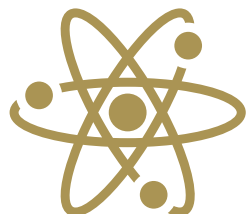
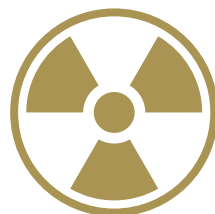


CHEMICAL, BIOLOGICAL, RADIOLOGICAL AND NUCLEAR (CBRN) THREATS IN WARTIME SITUATIONS:

THE IMPACT ON BREASTFEEDING SAFETY AND INFANT/ YOUNG CHILD FEEDING PRACTICES



INTRODUCTION

In today's modern warfare, there is an increased risk of chemical, biological, radiological, and nuclear weapons use and of nuclear emergencies due to damage to existing nuclear power plants. Most international agencies and ministries of health have guidelines for the general population about what to do in the event of a Chemical, Biological, Radiological and Nuclear (CBRN) emergency. However, an urgent gap exists in guidance specifically for the breastfeeding population. It is known that in wartime situations, women, infants and young children are often the most vulnerable and most impacted. While information exists in the literature across different organizations and publications, there is no one place where agencies or individuals can go to access vital information about the safety of breastfeeding in CBRN crises.

The Infant Feeding in Emergencies (IFE) Core Group, a global collaboration of agencies and individuals that addresses policy guidance and training resource gaps on infant and young child feeding support in emergencies, took up the initiative, along with the Johns Hopkins Center for Humanitarian Health to create guidelines for the breastfeeding population in the context of CBRN threats. The following guidance notes detail the mechanisms of the most common CBRN agents, management, and treatment, and make recommendations for breastfeeding and infant and young child feeding. It is intended for policymakers, healthcare workers and emergency planners in the case of CBRN emergencies to optimally support infants and young children.

This guidance should be used in conjunction with existing guidance for the general public, healthcare workers and policy makers. The guidance reflects our collective knowledge and draws on expertise from relevant fields. We acknowledge that this guidance will evolve over time as more information becomes available and we welcome suggestions for improvement to ife@ennonline.net.

Acknowledgements:

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CONTENTS

GUIDANCE NOTE: INFANT AND YOUNG CHILD FEEDING (IYCF) IN THE CONTEXT OF A CHEMICAL ATTACK	5
What are the most likely forms of chemical attack?	5
What information do we have on breastfeeding safety following a chemical attack?	6
Nerve Agents	9
Sarin	9
Tabun	9
VX	10
Pulmonary/Choking Agents	12
Chlorine	12
Blood/Systemic Agents	14
Hydrogen cyanide	14
Blistering Agents	16
Sulfur mustard	16
Lewisite	17
Conclusion	18
Appendix 1: How chemical agents impact the body	19
Appendix 2: Safety information and doses for atropine and 2-PAM	20
Appendix 3: Supporting breastfeeding mothers and infants if breastfeeding needs to be temporarily interrupted	21
Appendix 4: Medications commonly used in the treatment of chemical agents and for use in breastfeeding women	22
Appendix 5: Important guidance	22
GUIDANCE NOTE: INFANT AND YOUNG CHILD FEEDING (IYCF) IN THE CONTEXT OF A BIOLOGICAL ATTACK	26
Background	26
Anthrax	29
Botulism	31
Ebola	32
Plague	33
Q fever	34
Smallpox	34
Tularemia	36
Conclusion	36
Appendix 1: Medications commonly used in the treatment of biological agents and use in breastfeeding women	37
Appendix 2: Supporting breastfeeding mothers and infants if breastfeeding needs to be temporarily interrupted	38
Appendix 3: Specific Resources for Ebola	39

CONTENTS

GUIDANCE NOTE: INFANT AND YOUNG CHILD FEEDING IN THE FIRST THREE DAYS AFTER A NUCLEAR POWER PLANT ACCIDENT	42
1. In the event of an accident at a nuclear power plant (NPP), people are likely to be concerned about continuing breastfeeding	43
2. The potential transfer of radioactive iodine to infants through breastmilk may only be a concern in extreme circumstances such as for local populations near the area most affected by a radioactive release	43
3. The risk of mothers absorbing or being exposed to radioactive iodine can be reduced to minimise the potential exposure to an infant through breastmilk	43
4. Breastfeeding is strongly recommended in most circumstances	44
5. If exposure or uptake of radioactive iodine cannot be reduced, the risks of interrupting versus continuing breastfeeding need to be considered before breastmilk substitutes are used	45
6. Breastfeeding women need support following a nuclear emergency. If breastfeeding is temporarily interrupted, mothers and infants need support to protect their breastmilk supply and guidance from the responsible authorities about when to resume breastfeeding	45
7. Breastmilk that was expressed and stored before the nuclear emergency is safe for use	46
8. Infants who need to use breastmilk substitutes can use ready-to-use infant formula (RUIF) or powdered infant formula (PIF) that were already in the home or manufactured before the nuclear emergency	46
9. All food and drinks in the home or that were packaged before the nuclear emergency are safe for consumption by all in the household including breastfeeding mothers and infants over six months of age	47
Appendix 1: Key messages on IYCF after an accident at an NPP in the context of the current Ukraine crisis	50
Appendix 2: Caesium and breastfeeding women, infants and young children	50
Appendix 3: KI doses for breastfeeding women, infants and young children	51
Appendix 4: Resources on increasing breastmilk supply	51
Appendix 5: Decision tree for healthcare workers: Advising breastfeeding mothers on breastfeeding practices in the first three days after an NPP accident in the context of the current Ukraine crisis	52

GUIDANCE NOTE:

INFANT AND YOUNG CHILD FEEDING IN THE CONTEXT OF A CHEMICAL ATTACK



This guidance note is a document developed by the IFE Core Group Sub-working Group on Infant and Young Child Feeding in Emergencies (IYCF-E) in the context of chemical, biological, radiological and nuclear threats. Its purpose is to outline key facts on IYCF in the context of a chemical weapon emergency to inform emergency plans and responses. The guidance note is intended for policymakers and for people who will provide guidance for health facilities in the case of a chemical agent attack. **There are a wide variety of possible agents that can be used in a chemical attack and therefore this guidance note will prioritise those most likely to be used, describing how IYCF could be impacted. For more information, please contact ife@enonline.net.**

What are the most likely forms of chemical attack?

The chemical agents that are most likely to be used in warfare or a terrorist attack could come in the following forms: nerve agents, pulmonary/choking agents, blood/systemic agents, and blistering agents.¹ Within each category, there is a different mechanism of action, different medical management and fatality rates, and therefore a different impact on IYCF.

