

labels. The largest source of trans fatty acids is the partially hydrogenated fat used in preparation of both fried and baked products both inside and outside the home.

Individual Approach

This approach focuses on people at high risk, such as children and adolescents with a family history of CVD or high cholesterol level or who themselves have high total cholesterol and LDL concentrations or other significant CVD risk factors. Some of these children have a strong genetic basis for their dyslipidemia, including the heterozygous form of familial hypercholesterolemia. These children and adolescents require a higher level of intervention. Initially, this intervention is focused on changing the diet. However, if this approach does not lower LDL to an acceptable concentration, these children may be candidates for pharmacologic intervention (see "Pharmacologic Intervention").

Diet

The recommended diet for the high-risk group is similar to that recommended for the population but restricts saturated fat to 7% of total calories and dietary cholesterol to 200 mg/day. Again, data from randomized clinical trials in children as young as 7 months of age have demonstrated that these dietary recommendations are safe and do not interfere with normal growth, development, and sexual maturation.[44,46,48]

The success of this diet depends on a number of factors, including the saturated-fat intake before changes are implemented. Because dyslipidemia is often a familial problem, some children will already be on a diet relatively low in saturated fat. For these children with a genetic cause of dyslipidemia and LDL concentration of ≥190 mg/dL, it is unlikely that diet alone will achieve appropriate concentrations of LDL. Nevertheless, it is important to implement dietary changes that are associated with reduction of LDL concentrations, which may allow for use of lower doses of pharmacologic agents when they are started. Dietary changes are still an important part of any long-term intervention.

Implementation of this more aggressive diet is likely to require involvement of a dietitian to help families make the appropriate changes without compromising good nutrition. There have been anecdotal reports of parents implementing a very low-fat diet without supervision, leading to nutritional insufficiency and failure to thrive.[50] The home environment is very important to help children and adolescents make the best choices and maintain a healthful diet. Parents must be empowered to choose the time and available food and drink for meals and snacks. It is most helpful if everyone in the family is consuming a healthful diet and parents act as a role model for their children.

Dietitians can also help children and their families navigate the food environment outside the house, which has become increasingly important because more children do more eating outside the home environment. Because the schedules of children and their parents are increasingly complex, these alternative venues for eating are more attractive, because they may provide more convenience and efficiency. These venues include school, the homes of friends, and restaurants. Fast-food restaurants also provide carryout foods to be eaten in the home environment. Making healthful choices in these settings is more difficult because of the myriad external cues for eating, including advertising and the choices of peers.

Other Nonpharmacologic Approaches

Some adjuncts to dietary therapy have also been recommended. Increasing the intake of soluble fiber can be helpful in reducing plasma LDL concentration. Some studies have shown a modest reduction of LDL concentration by approximately 7%, but others have been equivocal.[51] Fiber is thought to bind with cholesterol in bile acids and remove it from the enterohepatic circulation. This often requires supplements of fiber. An appropriate dose of supplemental fiber is calculated as the child's age plus 5 g/day, up to a dose of 20 g/day at 15 years of age.[34]

Plant stanols and sterols are added to a number of products, including spreads and margarine, orange juice, yogurt drinks, cereal bars, and dietary supplements. These compounds lower the absorption of dietary cholesterol and, in adults, have been shown to reduce cholesterol concentration by approximately 5% to 10% with minimal adverse effects.[52] One of the few randomized clinical trials with children showed that a margarine product resulting in 20 g/day intake of plant sterol reduced LDL concentration by 8%.[53] The most important safety concern with these products is that they also result in decreased absorption of fat-soluble vitamins and β carotene.

Increased physical activity may also be useful for improving dyslipidemia in children and adolescents. Physical activity primarily affects HDL and triglyceride concentrations, but improvement of LDL concentration has also been documented.[54,55] Although there have been few randomized clinical trials to document the effects of physical activity as a specific intervention for children and adolescents, supportive data are available from epidemiologic studies.[55]

PHARMACOLOGIC INTERVENTION

The concentrations of LDL at which pharmacologic intervention is recommended for children 8 years and older and adolescents are presented in Table 5. It is recommended that pharmacologic intervention in children younger than 8 years only be implemented if they have the dramatic elevation of LDL concentration (>500 mg/dL) as seen with the homozygous form of familial hypercholesterolemia. For children and adolescents with diabetes, renal disease, congenital heart disease, or collagen vascular diseases and those who are cancer survivors, more aggressive treatment of high LDL concentration is indicated.[56]

It is difficult to develop an evidence-based approach for the specific age at which pharmacologic treatment should be implemented. At the time of the NCEP report,

