Safe Preparation and Handling of Infant Formula

Introduction

This document gives health professionals evidence-based recommendations for preparing, handling, and storing infant formula. The World Health Organization recognizes breastmilk is the optimal milk for infants and recommends it for up to 24 months of age or longer.[1] When infants are not exclusively fed breastmilk for personal, social, or medical reasons, parents require information and guidance to safely prepare, handle and store infant formulas, the only appropriate substitute for breastmilk.[2] (See Key Questions List).

For information on toddler formulas, refer to the Nutrition Guideline: Milk.

This information is a general resource only and does not replace advice from a physician or registered dietitian (RD). Health professionals are responsible for evaluating the situation of each of their patients and applying nutrition guidelines appropriately. Individuals at high risk of malnutrition or with a medical condition affected by nutrition should receive registered dietitian intervention. These include the use of specialized and/or higher calorie preparations of infant formula.

Referral to a Registered Dietitian

To refer a patient to a registered dietitian Alberta Health Services (AHS), visit Referring Patients for Nutrition Services.

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Background

This NG was developed by the Nutrition Services 0–6 Target Population Provincial Working Group and is based on scientific evidence and best practice. If inappropriately prepared or handled, infant formula can be an excellent growth medium for bacteria due to its moisture and nutrient-rich content.[3–5] The following document provides specific guidance on the most appropriate way to prepare and handle infant formula to reduce the risk of foodborne illness.

Key Recommendations

For the purpose of this guideline, these definitions are used:

- When referring to age in months, use the chronological age for full-term infants and the corrected age for preterm infants.
- Infant formula refers to commercial infant formulas available on the Canadian market unless otherwise specified.
- The term 'parent' is used throughout to indicate parents, caregivers or other family members caring for a child.

- Breastmilk is the optimal milk for infants and is recommended for up to 24 months of age or longer.[1]
- When parents make an informed decision not to or are unable to exclusively feed breastmilk, infant formula can be used. Support parents by considering cost and access as potential barriers when choosing an infant formula.
- Specialized and higher calorie preparations of infant formula may be recommended following assessment by a physician or registered dietitian for specific nutritional, growth and/or medical considerations.
- From birth until four months of age, encourage parents to use the methods and tips in these guidelines to:
    - Sanitize equipment used to prepare and feed infant formula, such as cups, bottles, nipples, caps, tongs, can openers and spoons.
    - Prepare infant formula with water that has been boiled for two minutes and cooled to room temperature or body temperature.
- Liquid infant formulas:
    - Concentrated and ready-to-feed liquid infant formulas are sterile until opened and are the safest option for infants requiring formula.
    - Are recommended for infants at the greatest risk of infection, such as pre-term or low birth weight infants less than two months of age or immunocompromised infants.
    - Infants at higher risk may be recommended a nutritionally appropriate powdered infant formula by their infant's primary healthcare provider or registered dietitian.

- Powdered infant formulas:
  - Is not a sterile product and may contain pathogens that can cause serious illness.
  - When powdered infant formula is prepared, handled, and stored appropriately, it can be safely used for healthy-term infants, and infants at high risk, if recommended by a physician or registered dietitian.
- It is recommended not to purchase infant formulas from outside of Canada as they may not be subject to the same rigorous safety or nutritional standards set by Health Canada. Infant formulas available on the Canadian market are nutritionally complete, address family and cultural preferences, and are highly regulated.

Considerations

Household Food Insecurity

Household food insecurity (HFI) is defined as "an inadequate or insecure access to food because of financial constraints";[6] it impacts physical, mental and social well-being. Health professionals will encounter parents of infants and children living in food-insecure households.[7]

Infant formula may be difficult to obtain for those experiencing HFI due to access, availability, or cost. For families who are formula feeding, ensure they are accessing funding for formula, if eligible. Review the PEAS Formula Coverage webpage and the Point of Care Reference document: Funding Options for Special Diets and Nutrition Products for additional information on health benefits/special diet options for different infant formulas.
Health professionals can offer better support if they are aware of when parents are worried about having enough money for food and are experiencing other challenges because of financial strain.[8,9] Health professionals are encouraged to work with patients to develop interventions that are sensitive to financial strain.

Key steps for health professionals include:

- Review the Nutrition Guideline: Household Food Insecurity for additional information on how to support families experiencing HFI.
- Assist patients in accessing available income supports. The provincial directory 211 (ab.211.ca) can be used to identify financial benefits, programs, and services.