Table 1: Category of Chemical Agents

Category of Chemical Agents	Examples
Nerve agents – Cause toxic effects by disrupting the transmission of nerve impulses in the brain, skeletal muscles, smooth muscles, and exocrine glands (glands with ducts)	Sarin, tabun, VX
Pulmonary/choking agents – Damage the large airways, small airways and air sacs, or both, leading to breathing problems	Chlorine
Blood/systemic agents – Prevent the normal use of oxygen by the body tissues	Hydrogen cyanide
Blister agents – Cause local damage (damage on contact) to eyes, skin, lungs, and damage to other tissues through distribution via the bloodstream	Sulfur mustard, lewisite

Agents that could be used as mass-casualty weapons include military chemical warfare agents and toxic industrial chemicals; some chemicals are dual use in that they have been used in both war and in industry. The most important things to know about any such agent are:

1. The actual **agent** or agents used
2. The **states or forms** (e.g., solid, liquid, vapour, gas, aerosol or combinations) of the chemical in the environment
3. The **routes of exposure** (how the chemical contacts and enters the body, e.g., via inhalation, the skin, the eyes, ingestion or wounds)
4. The **dose** (the amount that contacts the body – the *exposed* dose – and the amount that crosses a protective lining of cells to get truly inside the body – the *absorbed* dose)
5. The **duration** of exposure (which contributes both to the exposed dose and the absorbed doses)

What information do we have on breastfeeding safety following a chemical attack?

This document will outline the agents most likely to be used in a chemical attack and the characteristics, management, and treatment associated with each agent.

Breastfeeding provides infants with hydration, comfort, connection, and high-quality nutrition. It protects them against disease and provides food security. This protection and security are critical during emergencies when there is often a lack of access to clean water, electricity, food supplies, and health care. Breastfeeding also has important consequences for maternal health and caregiving capacity. It is critically important to provide caregivers with clear and accurate information, reassurance, and guidance to protect, promote, and support appropriate IYCF in the event of a chemical attack and to ensure that women do not stop breastfeeding unnecessarily.

There is limited information in the literature about the impact of chemical agents on breastfeeding. In situations of a chemical attack, often medical measures must be administered rapidly and patients may not be conscious. Therefore, medical professionals may not be aware of the breastfeeding status of a patient. We will outline the latest information available on the safety of the treatments used for each agent and the current literature on whether the chemical agent in question can be excreted in breast milk. Given the lack of data on the subject, decisions about whether to continue to breastfeed following a chemical attack should be made on a case-by-case basis.

A note on food safety for breastfeeding mothers or young children in case of a chemical attack: There is a chance of contamination of food and water for many of the chemical agents listed below. It is recommended not to use unpackaged or packaged food until deemed safe by local authorities. There is a possibility of a residue of agents on packaged food and therefore touching the surfaces of packaging can create a hazard. This applies to all materials including tinfoil, glass, cans, and hard plastic alike.

Table 2 serves as a summary of the information contained in this guidance note. A detailed explanation of key facts, symptoms, management, medical treatment and breastfeeding safety is included under each specific agent.

Table 2: Summary of breastfeeding safety and treatment by agent. Note: If there are clear guidelines on when breastfeeding can be resumed, the guidance states, “temporarily interrupt” and will give recommendations regarding when it is safe to resume. If there are no evidence-based guidelines on when to resume, the guidance uses the word “halt”.

Agent	Treatment for breastfeeding women	Treatment for infants and children	Is breastfeeding safe after exposure?	Is breastfeeding safe during treatment?
Chlorine gas	Decontamination, supportive care, and treatment of pulmonary injury. Treatment: Albuterol, Sodium bicarbonate, prednisone, prednisolone.	Decontamination, supportive care, and treatment of pulmonary injury. Treatment: Nebulized sodium bicarbonate, inhalation of albuterol via metered-dose aerosol.	Yes. Breastfeeding can continue if the mother is physically able to do so.	Yes. Breastfeeding can continue if the mother is physically able to do so. Albuterol and sodium bicarbonate are considered safe for breastfeeding women. Prednisone and prednisolone are considered safe with breastfeeding.
Hydrogen cyanide	Decontamination, supportive care. Antidotes: IV hydroxocobalamin, Nithiodote (sodium nitrite with sodium thiosulfate; amyl nitrite).	Decontamination, supportive care. Antidotes: IV hydroxocobalamin, Nithiodote (sodium nitrite with sodium thiosulfate) (not for infants under 6 months of age). Dosing available for paediatric population.	No. Temporarily interrupt for 15 days post exposure.	No. Temporarily interrupt for 15 days post exposure. If a breastfeeding mother is treated with Nithiodote (sodium nitrite with sodium thiosulfate), breastfeeding should be temporarily interrupted. IV hydroxocobalamin (Vitamin B ₁₂) is considered safe for breastfeeding women.
Lewisite	Decontamination, supportive care. Antidote: Intramuscular injection of British Anti-Lewisite (BAL or dimercaprol). Due to its significant side effects, it is recommended only for people who have signs of shock or significant pulmonary injury. Contraindicated in anyone with a peanut allergy.	Decontamination, supportive care. Antidote: Intramuscular injection of British Anti-Lewisite (BAL or dimercaprol). Due to its significant side effects, it is recommended only for people who have signs of shock or significant pulmonary injury. Dosing available for the paediatric population but not for the infant population.	No. Breastfeeding should be temporarily interrupted. Arsenic can be excreted into milk and can be toxic to a nursing infant. Can resume after 15 days if the mother is physically able.	No. Can resume after 15 days if the mother is physically able to do so with or without treatment. (See full recommendation for Lewisite for information on half-life of both Lewisite and BAL). BAL is considered contraindicated by some sources for breastfeeding women given its possible excretion into breast milk.

Table 2 continued...

Sarin	<p>Decontamination, supportive care.</p> <p>Antidote: Atropine and pralidoxime chloride (2-PAM).</p> <p>Diazepam or Midazolam – when there is evidence of seizures.</p> <p>See Appendix 2 for dosage recommendations for nerve agents.</p>	<p>Decontamination, supportive care.</p> <p>Antidote: Atropine and pralidoxime chloride (2-PAM) if over 1 year of age, only atropine if under 1 year of age.</p> <p>Diazepam – when there is evidence of seizures.</p> <p>See Appendix 2 for dosage recommendations for nerve agents.</p>	<p>No. Breastfeeding should be halted.</p> <p>In the absence of knowledge and data, if a safe breastmilk substitute (BMS) alternative is available, halt breastfeeding.</p>	<p>No. Breastfeeding should be halted.</p> <p>In the absence of knowledge and data, if a safe BMS alternative is available, halt breastfeeding.</p>
Sulfur Mustard	<p>Decontamination, supportive care.</p> <p>Pain medication for eye pain, blisters, and skin burns. Oral antihistamines for skin itching and irritation.</p>	<p>Decontamination, supportive care.</p> <p>Pain medication and oral antihistamines.</p>	<p>No. Breastfeeding should be halted.</p> <p>Halt breastfeeding due to high fat solubility of sulfur mustard.</p>	<p>No. Breastfeeding should be halted.</p> <p>Halt breastfeeding due to high fat solubility of sulfur mustard.</p>
Tabun	<p>Decontamination, supportive care.</p> <p>Antidote: Atropine and pralidoxime chloride (2-PAM).</p> <p>Diazepam – when there is evidence of seizures.</p> <p>See Appendix 2 for dosage recommendations for nerve agents.</p>	<p>Decontamination, supportive care.</p> <p>Antidote: Atropine and pralidoxime chloride (2-PAM) if over 1 year of age, only atropine if under 1 year of age.</p> <p>Diazepam – when there is evidence of seizures.</p> <p>See Appendix 2 for dosage recommendations for nerve agents.</p>	<p>No. Breastfeeding should be halted.</p> <p>In the absence of knowledge and data, if a safe BMS alternative is available, halt breastfeeding.</p>	<p>No. Breastfeeding should be halted.</p> <p>In the absence of knowledge and data, if a safe BMS alternative is available, halt breastfeeding.</p>
VX	<p>Decontamination, supportive care.</p> <p>Antidote: Atropine and pralidoxime chloride (2-PAM).</p> <p>Diazepam – when there is evidence of seizures .</p> <p>See Appendix 2 for dosage recommendations for nerve agents.</p>	<p>Decontamination, supportive care.</p> <p>Antidote: Atropine and pralidoxime chloride (2-PAM) if over 1 year of age, only atropine if under 1 year of age.</p> <p>Diazepam-when there is evidence of seizures.</p> <p>See Appendix 2 for dosage recommendations for nerve agents.</p>	<p>No. Breastfeeding should be halted.</p> <p>In the absence of knowledge and data, if a safe BMS alternative is available, halt breastfeeding.</p>	<p>No. Breastfeeding should be halted.</p> <p>In the absence of knowledge and data, if a safe BMS alternative is available, halt breastfeeding.</p>