TABLE 5 **Recommended LDL Concentrations for Pharmacologic Treatment of Children and Adolescents 10 Years and Older[22,56]**

Patient Characteristics	Recommended Cut Points
No other risk factors for CVD	LDL concentration is persistently >190 mg/dL despite diet therapy
Other risk factors present, including obesity, hypertension, or cigarette smoking or positive family history of premature CVD	LDL concentration is persistently >160 mg/dL despite diet therapy
Children with diabetes mellitus	Pharmacologic treatment should be considered when LDL concentration is ≥130 mg/dL

there were few studies of pharmacologic intervention in children, and the degree to which such therapy would produce important adverse effects was not known.[22] More recent studies of children and adolescents have established the effectiveness and safety of the available agents, including their use in prepubertal children and children between 8 and 10 years of age. It is not known whether there is an age at which development of the atherosclerotic process is accelerated. Pathology studies have shown that the frequency of fibrous plaques increases with age.[6–8] Although these studies were performed before the recent epidemic of childhood obesity, increased BMI was an important risk factor for both fatty streaks and fibrous plaques. It is possible that if these studies were repeated, they would show an overall more aggressive atherosclerotic process in children today.

MEDICATIONS AVAILABLE FOR THE TREATMENT OF DYSLIPIDEMIA

Several classes of medication are available for treatment of dyslipidemia in children and adolescents (see Table 6).

Bile Acid–Binding Resins

Bile acid–binding resins work by binding the cholesterol in bile acids in the intestinal lumen, which prevents their reuptake as part of the enterohepatic circulation. The advantage of these medications is that they do not have systemic effects. Average lowering of cholesterol is 10% to 20% below baseline. Although adverse effects of bile acid–binding resins are limited to gastrointestinal discomfort, these adverse effects and the fact that the medication is difficult to take limits their use for young patients. They are available as either a granular powder that must be mixed with liquid or as a tablet that is large and cannot be broken. McCrindle et al[57] compared the 2 formulations in children with heterozygous familial hypercholesterolemia. They found that the tablet form was more acceptable, but gastrointestinal complaints were common for both groups, and compliance was generally poor.

TABLE 6 **Classes of Medication for Treatment of Dyslipidemia in Children and Adolescents**

Class	Potential Adverse Effects
Bile acid sequestrant	Gastrointestinal symptoms, constipation, cramping, bloating
Cholesterol-absorption blocker	Gastrointestinal symptoms
3-Hydroxy-3-methyl-glutaryl coenzyme A reductase inhibitors	Myopathy, rhabdomyolysis, increased hepatic transaminase levels, teratogenicity

Niacin

Niacin or nicotinic acid can be effective in lowering LDL and triglyceride concentrations while increasing HDL concentration. The mechanism of action is by decreasing hepatic production of very low-density lipoprotein (VLDL). Niacin may also lower lipoprotein(a). Because of these effects, niacin is a potentially attractive medication for treatment of dyslipidemia. Unfortunately, the adverse effects associated with niacin make it very difficult to use it in pediatric clinical practice. Adverse effects include flushing, which is quite common, as well as hepatic failure, myopathy, glucose intolerance, and hyperuricemia. In 1 pediatric study, adverse effects such as flushing occurred in 76% of the children, and elevation of hepatic transaminase concentrations occurred in 26%.[58] Because of those adverse effects, niacin should not be recommended for routine use in the treatment of pediatric dyslipidemia.

3-Hydroxy-3-methyl-glutaryl Coenzyme A Reductase Inhibitors (Statins)

Statins inhibit the rate-limiting enzyme 3-hydroxy-3-methyl-glutaryl coenzyme A reductase for endogenous synthesis of cholesterol, which lowers the intracellular cholesterol level and upregulates the LDL receptors, resulting in increased clearance of LDL from the circulation. In general, the statins are well tolerated and result in cholesterol lowering of 20% to 50% below baseline, depending on the baseline value and the dose used.[59] In adults, a 1% reduction in LDL concentration results in a reduction of coronary events by approximately 1%. Adverse effects of statins are related to increased hepatic transaminase levels and also elevations of creatine kinase, which may be associated with rare but clinically important episodes of rhabdomyolysis. There is also a concern about the potential of statin medications to be teratogenic, so they are not recommended for women who are pregnant, seeking to become pregnant, or breastfeeding. Patients should be monitored with periodic measurement of liver transaminase and creatine kinase levels. Patients should also be instructed to report symptoms of muscle aches or cramping.