Definitions

Infant formula: a product designed for infants as a sole source of nutrition, or to partially replace or supplement breastmilk.[10,11] Available in powder, liquid concentrate, and ready-to-feed formulations.[11]

Corrected age (weeks or months): for preterm infants (less than 37 weeks, 0 days gestation), the age of the infant from birth minus the number of weeks born before 40 weeks of gestation.[12]

Heat shocking: a specified process used when preparing powdered infant formula with hot water (70˚C) to inactivate, reduce, and prevent the proliferation of pathogenic microorganisms.[13]

High-risk infants: premature and low birth weight infants under two months corrected age, or immunocompromised infants.[14]

Liquid concentrate: a liquid formula that requires adding water before feeding.[14] These products are sterile before opening.

Liquid formula: all types of liquid formula for infants or young children, (liquid concentrate or ready-to-feed) intended as a source of nutrition, or to partially replace or supplement breastmilk. These products are sterile before opening.[14]

Low birth weight: weight at birth of less than 2500 grams.[15]

Nursery water: not sterile, distilled water marketed for infants and young children.[16]

Powdered infant formula (PIF): all types of powdered formula intended for infants (standard infant formula, specialty infant formula, follow-up formula) or young children as a source of nutrition, or to partially replace or supplement breastmilk.[14]

Preterm infant: born at less than 37 weeks, 0 days gestation.[17]

Ready-to-feed formula: a liquid formula that is heat-treated to be sterile by the manufacturer.[14] Addition of water prior to feeding is not required.

Spray sanitizer: designed to be sprayed on hard, non-porous surfaces specifically certain breast pumps and infant feeding equipment.[18]

Key Questions

Key nutrition questions related to the safe handling and preparation of infant formula addressed in this NG are listed below.

- Why are cleaning and sanitizing steps important when preparing infant formula?
- Why is water boiled to prepare formula for infants under four months of age?
- What are the steps to properly clean the formula preparation space and equipment?
- What are the steps to prepare water for formula mixing?
- Can bottled water be used to prepare infant formula?
- Can an electric kettle be used to prepare water for formula mixing?
- How is liquid infant formula (ready-to-feed and liquid concentrate) prepared safely?
- How is powdered infant formula prepared safely?
- How can powdered infant formula be prepared for later use?
- How is prepared infant formula properly stored?
- How is infant formula prepared when away from home?
- How can infant formula be warmed?
- How long can infant formula be kept once warmed?
- How are powdered infant formula cans stored?
- How is open liquid formula (ready-to-feed or concentrate) stored?
- What home appliances can sanitize feeding equipment?
- Can automatic infant formula machines be used to prepare powdered infant formula?
- Can plastic bottles or nipples be sanitized by boiling?
- Is a thermometer needed when a fridge has a thermostat?
- What are the risks of giving infants under or over-concentrated formula?
- Is liquid infant formula more expensive than powdered infant formula?
- Are imported infant formulas better for baby?
- Is freeze-dried human milk recommended as a breastmilk substitute?
- What other resources are available for parents?
- What other professional resources available?

Answers to Key Questions

Why are cleaning and sanitizing steps important when preparing infant formula?

Poor hygiene and inadequately cleaned and sanitized equipment used for preparing infant formula have been reported as probable causes of some bacterial outbreaks.[4,5] PIF has additional risks related to potential contamination with *Salmonella* and *Cronobacter*.[3,19] Before assembling any equipment and starting the formula-making process, the person preparing the formula should clean the preparation surface and wash their hands with soap and water.[20,21] Washing hands and cleaning surfaces reduces the risk of feeds becoming contaminated during preparation.[22] *Cronobacter* can grow on surfaces (known as a biofilm) commonly used in infant feeding equipment, such as latex, silicone, and stainless steel.[23] Biofilms on such equipment may result in continual contamination of feeds.[23] All infant feeding and preparation equipment (e.g., cups, bottles, nipples, caps, tongs, can openers, and spoons) must be thoroughly cleaned (and sanitized if the infant is under four months of age).[14]

Why is water boiled to prepare formula for infants under four months of age?

Drinking water, including tap water, well water, and commercially bottled water, is not sterile.[24] The three main types of microorganisms that can be found in drinking water (naturally or as a result of contamination from human or animal waste) include bacteria, viruses, and protozoa.[25] These waterborne microorganisms can cause human infection, with gastrointestinal upset (nausea, vomiting, and diarrhea) as the most common manifestation of illness.[25]In susceptible infants, the resulting illness can be more severe, chronic or fatal.[25] While it is not currently possible to eliminate the risk of waterborne disease, the purpose of boiling drinking water is to remove or kill most of these organisms to help reduce this risk.[25] See the step to prepare water for formula mixing.