Nerve Agents

There are three common nerve agents that are discussed here in detail: sarin, tabun and VX. **Please refer to Appendix 1 for detailed information on how nerve agents impact the body.**

SARIN

Key facts

- Sarin (GB)ⁱ is a colourless, tasteless nerve agent that often has a faint fruity odour.¹ It is one of the so-called G-series agents, or G agents, that were developed by Germany before and during World War II.
- All G agents are volatile, meaning that they can quickly and easily evaporate from a liquid to a vapour that can spread rapidly through the air. Sarin is the most volatile of the G agents; it evaporates at almost the exact rate as water.²
- Sarin vapour is heavier than air so it will usually sink to lower ground or low-lying areas.²
- People can be exposed by breathing air that contains sarin or through skin or eye contact.² Sarin mixes easily with water and therefore people can be exposed by touching or drinking water that contains sarin.²
- Although exposure can also happen by eating food contaminated with sarin, ingestion is an uncommon route of exposure.
- A person's clothing can harbour sarin vapour and therefore can lead to exposure of others by releasing the sarin vapour.³
- Sarin has low persistence in the environment meaning, in vapour form, it will last minutes to hours and in liquid form, 2 to 24 hours. The level of persistence will depend on the amount of agent released, the method of release, the environment conditions, and the types of surfaces impacted.³

Symptoms

- Symptoms can appear within a few seconds of a high-dose exposure to sarin vapour and within minutes of a high dose of the liquid form. Fatal liquid exposures to the skin usually create symptoms within half an hour or less.³
- Exposure to a large dose of sarin by any route may cause loss of consciousness, convulsions, paralysis, respiratory failure, and death.⁴
- People exposed to a low or moderate dose of either sarin vapour or liquid sarin may experience the following symptoms within seconds to hours: runny nose, watery eyes, excessive sweating, chest tightness, rapid breathing, diarrhoea, nausea, vomiting, confusion, weakness, headache, slow or fast heart rate, and low or high blood pressure.⁴
- There is ample evidence showing that some individuals exhibit long-term effects from even mild to moderate sarin exposure. These effects include visual effects, changes to the central nervous system, and impairments of learning, memory, and intelligence and concentration.⁵
- Severely exposed people are less likely to survive.³
- Although sarin is metabolised and excreted relatively quickly from the body, it is so toxic that it can cause death before metabolism and elimination can occur.^{3,4}

TABUN

Key facts

- Tabun (GA)ⁱ is a colourless and tasteless liquid with a slightly fruity odour.¹ The liquid slowly evaporates to form a vapour.⁶
- Tabun vapour is heavier than air and so will sink to low-lying areas.
- People can be exposed to tabun primarily through skin contact, eye contact, or inhalation.⁷
- In a trauma situation, any nerve agent can also enter the body through wounds.
- Water and food supply can also be contaminated with tabun.

ⁱ In addition to their chemical names, some chemical agents have a 1-3 letter North Atlantic Treaty Organization (NATO) code.

- A person's clothing can harbour tabun after contact with vapour and lead to exposure of other people through "off-gassing".⁷
- Tabun evaporates more slowly than sarin does but is still considered a volatile and non-persistent agent and therefore a relative short-term threat.⁷
- Tabun breaks down slowly in the body so repeated exposures can have cumulative effects.⁷

Symptoms

- Symptoms can appear within a few seconds after exposure to tabun vapour and within a few minutes to hours after exposure to liquid tabun.¹
- Exposure to a large dose of tabun by any route may cause loss of consciousness, convulsions, paralysis, respiratory failure, and death.⁷
- The clinical presentation of tabun is essentially the same as that of sarin; people exposed to a low or moderate dose of either tabun vapour or tabun liquid may experience the following symptoms within seconds to hours: runny nose, watery eyes, excessive sweating, chest tightness, rapid breathing, diarrhoea, nausea, vomiting, confusion, weakness, headache, slow or fast heart rate, and low or high blood pressure.^{6,7}
- As with sarin, there are differences in the onset of symptoms depending upon the state of the agent (liquid vs. vapour) and the routes of exposure.

VX

Key facts

- VX is among the most potent of nerve agents.⁸
- It is an odourless, tasteless liquid that is amber in colour and has very low volatility, meaning that it is quite slow to evaporate.¹
- VX is primarily a liquid exposure hazard but, if it is heated to high temperatures, it can turn to vapour.⁸
- VX vapour is heavier than air so will sink to low-lying areas.
- Once VX is released into the air, people can be exposed through skin contact, eye contact, or inhalation of VX vapour or aerosol.⁸
- VX can pose a risk of food or water contamination.
- VX breaks down slowly in the body so repeated exposures can have cumulative effects.⁸
- Compared to sarin, VX is much more toxic, especially through skin contact.⁸ Any visible VX liquid contact on the skin would be lethal if not washed off immediately.
- VX is persistent in the environment, capable of lasting for days on objects under average weather conditions and for months under very cold conditions.⁸ Because of this slow evaporation, it is considered both a long-term and short-term threat due to its potential contamination of surfaces.⁸

Symptoms

- Symptoms can appear within a few seconds if exposed to the vapour form and within a few minutes to 18 hours if exposed to the liquid form.⁸
- Exposure to a large dose of VX by any route may cause loss of consciousness, convulsions, paralysis, and respiratory failure possibly leading to death.⁸
- People exposed to a low or moderate dose of VX by any of the above methods may experience the following symptoms within seconds to hours: runny nose, watery eyes, excessive sweating, chest tightness, rapid breathing, diarrhoea, nausea, vomiting, confusion, weakness, headache, slow or fast heart rate, and low or high blood pressure.⁸

Management of nerve agent exposure

- Treatment consists of removing the agent from the body as soon as possible and providing supportive care in a medical setting.
- If people think they have been exposed, they should leave the area where the agents were released and get to fresh air. Since all three nerve agents are heavier than air, people should go to the highest ground possible.
- If a nerve agent was released indoors, people should be advised to quickly get out of the building.³
- If people think they have been exposed, they should remove their clothing and any clothing that must be pulled over the head should be cut off the body instead of being pulled over the head.^{3,7,8} People should seal clothing in a plastic bag and then seal that bag in a second plastic bag.^{3,7,8} Local or state health departments or emergency personnel should be informed upon their arrival that there is contaminated clothing and no one should handle the plastic bags. Those exposed should quickly wash the entire body with large amounts of soap and water and rinse the eyes with plain water for 10 to 15 minutes if there is eye pain or if vision is blurred.^{3,7,8}
- All people who think they have been exposed should seek medical care as soon as possible.^{3,7,8}
- As with all chemical agents, people should not touch or use unpackaged or packaged food until deemed safe by local authorities.¹ There is a possibility of a residue of agents on packaged food and therefore touching the surfaces of packaging creates a hazard. This applies to all materials including tinfoil, glass, cans, and hard plastic alike.