There have been a number of clinical trials of statins in children and adolescents.[60–67] Although these studies have generally been short-term, they have shown statins to be safe and effective in lowering cholesterol concentrations. More recent studies have included measures of vascular structure and function. For example, de Jongh et al[68] evaluated the response of the brachial artery to ischemia and subsequent hyperemia. This evaluation used ultrasonography and

has been found to be a measure of the function of the vascular endothelium. In adults, endothelial dysfunction has been shown to be an early marker of atherosclerosis. De Jongh et al[68] demonstrated improvement in endothelial function in children with high cholesterol levels who were treated with a statin, compared with those who were treated with placebo. Wiegman et al[69] showed that children with hypercholesterolemia treated with placebo had an increase in carotid IMT over 2 years, whereas children treated with a statin medication had regression of carotid IMT. The results of these studies are encouraging in that these noninvasive vascular measurements are thought to provide an assessment of the extent of the atherosclerotic process, which has an effect on both the structure and function of arteries. Furthermore, this study included prepubertal children as young as 8 years of age, and on the basis of these results and reassuring safety data, the US Food and Drug Administration has approved the use of pravastatin for children with familial hypercholesterolemia who are 8 years and older, regardless of pubertal status.

Cholesterol-Absorption Inhibitors

The dietary cholesterol-absorption inhibitors represent the newest class of cholesterol-lowering agents. Although they are thought to act mainly on intestinal absorption, unlike resins, these drugs are absorbed, enter the enterohepatic circulation, and may have systemic effects. Ezetimibe has been shown to reduce LDL concentrations by 20%, but in adults they are used primarily in combination with statins. These medications have not been extensively studied in children, particularly in combination with other medications such as statins. Because the adverse effects are limited to gastrointestinal discomfort and they come in a palatable, small tablet form, they represent a potentially important first-line treatment for children. Additional study will be needed to evaluate their long-term effectiveness in young patients.

Fibrates

Pharmacologic therapy for elevated triglyceride concentrations, such as the fibrates, has not been extensively studied in children. Fibric acid derivatives inhibit the synthesis and increase the clearance of the VLDL apoprotein B, which then leads to a decrease in VLDL production. These medicines also inhibit peripheral lipolysis and decrease hepatic extraction of free fatty acids, which reduces hepatic triglyceride production. These medications should be used cautiously and under the supervision of a pediatric lipid specialist. The adverse effects of fibrates are similar to those of statins. The risk of myopathy and rhabdomyolysis is markedly increased when fibrates (especially gemfibrozil) are used in combination with statins or in patients with renal insufficiency.

SUMMARY

1. The population approach to a healthful diet should be recommended to all children older than 2 years according to Dietary Guidelines for Americans. This approach includes the use of low-fat dairy products. For children between 12 months and 2 years of age for whom overweight or obesity is a concern or who have a family history of obesity, dyslipidemia, or CVD, the use of reduced-fat milk would be appropriate.
2. The individual approach for children and adolescents at higher risk for CVD and with a high concentration of LDL includes recommended changes in diet with nutritional counseling and other lifestyle interventions such as increased physical activity.
3. The most current recommendation is to screen children and adolescents with a positive family history of dyslipidemia or premature ($\leq$55 years of age for men and $\leq$65 years of age for women) CVD or dyslipidemia. It is also recommended that pediatric patients for whom family history is not known or those with other CVD risk factors, such as overweight (BMI $\geq$ 85th percentile, $<$95th percentile), obesity (BMI $\geq$ 95th percentile), hypertension (blood pressure $\geq$ 95th percentile), cigarette smoking, or diabetes mellitus, be screened with a fasting lipid profile.
4. For these children, the first screening should take place after 2 years of age but no later than 10 years of age. Screening before 2 years of age is not recommended.
5. A fasting lipid profile is the recommended approach to screening, because there is no currently available noninvasive method to assess atherosclerotic CVD in children. This screening should occur in the context of well-child and health maintenance visits. If values are within the reference range on initial screening, the patient should be retested in 3 to 5 years.
6. For pediatric patients who are overweight or obese and have a high triglyceride concentration or low HDL concentration, weight management is the primary treatment, which includes improvement of diet with nutritional counseling and increased physical activity to produce improved energy balance.
7. For patients 8 years and older with an LDL concentration of $\geq$190 mg/dL (or $\geq$160 mg/dL with a family history of early heart disease or $\geq$2 additional risk factors present or $\geq$130 mg/dL if diabetes mellitus is present), pharmacologic intervention should be considered. The initial goal is to lower LDL concentration to $<$160 mg/dL. However, targets as low as 130 mg/dL or even 110 mg/dL may be warranted when there is a strong family history of CVD, especially with other risk factors including obesity, diabetes mellitus, the metabolic syndrome, and other higher-risk situations.

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Pediatrics 2008;122;198
DOI: 10.1542/peds.2008-1349