There is no research supporting a specific age at which it is safe to stop boiling water for infant formula preparation. Age alone is a poor predictor of infant vulnerability to foodborne illness and immune status varies among infants.[26,27]

AHS Nutrition Services recommends parents may discontinue boiling water at four months of age, as:

- this has historically been recommended for healthy-term infants
- infants commonly put many non-sanitized objects in their mouths at this time.[28]

If your community is on a 'boil water advisory', it is important to follow recommendations for treating the water.[29] Ready-to-feed formula or use of bottled water in preparation of infant formula may be alternative options. For infants under four months of age, bottled water would need to be boiled as outlined in the What are the steps to prepare water for formula mixing? section of this guideline.

What are the steps to properly clean the formula preparation space and equipment?

For Infants Under Four Months of Age

Cleaning, Sanitizing, and Storing All Feeding Equipment

Clean

1. Wash hands – Always wash hands thoroughly with soap and water, for at least 20 seconds, before cleaning, sanitizing, and handling feeding and preparation equipment.[3,20,24]
2. Clean feeding equipment and preparation area – wash all equipment (e.g., cups, bottles, nipples, caps, tongs, can openers, and spoons) in hot soapy water.[3] Remove all remaining food residue is removed prior to sanitization.[3] Use a teat brush to scrub hard-to-reach places for bottles/nipples.[3]
3. Rinse all feeding and preparation equipment in clean potable water.[3]

Sanitize

4. Sanitize all feeding and preparation equipment * by boiling or using either a dishwasher with an NSF/ANSI 184 approval,[30] or commercial home sanitizer,** such as an electric or microwave steam sanitizer).[3]

   To sanitize equipment using the boiling water method:

   a. fill a large pot with water and put in all feeding equipment;[3]
   b. bring water to a rolling boil in an uncovered pot for two minutes;[24]
   c. remove feeding equipment with sanitized tongs;[3]
   d. set on a clean paper towel or clean cloth to air dry.[3,20,24]

To sanitize equipment using a commercial home sanitizer, follow the manufacturer's instructions.[3] Spray sanitizers are not recommended for routine use.**

Store

5. Storage – if bottle(s) are not used immediately:
   a. Assemble the bottle(s) only when completely dry to prevent contamination.
   b. Cover with a clean tea towel and store all feeding equipment in a clean place.[3,20,24]

*This step does not apply to pre-sterilized single-use equipment.

**Spray sanitizers do not replace the need for physical removal of food build-up. While they may have applicability in certain circumstances (e.g., travel where other sanitization methods are unavailable), it is not recommended for routine use as the spray may not reach hard-to-reach places for full sanitization.[31]

For Infants Four Months of Age and Older

Cleaning and Storing All Feeding Equipment*

Clean
1. Wash hands – hands should always be washed thoroughly with soap and water, for at least 20 seconds, before cleaning, sanitizing, and handling feeding and preparation equipment.[3,20,24] 2. Clean feeding equipment and preparation area – wash all feeding and preparation equipment (e.g., cups, bottles, nipples, caps, tongs, can openers, and spoons) in hot soapy water.[3] Ensure all remaining food residue is removed prior to sanitization.[3] Use a teat brush to scrub hard-to-reach places for bottles/nipples.[3] 3. Rinse – rinse all feeding and preparation equipment in clean potable water.[3]
Store
4. Store bottle(s) not used immediately: a. To prevent the inside from being contaminated, fully assemble the bottle(s) when completely dry. b. Cover with a clean tea towel and store all feeding equipment in a clean place.[3,20,24] *This step does not apply to pre-sterilized single-use equipment. **Food must still be removed when using spray sanitizers. Spray sanitizers can be used travelling or when no other method is available. They are not recommended for routine use as hard-to-reach place may not be sanitized.[31]

What are the steps to prepare water for formula mixing?

Use safe age-appropriate water when preparing formula from liquid concentrate or powdered infant formula (PIF) and follow directions below. For more information on appropriate water choices, refer to the Nutrition Guideline: Water.