Medical treatment

- Atropine and pralidoxime chloride (2-PAM) are antidotes for nerve agent toxicity and they are most useful if given as soon as possible.^{3,7,8}
- 2-PAM must be given within minutes or a few hours following exposure to be effective.^{3,7,8} Atropine should be given every 5-10 minutes as needed.^{3,7,8}
- Diazepam or midazolam should be given initially and when there is evidence of seizures.^{3,7,8} See Appendix 2 for dosage recommendations for nerve agent treatments.
- There are infant doses documented for atropine and doses for diazepam in infants over the age of one month.

Breastfeeding safety

- Breastfeeding should be halted.
- It is not known whether nerve agents are absorbed and secreted into breast milk. It is known that nerve agents are both water- and fat-soluble and recent research indicates that the elimination of nerve agents from the body may continue over time.^{9,10}
- In the absence of knowledge and data, if there are safe breastmilk substitute (BMS) alternatives and the required resources to safely prepare BMS, it is recommended that breastfeeding be halted following exposure to nerve agents and BMS be used.
- See Appendix 4 for further guidance on BMS.
- If breastfeeding cannot be halted, please see Appendix 2 for information on the safety and dosage of treatment for nerve agents for breastfeeding women and for infants.

Pulmonary/Choking Agents

Chlorine is the sole representative of this class that this guidance note will examine although others, such as phosgene, may be added at a later date. **Please refer to Appendix 1 for detailed information on how pulmonary/choking agents impact the body.**

CHLORINE

Key facts

- Chlorine exists in the environment as a yellow-green gas with a characteristic chlorine smell.¹
- It is heavier than air so it tends to settle near the ground.¹¹
- Most effects tend to be pulmonary but chlorine exposure can also cause skin and eye injuries.^{11,12}
- Children may be more sensitive to exposure to high concentrations of chlorine gas than adults because they have a greater lung-surface-area-to-body-weight ratio and smaller-diameter airways.¹¹

Symptoms

- It typically causes nearly immediate eye and mucous membrane irritation and pain as well as sneezing and hoarseness.
- Signs and symptoms from contact with the eyes and mouth include irritation, pain, and swelling of the eyes, mouth, and throat as well as sneezing and hoarseness; effects from damage to the large airways can include immediate airway irritation, pain, coughing, hoarseness, wheezing, and inspiratory stridor (a high-pitched noise while breathing in).¹¹⁻¹⁴ The shortness of breath or chest tightness from damage to the alveoli is usually delayed, often for hours. Later, with increasing fluid in the alveoli and airways, oxygen saturation drops, and cyanosis (bluish discoloration of the skin) is seen and may be followed by death.^{11,15,16}
- As with most agent exposures, a shorter than expected latent period indicates a higher dose and the onset of shortness of breath within 4 hours of exposure suggests a potentially fatal exposure.
- Most patients who have mild to moderate exposure will see acute symptoms resolve in 3-5 days and will have normal pulmonary function tests after several months.^{11,13} Some patients will develop chronic respiratory problems such as reactive airway disease as well as an elevated risk for congestive heart failure.¹³
- The actual signs and symptoms, their onset, and their severity depend on the state of the agent, the routes of exposure, the dose, and the region or regions of the respiratory tract targeted by the inhaled compound.

Management of exposure to chlorine

- The management of chlorine exposure involves decontamination, supportive care, and the treatment of pulmonary injuries.¹²
- If people think they have been exposed, they should remove their clothing and any clothing that must be pulled over the head should be cut off the body instead of pulled over the head.¹² People should seal clothing in a plastic bag and then seal that bag in a second plastic bag.¹² Local or state health department or emergency personnel should be informed upon their arrival that there is contaminated clothing and no one should handle the plastic bags. Those exposed should quickly wash the entire body with large amounts of soap and water and rinse the eyes with plain water for 10 to 15 minutes if they are burning or if vision is blurred.¹²
- All people who think they have been exposed should be kept at rest as much as possible and seek medical care as soon as possible.¹²

Medical treatment

- No antidotes are available.
- Beta-agonists such as albuterol can be useful for bronchospasm.¹¹
- Nebulized sodium bicarbonate can also be used to decrease symptoms and decrease lung injury.^{13,17}
- There is evidence that early corticosteroid use may help with lung inflammation and might prevent post-injury scarring.¹³
- While albuterol and nebulized sodium bicarbonate can safely be used in children over the age of 2 years, the safety and effectiveness of albuterol sulfate inhalation solution in children below the age of 2 years have not been established, nor is there any data on nebulized sodium bicarbonate in infants.¹⁸

Breastfeeding safety

- Breastfeeding can continue after exposure to chlorine gas and during/after treatment if the mother is physically able to do so.
- Chlorine gas almost exclusively affects exposed eyes, mucous membranes, and both compartments of the respiratory tract.
- Although high concentrations can reach the bloodstream, inhaled chlorine is rapidly metabolised and eliminated from the body.¹¹
- It is highly unlikely to be present in breast milk in appreciable quantities to impact breastfeeding.
- Albuterol and sodium bicarbonate are considered safe for breastfeeding women.^{17,19,20}
- Corticosteroids such as prednisone and prednisolone are also considered safe to use with breastfeeding.¹⁹⁻²¹

Blood/Systemic Agents

At this time, hydrogen cyanide is the sole representative of this class that this guidance note will examine although others may be added later. **Please refer to Appendix 1 for detailed information on how blood/systemic agents impact the body.**

HYDROGEN CYANIDE

Key facts

- Hydrogen cyanide (AC)ⁱ is the simplest cyanide-containing compound.
- It is a colourless or pale blue volatile liquid or colourless vapour or gas with a distinct odour of bitter almonds although a large proportion of people cannot detect the odour.²²
- Cyanide vapour and gas are lighter than air and so will rise.
- Cyanide has whole-body (systemic) effects by preventing the normal use of oxygen by nearly every organ in the body.²²
- It has the most impact on the brain, heart, and lungs because these organ systems are the most sensitive to low oxygen levels.²²
- Effects occur rapidly following inhalation exposure, with symptoms beginning within seconds to minutes.^{22,23} Death may occur within minutes.
- After skin exposure, symptoms may be immediate or delayed for 30 to 60 minutes.²⁴
- The time of the onset of the effects depends on the amount of cyanide a person is exposed to, the state of the agent, and the routes and duration of exposure.²⁴
- People can be exposed to cyanide by breathing air, drinking water, eating food, or touching soil that has been contaminated with cyanide.¹²
- Breathing cyanide vapour or gas causes the most harm of all methods of poisoning, but swallowing cyanide can also be toxic.^{22,24}
- Cyanide vapour or gas is most dangerous in enclosed spaces; it evaporates quickly in open spaces making it less dangerous (but not necessarily harmless) outdoors.²²