Water Preparation

Infants Under Four Months of Age
Boil water to prepare formula from liquid concentrate and PIF 1. Fill a large pot with cold tap water. Do not use hot tap water as it may contain more metal contaminants from the pipes such as copper or lead.[24] 2. Bring water to a rolling boil in an uncovered pot for two minutes.[14] Extended boiling increases the concentration of potential contaminants and minerals such as lead, therefore, is not recommended.[29] Consider using a timer to prevent extended boiling times. 3. Boiled water can be stored in a sanitized, tightly closed container for two to three days in a refrigerator, or for 24 hours at room temperature.[32]
Infants Four Months of Age and Older
Use cold tap water. Do not use hot tap water as it may contain more metal contaminants from the pipes such as copper or lead.[24]

Can bottled water be used to prepare infant formula?

Commercially bottled water (including Nursery water, but excluding carbonated and mineral water) can be used to prepare infant formula;[24] however, bottled water is not sterile and therefore must be boiled until an infant is four months of age.[24]

Can an electric kettle be used to prepare water for formula mixing?

Yes. An electric kettle can be used as long as it does not have an automatic shut-off once the water comes to a boil. It is recommended that water is at a rolling boil for two minutes, then cooled to room, body, or fridge temperature (≤4˚C) before formula mixing.

How is liquid infant formula (ready-to-feed and liquid concentrate) prepared safely?

Ready-to-feed Infant Formula

Infants Under Four Months of Age
1. Wash the top of the formula can with hot soapy water. Rinse with clean water.[24] 2. Shake before opening (or as per manufacturer's instructions). Pour the formula into a **sanitized bottle** and cover it with a lid or nipple. **Do not add water.** For unused liquid formula see question How is open liquid formula (ready-to-feed or concentrate) stored? 3. For immediate use: formula that has been opened and left out at room temperature, and/or not consumed within two hours should be discarded.[14,33] 4. For later use: place opened formula (that has not been offered to baby) in the refrigerator immediately. Unless otherwise indicated on the formula can, use within 48 hours.[34]
Infants Four Months of Age and Older
Follow the steps above. For step 2, a clean bottle may be used in place of a sanitized bottle.

Liquid Concentrate Infant Formula

Infants Under Four Months of Age
1. Wash the top of the formula can with hot soapy water. Rinse with clean water.[24] 2. Shake before opening (or as per manufacturer's instructions). Pour the liquid concentrate formula into a **sanitized bottle.** For unused liquid formula (that has not been offered to baby) see the question How is open liquid formula (ready-to-feed or concentrate) stored? 3. Use **previously boiled water** that has been cooled to room, body, or fridge (≤4˚C) temperature.[14] 4. Follow the manufacturer's instructions for the amount of water to be added. Cover with a lid or nipple. 5. Shake concentrate and water to mix. 6. For immediate use: formula which has not been consumed within two hours should be discarded.[14,33] For later use: place prepared formula (that has not been offered to baby) in the refrigerator immediately. Prepared formula can be stored in the refrigerator for up to 24 hours.[21]
Infants Four Months of Age and Older
Follow the steps above. For step 2, a clean bottle may be used in place of a sanitized bottle. For step 3, cold tap water may be used in place of previously boiled water.

How is powdered infant formula prepared safely?

Although some jurisdictions recommend using very hot water (heat shocking) to prepare PIF, AHS Nutrition Services is recommending powdered infant formula (PIF) be prepared **for immediate use.** Heat shocking is not always practical and there are concerns with scalding and parent fatigue. Preparing feeds for immediate use decreases the risk of bacterial growth.[35] Heat shocking may be recommended in certain situations by a registered dietitian.

Prepare Powdered Infant Formula for immediate use

Infants Under Four Months of Age
1. Wash the top of the new formula can with hot soapy water. Rinse with clean water.[24] Label the top of the formula with the date.[21] For future use, simply wipe down the lid with a clean cloth before opening. 2. Use **previously boiled water** that has been cooled to room, body, or fridge temperature (≤4˚C) to reconstitute powder infant formula (PIF). 3. Pour previously boiled water into a **sanitized bottle**. Follow the manufacturer's instructions for the amount of water to be added. 4. Fill the measuring scoop with formula powder and level off using a sanitized knife. Take care to add the correct number of scoops of PIF to the water in the bottle. Always measure the amount of powder using the scoop provided in the can as scoop size varies among cans of formula. 5. Cover the bottle with a lid or nipple. Shake powder and water to mix.[3] Prepared formula, which has not been consumed within two hours, should be discarded.[14,24]
Infants Four Months of Age and Older
Follow the steps above. For step 2, cold tap water may be used in place of previously boiled water. For step 3, a clean bottle may be used in place of a sanitized bottle.

How can powdered infant formula be prepared for later use?

It is recommended to prepare PIF for immediate use to protect infants from food-borne illness.[24] However, it is recognized that in some circumstances, this may not be feasible. If PIF needs to be prepared ahead, it is recommended to prepare small batches (e.g., two bottles at a time) to mitigate bacterial growth.[36]

Prepare Powdered Infant Formula for Later Use

Infants Under Four Months of Age
1. Wash the top of new formula can with hot soapy water. Rinse with clean water.[24] Label the top of the formula with the date.[21] Wipe down the lid with clean cloth prior to future use. 2. Use **previously boiled water** that has been cooled to room, body, or fridge temperature (≤4˚C) to reconstitute powder infant formula (PIF). 3. Pour previously boiled water into a **sanitized bottle**. Follow the manufacturer's instructions for the amount of water to be added. 4. Fill the measuring scoop with formula powder and level off using a sanitized knife. Take care to add the correct number of scoops to the water in the bottle. Always measure the amount of powder using the scoop provided in the can as scoop size varies among cans of formula. 5. Cover bottle with lid or nipple. Shake powder and water to mix.[3] 6. Place reconstituted formula in the refrigerator immediately and use for next bottle feeds. [14] There is insufficient evidence to provide recommendations on the length of time reconstituted PIF with previously boiled water can be safely stored in the refrigerator prior to use. However, if parents choose to prepare PIF for later use, all prepared formula in bottles or other types of containers should be refrigerated at ≤4˚C immediately after the powder has been added and dissolved in the water and used within 24 hours.[14]
Infants Four Months of Age and Older
Follow steps above. For step 2, cold tap water may be used in place of previously boiled water. For step 3, a clean bottle may be used in place of a sanitized bottle.

If parents need to prepare larger batches, it is recommended that they consult with a registered dietitian for guidance as heat shocking may be recommended. (Refer to the World Health Organization's Safe preparation, storage and handling of powdered infant formula: guidelines for more information on heat shocking.) Discard any unused heat-shocked prepared PIF from the refrigerator after 24 hours.[14]

How is prepared infant formula properly stored?

It is recommended to prepare infant formula for immediate use, however, if formula needs to be prepared ahead of time, it is important to store formula in a way that prevents or slows down the growth of harmful bacteria.[3] Feeds should be stored in a refrigerator immediately after preparation and discarded after 24 hours if not consumed.[21] Refrigerators should remain at ≤4°C to prevent or slow down the growth of harmful bacteria.[14,37] When feeds are stored at ≤4°C, bacteria growth is considerably less than when feeds are stored at higher temperatures. It is not recommended to freeze formula as it may cause the formula components to separate.[38]

Store prepared infant formula in the main compartment of a refrigerator. It is not recommended to place prepared infant formula in the door compartment as this section has been found to have higher temperatures than inside the refrigerator.[39] Monitor the temperature of the refrigerator daily[3] with a digital thermometer[26] or appliance thermometer[40] that is kept in the centre of the fridge to ensure it stays ≤4°C, as many home refrigerators exceed this temperature.[41,42]

How is infant formula prepared when away from home?

Prepare infant formula for immediate use to limit the time for potential bacterial growth.[3,14,24] As such, it is best to prepare the formula once at the destination by following the instructions below. If not refrigerated, discard any infant formula which has not been consumed within two hours of preparing. [3,20,24]

Liquid Concentrate

Bring a clean* bottle/nipple with premeasured water** and a washed, unopened can of formula. Wipe the lid with a clean cloth prior to opening. Mix the appropriate amount of infant formula (concentrate) into the bottle and serve immediately. Store the remaining liquid concentrate in a fridge if possible and use within 48 hours.

Ready-to-feed Infant Formula

Bring a clean* bottle/nipple and an unopened, washed formula can. The ready-to-feed formula can be poured into the bottle and served immediately.

Powdered Infant Formula:

Bring a clean* bottle/nipple with premeasured water** and a clean* container with premeasured powder infant formula (PIF).[1] Mix the PIF into the bottle of premeasured water and serve immediately.

*Sanitized if the infant is under four months
**Boiled if the infant is under four months

Prepared infant formula can be transported, but ensure the feed is cold (≤4°C) before and during transport.[3] This applies to all formulas except unopened ready-to-feed infant formula*.