Symptoms

- Symptoms of mild inhalation exposure include headache, weakness, confusion, and loss of consciousness as well as heart palpitations, difficulty breathing, shortness of breath and nausea, and vomiting.^{22,24,25}
- Eye contact may result in eye inflammation and temporary blindness.²⁴
- The first evidence of inhalation of a high dose may be brief gasping.
- Symptoms of severe inhalation exposure include shock, disordered heart rhythms, cardiac arrest, pulmonary oedema, coma, seizures, and fatal respiratory arrest.²⁴
- Children exposed to hydrogen cyanide may receive larger doses than adults because they have a larger surface-area-to-body-weight ratio as well as higher metabolic rates and are therefore more vulnerable to toxicants.²⁴
- Usually, death occurs rapidly or there is prompt recovery.
- Survivors of serious exposures may suffer brain damage and examples of long-term effects include memory loss, movement disturbances, and personality changes.²⁴

Management of exposure to hydrogen cyanide

- If hydrogen cyanide gas was released indoors, advise people to get out of the building.²⁴
- If the cyanide gas was released outdoors, people should move away from the area where it was released.²²
- If people cannot get out of the area where the cyanide gas was released, they should stay as low to the ground as possible.²²
- If people think they have been exposed, they should remove their clothing and any clothing that must be pulled over the head should be cut off the body instead of pulled over the head.²² Clothing should be sealed in a plastic bag and then that bag should be sealed in a second plastic bag.²² Local or state health department or emergency personnel should be informed upon their arrival that there is contaminated clothing and no one should handle the plastic bags. Those exposed should quickly wash the entire body with large amounts of soap and water and rinse the eyes with plain water for 10 to 15 minutes if they are burning or if vision is blurred.²²

Medical treatment

- Speed is critical in the management of cyanide poisoning.
- Initial treatment consists of the administration of antidotes, oxygen, and IV fluids, the correction of chemical imbalances in the blood, seizure control, and especially airway management and ventilation as indicated.²⁴
- Antidotes for cyanide toxicity include IV hydroxocobalamin, amyl nitrite, sodium nitrite, and sodium thiosulfate^{1,26} (the latter mostly given in combination under the label Nithiodote²⁶).
- IV Hydroxocobalamin is considered a first-line treatment option, and amyl nitrite with sodium nitrite and sodium thiosulfate can be used if IV hydroxocobalamin is not available.
- Hydroxocobalamin, sodium nitrite, and sodium thiosulfate are all available in IV paediatric and infant doses.
- Sodium nitrite should be used with caution in patients under 6 months of age because of the higher risk of developing severe methemoglobinemia compared to older children and adults.²⁶

Breastfeeding safety

- Breastfeeding should be temporarily interrupted.
- Animal studies show that cyanide can be transferred into milk and passed to nursing goats.²⁵ However, there are no studies looking at cyanide and excretion into human breast milk.²⁵
- The half-life for hydrogen cyanide elimination is one hour and it has limited fat solubility.²⁷ However, cyanide rapidly metabolises to thiocyanate which can be excreted into breast milk and can be toxic to the infant.
- Given the half-life of thiocyanate is 2.7 days, it would be advisable to temporarily interrupt breastfeeding for 15 days (5 half-lives) after cyanide poisoning for thiocyanate to be fully eliminated from the mother's body.²⁷
- IV hydroxocobalamin (Vitamin B₁₂) is considered safe for breastfeeding women.^{19,20}
- Breastfeeding is not recommended during treatment with Nithiodote because of the potential for serious adverse reactions in breastfed infants.²⁶

Blistering Agents

The two blistering agents covered in this guidance note are sulfur mustard and lewisite. **Please refer to Appendix 1 for information on how blistering agents impact the body.**

SULFUR MUSTARD

Key facts

- Sulfur mustard is also known, inaccurately, as mustard gas.
- It can smell like mustard, garlic, onions, or even asphalt and is sometimes odourless.²⁸
- Sulfur mustard can exist as a solid (below 58 degrees Fahrenheit, 14 degrees Celsius), an oily liquid in association with a vapour or a gas (but only above 423 degrees Fahrenheit, 217 degrees Celsius).^{28,29}
- Sulfur mustard is heavier than air so it will settle in low-lying areas.
- Sulfur mustard can last for up to 1-2 days in a typical ambient environment and for weeks or months in very cold conditions.²⁸
- Exposure to sulfur mustard can kill although most cases are not fatal.²⁸
- Both skin and inhalational exposures are associated with significant latent periods (the times between exposure and the onset of signs and symptoms) and people typically may not know immediately that they have been exposed.²⁸
- Depending on the severity of the exposure, symptoms may not appear for up to 24 hours but extremely high doses may be obvious within an hour or two or even (for massive and usually fatal doses) even less.²⁸
- If sulfur mustard is released into the air as a vapour, people can be exposed through eye contact, skin contact, inhalation, or any combination of these. It can also be released into water thus contaminating water for drinking, bathing, and other uses.
- Sulfur mustard breaks down slowly in the body and can have cumulative effects if people have repeated exposures.²⁸

Symptoms

- The agent, both as a liquid and a vapour, can cause eye pain and injury, skin burns and blisters, and damage, especially to the large airways. It is more dangerous to warm, moist, and oily skin and in hot and humid conditions and climates.²⁸
- Respiratory effects are predominantly on the larger airways at low to moderate doses but can involve the entire respiratory tract at high doses.
- Systemic effects include nausea, vomiting, and diarrhoea as well as bone-marrow depletion.^{28,29}
- Cancer is another systemic effect but arises only years after exposure.
- Sulfur mustard exposure in children causes similar local damage (to eyes, skin, and the respiratory tract) and similar systemic damage as in adults. However, the effects tend to be more severe and begin earlier in children.²⁹
- Long-term health effects include permanent eye injury, chronic respiratory disease, skin burns with scarring, and skin and respiratory cancer.^{28,29}

Management of exposure to sulfur mustard

- The most important factor is the prompt removal of sulfur mustard from the body.
- If a sulfur mustard release is suspected, people should be advised to find higher ground.
- If avoiding exposure is not feasible, removing the sulfur mustard as soon as possible after exposure is the only effective way to prevent or decrease damage to the body.²⁸
- The removal of sulfur mustard from the skin within two minutes if possible is ideal, but even late decontamination can minimise not only the contamination of others by the patient but also, and just as importantly, the continued absorption of sulfur mustard (especially thickened mustard) from the surface of the skin.²⁸
- Those exposed to sulfur mustard should remove their clothing and any clothing that would normally be pulled over the head should be cut off the body instead of pulled over the head.²⁸ People should seal clothing in a plastic bag and then seal that bag in a second plastic bag.²⁸ Local or state health department or emergency personnel should be informed upon their arrival that there is contaminated clothing and no one

should handle the plastic bags. Those exposed should quickly wash the entire body with large amounts of soap and water and rinse the eyes with plain water for 10 to 15 minutes if eye contact with either vapour or liquid is suspected or confirmed. Do not wait until eye irritation or the blurring of vision occurs.²⁸ If contact lenses are worn, these should be removed and placed with contaminated clothing.²⁸

Medical treatment

- There is no antidote to sulfur mustard and the treatment is similar to that of burn injuries.
- Pain medication may be given for eye pain, blisters, and skin burns and oral antihistamines may be given for skin itching and irritation.