When transporting prepared infant formula, remove cold feeds from the refrigerator and place them in a cooler bag with an ice pack right before leaving home.[3] Infant formula that is transported cold and arrives at the destination within two hours, can be provided to the infant or stored in a refrigerator.[3] If the formula is not transported in a cooler bag with an ice pack, the formula must be used within two hours of preparation.[3,20,24] It is not recommended to pre-prepare feeds for trips longer than two hours where feeds cannot be kept cold. In these circumstances, feeds can be prepared as needed for immediate use.[3]

*unopened ready-to-feed infant formula can be stored in a cool, dry, indoor place.[21] This does not include vehicles, garages, or an outdoor place.[21]

How can infant formula be warmed?

1. Place the bottle with the prepared formula in a bottle warmer or a container of warm water.[14,21] Warm formula for no more than 15 minutes as many bacteria, including *Cronobacter,* can grow rapidly in warm temperatures (6 to 47°C).[3,23,62–64]
2. The bottle lid/nipple should not be covered with water when being warmed as this can lead to contamination of the formula.
3. An appropriate temperature for the formula is between room and body temperature.[14] Parents should swirl the formula in the bottle to prevent hot spots.[3] Test a few drops on the inside of your wrist to check the temperature.[21] Too cool is better than too warm.

Infant formula should be prepared for immediate use. If it is not possible to prepare for immediate use, infant formula prepared earlier and stored in the refrigerator should be removed from the refrigerator just prior to feeding to decrease the risk of bacterial growth.[33]

How long can infant formula be kept once warmed?

Once warmed, the formula should be fed immediately. Discard any infant formula not consumed within two hours (even if the infant did not consume any of it.[14,33] Never rewarm, refrigerate or save leftovers for the next feed.[3] Increased feeding times or holding prepared feeds at temperatures greater than 4°C for extended periods are associated with increased risk for bacterial growth.[3]

How are powdered infant formula cans stored?

Store cans of powdered infant formula (PIF) in a cool, dry place (not in the refrigerator or the freezer) with the lids tightly closed.[21] Always dry the scoop before placing it back in the can.[43] Record the date on the lid once opened. [21] Use formula within one month of opening and before the expiry date.[21] Do not use PIF which is passed its expiry date.[21] Avoid purchasing or using dented or damaged products.[11]

If transferring to another container for storage or portioning for travel, ensure the container is clean or sanitized for those under four months of age.[3]

How is open liquid formula (ready-to-feed or concentrate) stored?

Liquid concentrate or ready-to-feed formulas are sterile until opened.[37] Unopened products should be stored in a cool place (do not freeze).[21] Unless directions on the formula can state otherwise, open cans of liquid formula should be covered tightly with clear plastic food wrap and placed in the refrigerator.[24] The date the can or tetra-pack is opened should be written on the container and used within 48 hours of opening unless otherwise specified by the manufacturer.[34] Liquid formulas past the expiry date should not be used.[21] Avoid purchasing or using dented or damaged products.[11]

What home appliances can sanitize feeding equipment?

All the equipment used to feed and to prepare feeds for infants (e.g., cups, bottles, nipples, caps, tongs, can openers, and spoons) must be cleaned before sanitizing to ensure all feed residue is removed.[3]

Dishwashers that are NSF/ANSI 184 approved can be used on the sanitizing cycle to sanitize feeding equipment.[30] This information is typically found on the top, inside of the dishwasher door. If using a commercial home sanitizer (e.g., electric or microwave steam sanitizer), follow the manufacturer's instructions carefully.

Pressure cookers are designed for cooking and canning; however, some may have a sanitizing option. Pressure cookers can sanitize by reaching temperatures at or above 100°C evidenced by the steam production escaping through the valve or port. If using a pressure cooker to sanitize, follow the manufacturer's instructions carefully.[31]

UV sanitizers are not recommended for sanitizing feeding equipment.[44] UV sanitizers work on the premise that microorganisms that are exposed to sufficient doses of UV radiation can be inactivated; however, microorganisms are protected from UV by the bottle and/or debris,[44] including food residue. Therefore, disruption of the nucleic acid necessary for inactivation cannot be achieved if there is anything between the microorganism and the UV radiation.[44] Additionally, not all pathogens can be inactivated by UV radiation.[44]

Contact your local public health inspector if you have questions about sanitization methods.

Can automatic infant formula machines be used to prepare powdered infant formula?

No. Concerns regarding accurate formula concentration with the recommended water-to-powder infant formula (PIF) ratio have been raised.[45] Some machines require formula compartments to be filled and maintained with a precise amount of formula to ensure adequate measurements. In addition, no published results from product testing demonstrate that consistent and accurate measurements of water and PIF are dispensed each time a bottle is prepared.

For infants under four months of age, automatic infant formula machines may not allow water to be at a rolling boil for two minutes, then cooled to room, body, or fridge temperature (≤4°C) before formula mixing. Some manufacturers recommend the use of bottled or distilled water to reduce the buildup of heavy mineral deposits. These waters are not sterile[24] and are recommended to be boiled for infants under four months of age.

These machines may have limited functionality; settings are not available for all formula types and brands and are only able to prepare at standard formula concentrations.

The safety of water and formula storage within the machine is unknown. Depending on the frequency of use, clients may store formula and/or water longer than recommended. Contamination of formula and/or water compartments with pathogens may also be a concern. In addition, manufacturers recommend regular cleaning and maintenance to ensure proper functioning; however, some do not recommend sanitization of machine parts. Nutrition Services recommends that all equipment (cups, bottles, nipples, caps, tongs, can openers, and spoons) used to prepare and feed formula for infants under four months of age be sanitized.

If these risks have been reviewed with a parent and they choose to use a formula machine for infant formula preparation, the following practical guidance can be offered:

- refer to the manufacturer's assembly guide and follow the measurement guidelines for their specific brand of formula;
- ensure proper boiling of water before it is added to the machine if feeding an infant younger than four months of age;
- follow regular cleaning/maintenance guidance as recommended by the manufacturer. (Note: this does not follow Nutrition Services recommendations to sanitize all equipment after each use for infants under four months of age); and
- contact a health professional to discuss any health or growth-related concerns.

Can plastic bottles or nipples be sanitized by boiling?

Many of the bottles and nipples on the market have been designed to withstand boiling, however, some may not. Refer to the manufacturer's information to determine if the bottles/nipples can be boiled. Some products may withstand boiling after every use, even if the product recommends only boiling prior to the first use. Parents can call the product manufacturer information line if they are unsure if their bottles or nipples can be sanitized by boiling. Do not use bottles or nipples which warp, melt, discolour, crack, or become sticky/ gummy when boiled.[46]

Is a thermometer needed when a fridge has a thermostat?

Yes, a digital[26] or appliance[40] thermometer is needed to ensure a refrigerator remains at ≤4°C. A refrigerator dial controls the temperature in a refrigerator, but dial numbers/levels do not correlate to a specific temperature. Only a digital thermometer can provide the accurate temperature of a refrigerator.

What are the risks of giving infants under or over-concentrated formula?

When preparing liquid concentrate and powder infant formula (PIF) it is important to follow the instructions for proper amounts of water to add. Always use the proper amount of formula and water recommended on the formula can unless otherwise prescribed by a registered dietitian or physician.

Adding more water than recommended reduces the caloric value of the formula, which can cause protein energy malnutrition.[47] In addition to inadequate calorie consumption, consuming an abundant amount of overly dilute formula can lead to symptomatic hyponatremia due to water intoxication.[48] Although oral water intoxication is rare, it can result in adverse medical effects such as hyponatremic seizures.[49] The most common reason for giving dilute formula to infants is the inability to pay for formula.[49] Refer to Considerations for more information about household food insecurity.

Adding less water than recommended can create an over-concentrated formula which may result in an infant suffering from hypernatremic dehydration.[47,50] Infants with hypernatremic dehydration due to improper formula mixing are rare, however, it often presents with minimal or generic symptoms such as diarrhea early on. The absence of clear symptoms can lead to delayed diagnosis.[50] Hypernatremic dehydration can result in severe complications including seizures, cerebral edema, venous sinus thrombosis, permanent brain damage, acute renal failure, and may be fatal.[50]

Providing over-concentrated formula may contribute to rapid weight gain and increased adiposity in formula-fed infants.[51] Rapid or excessive weight gain in infancy is associated with a higher risk of being overweight or obese in childhood and adulthood.[52]

Although severe consequences from under or over-concentrating infant formula are rare, reviewing and offering proper guidance on mixing infant formula can help prevent potential complications.

The preparation instructions on the can of infant formula have been found to have an average reading difficulty at the college level therefore reviewing mixing instructions with parents is important to prevent mixing errors.[53]

Is liquid infant formula more expensive than powdered infant formula ?