Breastfeeding safety

- Breastfeeding should be halted.
- It is not known if sulfur mustard can be passed to infants in breast milk.^{29,30} However, due to the high fat solubility of sulfur mustard and persistence in the body, there is a higher risk that sulfur mustard could appear in the breast milk of exposed mothers.³⁰ Therefore, halting breastfeeding is recommended.

LEWISITE

Key facts

- Lewisite is an oily, pale amber to brown liquid that can evaporate to form a colourless vapour said to have the odour of geraniums or fruit.³¹
- Lewisite vapour is heavier than air so it will settle in low-lying areas.
- If lewisite is released into the air, people can be exposed through eye contact, inhalation, and skin contact with lewisite vapour.³¹
- People can also be exposed to lewisite through water or food contamination as well as by coming into direct contact with liquid lewisite.³¹
- It remains a liquid under a variety of environmental conditions and therefore can last in the environment for a long time.³²
- Lewisite contains arsenic and is a powerful irritant and blistering agent. It immediately damages the skin, eyes, and respiratory tract.³¹
- Because it contains arsenic, lewisite can also cause abdominal distress, the leakage of fluid from capillaries throughout the body (most notably in the capillaries surrounding the alveoli in the lungs), and low blood pressure.^{31,32}

Symptoms

- Unlike sulfur mustard, lewisite has a very short latent period with initial pain occurring within a couple of minutes of exposure; blisters form within several hours.³²
- Victims can experience eye irritation, a bloody nose, coughing, and other large-airway signs and symptoms and, at lower doses than for sulfur mustard, pulmonary oedema with low blood pressure, a condition caused by capillary leakage in the lungs and called lewisite shock.
- Digestive tract symptoms include nausea, vomiting, and diarrhoea.^{31,32}
- For the same reasons that children are more likely to have greater susceptibility than adults to sulfur mustard, children might be expected to be at a similarly heightened risk of severe effects from lewisite.
- The possible long-term effects of extensive exposure to lewisite include permanent eye damage (including blindness), skin burning and scarring, and chronic respiratory disease.³²
- Lewisite is not known to suppress the immune system.^{31,32}

Management of exposure to lewisite

- Immediate decontamination is the only way to limit injury.
- People should quickly move to an area with fresh air and go to the highest possible ground.³¹ Those exposed should quickly remove clothing and any clothing that would normally be pulled over the head should be cut off the body instead of pulled over the head.³¹ Clothing should be sealed in a plastic bag and

then that bag should be sealed in a second plastic bag. Local or state health department or emergency personnel should be informed upon their arrival that there is contaminated clothing and no one should handle the plastic bags.³¹ Those exposed should quickly wash the entire body with large amounts of soap and water and rinse the eyes with plain water for 10 to 15 minutes if eye contact with either vapour or liquid is suspected or confirmed. They should not wait until eye irritation or the blurring of vision occurs.³¹ If a person wears contact lenses, these should be removed and placed with contaminating clothing.³¹

Medical treatment

- The antidote for lewisite is British Anti-Lewisite (BAL, or dimercaprol).^{32,33}
- This is given via intramuscular injection and binds to arsenic to prevent systemic toxicity but it will not prevent injury to skin, eyes, or mucous membranes.^{32,33}
- Due to its significant side effects, it is recommended only for people who have signs of shock or significant pulmonary injury.³³
- It is contraindicated in anyone with a peanut allergy.³²
- Paediatric dosing is available for dimercaprol although not for the infant population.³⁴
- Safer alternatives to BAL are under investigation.

Breastfeeding safety

- Given that both the agent and the treatment can be excreted in breast milk, breastfeeding should be temporarily interrupted.
- BAL is considered contraindicated by some sources for breastfeeding women given its possible excretion into breast milk.^{19,20}
- Arsenic can be excreted into breast milk and can be toxic to a nursing infant.³⁵
- The half-life of lewisite ranges from 55 to 75 hours and the half-life of BAL is 4 hours.^{34,36}
- In the absence of other alternatives, it would be safe to resume breastfeeding 15 days (5 half-lives) after exposure and treatment completion upon clearance from a physician and if the mother is physically able to do so.

CONCLUSION

This guidance note is considered a living document. Currently, the guidance presented is based on the most recent research and evidence. As more information and research become available regarding the treatment of breastfeeding women who are exposed to chemical agents, we will continue to update as needed. Appendix 3 outlines BMS and relactation guidance for use in cases where breastfeeding must be halted or temporarily interrupted.

Appendix

Appendix 1: How chemical agents impact the body

Nerve agents

In the body, a small molecule called acetylcholine (ACh) acts as a neurotransmitter (signal transmitter) in the brain, skeletal muscles, smooth muscles, and exocrine glands (glands that secrete through ducts).³⁷ Electrical impulses sent along neurons cause the release of ACh at target organs and the ACh causes the target muscle, neuron, or gland to respond. Once ACh has transmitted its message, it is normally broken down by an enzyme called acetylcholinesterase (AChE). Nerve agents bind to and inactivate AChE, leading ACh to build up and cause overstimulation and eventually fatigue and the failure of its target organs.

Effects in the brain can include seizures, loss of consciousness, and cessation of breathing. Breathing can also stop from the direct effects on the diaphragm and other breathing muscles. Twitching and paralysis can affect other skeletal muscles as well, and smooth-muscle effects can include miosis (pinpoint pupils), vomiting and diarrhoea, and bronchoconstriction (asthma-like tightness in the chest).³⁸ The effects on exocrine glands lead to increased secretions including tearing, runny nose, drooling, and excessive sweating.¹ This constellation of signs and symptoms is similar for all nerve agents and is called the cholinergic toxidrome.³⁹ The extent of poisoning from any nerve agent depends on whether the agent is encountered as a liquid or a vapour, the routes of exposure, the dose, and the amount to which a person is exposed. While it is difficult to measure actual doses of nerve agents during a terrorist attack, doses can often be inferred based on the length of the latent period which is the time between exposure and the onset of symptoms; a shorter latent period implies a higher dose.³⁹ Very low exposures may cause detectable decreases in AChE activity without any symptoms. Mild exposures may result in only local effects such as tearing, a runny nose, a decrease in pupil size from vapour exposure, or localised sweating and twitching from liquid contact with the skin; symptoms from vapour exposure predictably occur much sooner than symptoms after mild to moderate skin exposures to liquid. Severe symptoms can lead to convulsions, apnoea, and death.³⁹

Children are not simply small adults and differ from adults in several ways other than size. Because of their smaller body mass, less agent is needed to poison them. In addition, children have immature respiratory tracts, higher respiratory rates, immature blood-brain barriers, greater susceptibility to seizures, and a less mature metabolism.⁴⁰ Their susceptibility to nerve agents is likely to be increased and the signs and symptoms in children exposed to nerve agents are known to differ in important ways from the clinical presentation of adults.^{23,40}