Yes. Ready-to-feed is generally at least two times more expensive than powder infant formula (PIF).[54–56] Liquid concentrate may be more expensive than powder related to store pricing and potential wastage if not used within the recommended timeframe. The cost of infant formula has been identified as a barrier for low-income families.[57] Additional barriers for ready-to-feed and liquid concentrate may be transporting the case home (e.g., walking, bus). If cost is a barrier, remind parents that all commercial infant formulas have to meet the same rigorous standards so there is no benefit to choosing one brand over another (e.g., name brand over store brand).

When barriers, including cost, do not permit the use of liquid formula, education and focus must be placed on the safe preparation and handling of PIF.

Are imported infant formulas better for baby?

No. European or other international formulas are not better for infants than formulas available in Canada. European infant formulas may be marketed as a more natural and healthier choice for baby, but similar products that are nutritionally complete and accommodating to family and cultural preferences are available on the Canadian market.

Infant formula is a highly regulated food in Canada. Powder infant formula (PIF) is not sterile and due to a high fat content, the nutrients are highly sensitive to changes in temperature and must be stored at proper temperatures to ensure the safety and quality of the product.[58] Canadian regulations ensure that all infant formulas sold in Canada meet the nutritional standards and safety requirements as outlined by Health Canada.[14,59,60] Health Canada ensures that any recalls on infant formula sold in Canada are widely reported and products are removed from the shelves. No system is currently in place to report food recalls for infant formulas outside of Canada. US and European infant formulas imported via third-party vendors and are not FDR-regulated, are prohibited as they limit consumer protections set by Health Canada that ensure infant formula safety.[60,61]

International infant formulas may not be labelled in English and French, and this creates a potential risk if formula preparation and storage cannot be followed as per the manufacturer's instructions. Instructions and scoop size are specific to the product and are not interchangeable between products. It is important to have clear instructions to ensure the safety and adequacy of the infant formula.

It is not recommended to purchase infant formula online from another country. Encourage parents to find infant formulas available in the Canadian markets that meet their needs. Refer to the Infant Formulas: Ingredients and Indications.

Some perceptions of European infant formulas have been addressed below:

Perception	European infant formulas use more simple or natural ingredients than Canadian infant formulas.
Fact	In Canada, similar ingredients are used as those in other countries, but they are listed by their chemical names on the label. For example, essential nutrients added to the formula such as iron will be listed with the more detailed name of ferrous sulphate.
Perception	European infant formulas use lactose as the primary carbohydrate whereas high fructose corn syrup is used in Canadian infant formulas.
Fact	In Canada, infant formulas that use lactose as the primary source of carbohydrate are available. There are also a variety of infant formulas available that use corn syrup solids. 'Corn syrup solids' are a safe source of carbohydrate and are not the same as 'high fructose corn syrup'
Perception	European infant formulas are the only formulas available that are organic and non-genetically modified (non-GMO).
Fact	Certified organic and non-GMO infant formulas are available for sale in Canada.

Note: In certain situations (e.g., shortages), Health Canada may provide interim marketing authorization to allow specific formulas to be imported for use in Canada. See: Interim policy on the importation and sale of infant formulas, human milk fortifiers (HMF) and metabolic products for inborn errors of metabolism to mitigate shortages.

Is freeze-dried human milk recommended as a breastmilk substitute?

No. Due to the lack of available evidence on the osmolar, microbial, and nutritional safety of freeze-dried human milk, Nutrition Services does not recommend its use. This includes use in its reconstituted form or as a fortifier in any setting. For more information refer to NS Putting Evidence into Practice: Freeze-dried Human Milk

What other resources are available for parents?

For infant nutrition resources visit Nutrition Education at ahs.ca/NutritionHandouts and search **formula.**

For more information related to healthy infants and children see Healthy Parents Healthy Children.

What other professional resources are available?

- Infant Formulas for Healthy Term Infants
  - Infant Formulas – Ingredients and Indications
  - Infant Formulas – Summary Sheet
- Infant formula nutrient composition, including sources of protein, fat and carbohydrate, is available for AHS health care professional use on Insite in the Infant & Pediatric Formula Compendium. For more information about infant formulas used in AHS, visit the Enteral Nutrition Insite page.
- Health Canada's website lists recalls, advisories and safety alerts:
  Health Canada Recalls and Safety Alerts – Recalls, advisories and safety alerts

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