Pulmonary/chocking agents

Pulmonary agents are primarily gases that can contact the eyes, nose, and throat and that can be inhaled to cause damage to the large airways (trachea, bronchi, and larger bronchioles), the small airways (smaller bronchioles), air sacs, and the alveoli or both. The damage, clinical presentation, and treatment are different depending upon the part of the respiratory tract affected. Large-airway (central-compartment) agents cause irritation and the shedding of the delicate lining of the airways and eventually partial or total airway obstruction. Small-airway (peripheral-compartment) compounds damage the cells enclosing the alveoli and lead to a gradually progressive fluid leakage into the alveoli and, eventually, even the large airways. This pathological process is called pulmonary oedema and can cause the clinical syndromes of acute lung injury or acute respiratory distress syndrome.^{1,15}

Blood/systemic agents

Systemic agents are a group of chemicals that impact the body by preventing the normal use of oxygen by the body tissues. Introduced into warfare after the pulmonary agents, systemic asphyxiants were called blood agents because they were systemically (widely) distributed to all body tissues through the blood.³⁹ Their site of action is not the blood however, since their predominant mode of action is in the tissues throughout the body.³⁹ They exert their toxic effects by inhibiting certain enzymes in the electron transport chain in mitochondria throughout the body.³⁹ The extent of poisoning from any blood/systemic agent depends on the state of the agent, the routes and duration of exposure, and the delivered dose.

Blistering agents

Blistering agents produce skin injuries that resemble those caused by burns.¹ Blistering agents include mustards (comprising sulfur mustard and three kinds of nitrogen mustards) and arsenicals. Sulfur mustard is the blistering agent considered to be the most likely of these compounds to be used as a mass-casualty agent. Sulfur mustard has local effects on the skin, eyes, and respiratory tract, primarily the large airways (although high doses can also cause pulmonary oedema), and can also be distributed systemically to damage DNA, especially in the bone marrow.²⁸ This causes decreased formation of blood cells and can cause decreased formation of platelets, leading to bleeding, infections, and weakness.^{28,29} Lewisite, an arsenical, is absorbed rapidly via inhalation and through the skin.²⁸ It has local effects on the skin, eyes, and large airways similar to those of sulfur mustard. It also acts as a systemic poison and through its arsenic component can cause leakage of fluid from capillaries, especially in the lungs.³² Children are probably at higher risk of severe poisoning than are adults because they are more likely to be closer to the low-lying areas of higher vapour concentration. The extent of poisoning from any blister agent depends on the state of the agent, the routes of exposure, the dose, and the duration of exposure.

Appendix 2: Safety information and doses for atropine and 2-PAM³

The following data on the safety of treatment for nerve agents in breastfeeding women is for information purposes only since breastfeeding should be halted when a woman is exposed to nerve agents. Atropine is considered safe to take while breastfeeding.^{19-21,41} There is no information on whether pralidoxime chloride (2-PAM) is excreted into breast milk. Breastfeeding should be held for at least 6 to 7 hours after a dose is given.²⁰ Diazepam may be excreted in breast milk.^{19,20} Monitor an infant breastfed by a mother receiving diazepam for drowsiness, decreased feeding, lethargy, and failure to thrive. Halt breastfeeding in cases with high doses of diazepam or when repeated administration is needed.⁴²

Infant (0 – 2 yrs.) for mild to moderate physical findings, including localised sweating, muscular twitching (fasciculations), nausea, vomiting, weakness, and shortness of breath (dyspnoea), administer atropine at 0.05 mg/kg IM; 2-PAM at 15 mg/kg IM (over 1 year).

Infant (0 – 2 yrs.) for severe physical findings, including unconsciousness, convulsions, cessation of breathing (apnoea), and floppy (flaccid) paralysis, administer atropine at 0.1 mg/kg IM; 2-PAM at 25 mg/kg IM (over 1 year).

Child (2 – 10 yrs.) for mild to moderate physical findings, including localised sweating, muscular twitching (fasciculations), nausea, vomiting, weakness, and shortness of breath (dyspnoea), administer atropine at 1 mg/kg IM; 2-PAM at 15 mg/kg IM.

Child (2 – 10 yrs.) for severe physical findings, including unconsciousness, convulsions, cessation of breathing (apnoea), and floppy (flaccid) paralysis, administer atropine at 2 mg/kg IM; 2-PAM at 25 mg/kg IM.

Adult, for mild to moderate physical findings, including localised sweating, muscular twitching (fasciculations), nausea, vomiting, weakness, and shortness of breath (dyspnoea); administer atropine at 2 to 4 mg IM; 2-PAM at 600 mg IM.

Adult, for severe physical findings, including unconsciousness, convulsions, cessation of breathing (apnoea), and floppy (flaccid) paralysis, administer atropine at 6 mg IM; 2-PAM at 1800 mg IM.

Appendix 3: Supporting breastfeeding mothers and infants if breastfeeding needs to be temporarily interrupted⁴³

The vast majority of mothers can and should breastfeed, just as the vast majority of infants can and should be breastfed. Only under exceptional circumstances can a mother's milk be considered unsuitable for her infant. For those few health situations where infants cannot, or should not, be breastfed, the choice of the best alternative – expressed breast milk from an infant's own mother, breast milk from a healthy wet-nurse or a human-milk bank, or a BMS fed with a cup which is a safer method than a feeding bottle and teat – depends on individual circumstances.

Relation

If breastfeeding is temporarily interrupted, mothers and infants need support to protect their breast milk supply and relactate once they are ready to resume breastfeeding.

During any temporary interruption of breastfeeding, women should be supported to maintain their breast milk supply through frequent breast milk expression (either through hand expression or pump).ⁱⁱ Expressing breast milk is also important to avoid discomfort and breast infections. Women should be supported to increase their breast milk supply and relactate once they are ready to resume breastfeeding. If mothers have breast milk that was expressed and stored before the exposure, this can be used to feed the infant. If breast milk is frozen, thaw the sealed bag/contained of milk in a bowl of warm water from a safe source (tap or bottled depending on emergency). An easily cleaned cup (i.e., open, without a teat or spout) should be used to feed the infant expressed breast milk (see below). If breast milk expressed before the chemical attack is not an option, infants should be fed with an appropriate BMS if available.

Important links:

<https://www.llli.org/breastfeeding-info/relactation/>

<https://www.llli.org/increasing-breastmilk-supply/>

<https://www.unicef.org.uk/babyfriendly/maximising-breastmilk-and-re-lactation-guidance/>

<https://abm.me.uk/breastfeeding-information/relactation/>

Artificially fed or non-breastfed infants

For infants being fed BMS, ready-to-use infant formula and powdered infant formula already in the home or manufactured before the chemical attack are suitable for consumption.

If infants under 6 months of age are being fed BMS, mothers and caregivers should be advised to use ready-to-use infant formula (RUIF) if this is available. RUIF carries the least risk for formula-fed infants during a chemical attack. If RUIF is not available, then powdered infant formula (PIF) should be used. PIF should be made using bottled water. If this is not possible, tap water can be used if the local authorities say it is safe. For infants over 6 months of age, alternative milks (such as ultra-high temperature milk, fermented milk or yogurt, pasteurised or boiled full-cream animal milks or reconstituted evaporated milk) may be used instead of RUIF and PIF.

An easily cleaned cup (i.e., open, without a teat or spout) should be used to feed the infant BMS and expressed breast milk. Bottles, teats or cups with a lid are hard to clean in an emergency. Using bottles, teats or cups with a spout may also limit the successful restarting of breastfeeding as they reduce suckling.

Important links:

UNICEF BMS Procurement 2021: <https://www.unicef.org/media/100911/file/BMS-Procurement-Guidance-Final-June-2021.pdf>

Safe preparation, storage, and handling of powdered infant formula – guidelines:

<https://apps.who.int/iris/handle/10665/43659>

<https://www.ennonline.net/attachments/93/pif.pdf>

<https://www.ennonline.net/attachments/545/poster-preparing-formula-in-care-settings.pdf>

How to prepare for cup feeding at home:

<https://www.ennonline.net/attachments/543/safe-prep-cup-feeding-leaflet.pdf>

If bottle feeding is necessary careful preparation and use is critical:

<https://www.ennonline.net/attachments/542/safe-prep-bottle-feeding-leaflet.pdf>

For more information on the supporting infants dependent on breastmilk substitutes and the resources needed, please see: <https://www.ennonline.net/ifecoregroupinfographicseries>

ⁱⁱ The parts of the breast pump in contact with breast milk need to be carefully cleaned after each use with water from a safe source. Where this cannot be done, hand expression is recommended. Please see standard breast pump guidelines: <https://www.cdc.gov/healthywater/hygiene/healthychildcare/infantfeeding/breastpump.html>

Appendix 4: Medications commonly used in the treatment of chemical agents and for use in breastfeeding women

	LactMed ¹⁹	Briggs ²⁰	Hales ²¹	EmbryoTox – Germany ⁴¹
Albuterol	Acceptable during breastfeeding	Compatible	L1: No data – compatible	Safe during breastfeeding
Amyl nitrite	No data		L4: Limited data – possibly hazardous	No data
Atropine	Limited data – safe for short term use	Limited human data – probably compatible	L3: No data – probably compatible	Limited data – safe for short term use
Diazepam	Use cautiously during breastfeeding	Limited human data – potential toxicity	L3: Limited data – probably compatible	Safe during breastfeeding as single dose. Use caution with long term use
Dimercaprol (BAL)	No data	Contraindicated	No data	No data
Hydroxocobalamin	Acceptable during breastfeeding	Compatible	No data	No data
Pralidoxime chloride (2-PAM)	No data	Breastfeeding should be held for at least 6 to 7 hours after a dose is given.	No data	No data
Prednisone	Acceptable during breastfeeding	Compatible	L2: Limited data – probably compatible	Safe during breastfeeding
Prednisolone	Acceptable during breastfeeding	Compatible	L2: Limited data – probably compatible	Safe during breastfeeding
Sodium bicarbonate	No data	Compatible	L2: No data – probably compatible	No data
Nithiodote – sodium nitrite/sodium thiosulfate	No data	No data	No data	No data

Appendix 5: Important guidance

Infant Feeding in Emergencies Core Group, Infant Feeding in Emergencies Operational Guidance for emergency relief staff and programme managers Version 3.0 – October 2017, Emergency Nutrition Network, 2017. <http://www.enonline.net/operationalguidance-v3-2017>

Sphere Association. The Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response, fourth edition, Geneva, Switzerland, 2018. www.spherestandards.org/handbook

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GUIDANCE NOTE:

INFANT AND YOUNG CHILD FEEDING IN THE CONTEXT OF A BIOLOGICAL ATTACK

This guidance note is a document developed by the IFE Core Group Sub-working Group on Infant and Young Child Feeding in Emergencies (IYCF-E) in the context of chemical, biological, radiological and nuclear threats. Its purpose is to outline the key facts on IYCF in the context of a biological weapon emergency to inform emergency plans and responses. The guidance note is intended for policymakers and for people who will provide guidance for health facilities in the case of a biological attack. **There are a wide variety of possible agents that can be used in a biological attack, and therefore this guidance note will prioritise those most likely to be used, describing how IYCF could be impacted. For more information, please contact ife@enonline.net.**

Background

A biological attack is the intentional release of a virus, bacteria or other microorganisms that can kill or sicken people, livestock or crops.¹ In the event of a biological agent attack on a population, large numbers of people may be impacted. Biological agent attacks are challenging because they more often involve covert dissemination and may not have an immediate impact because of the delay between exposure and illness.² Some potential agents that may be used in a biological attack are anthrax, botulism, plague, Ebola, tularemia, Q fever, and smallpox.

Breastfeeding provides infants with hydration, comfort, connection, and high-quality nutrition. It protects them against disease and provides food security. This protection and security are critical during emergencies when there is often a lack of access to clean water, electricity, food supplies, and healthcare. Breastfeeding also has important consequences for maternal health and caregiving capacity. It is critically important to provide caregivers with clear and accurate information, reassurance, and guidance, to protect, promote, and support appropriate infant and young child feeding (IYCF) in the event of a biological attack and to ensure that women do not stop breastfeeding unnecessarily.

In order to weigh the risks and benefits of breastfeeding, multiple factors must be considered. These include the known short- and long-term benefits of breastfeeding for the infant, the immediate need for medication for the mother, the potential impact of the drug on milk production, the amount of drug excretion into breastmilk, and the potential adverse effects on the breastfeeding infant. A chart outlining the safety of common antimicrobials and treatments and breastfeeding is included in Appendix 1. Table 1 serves as a summary of the information contained in the guidance note.

Table 1: Summary of Breastfeeding safety and Treatment by Biological Agent/Disease. Note: If there are clear guidelines on when breastfeeding can be resumed, the guidance states “temporarily interrupt” and will give recommendations of when it is safe to resume. If there are no evidence-based guidelines on when to resume, the guidance uses the word “halt”.

Agent/ Disease	Spread (Person- to-person)	Treatment for breastfeeding women	Treatment for infants and young children	Is breastfeeding safe after exposure?	Is breastfeeding safe during treatment?
Anthrax	No	Antibiotics – first-line treatment – ciprofloxacin, levofloxacin, moxifloxacin; amoxicillin (if strain is susceptible to penicillin).	Antibiotics – ciprofloxacin and doxycycline; amoxicillin if strain is susceptible to penicillin.	<p>Yes. Breastfeeding is safe to continue after exposure.</p> <p>Women with active skin lesions from anthrax on the breast should avoid infant contact with the affected breast and not breastfeed from that breast until 48 hours after appropriate antimicrobial therapy has been initiated.³</p> <p>Expressed breastmilk can be used safely if hygiene and protective precautions were taken during expression, including hand washing and ensuring that no lesions come in contact with pump equipment if using pump.</p>	Yes. Breastfeeding is safe to continue during treatment.
Botulism	No	Supportive care (including assisted breathing using a ventilator for breathing difficulties and IV fluids if the person cannot swallow); early IV administration of botulinum antitoxin heptavalent (HBAT). ⁴	<p>Supportive care and early IV administration of HBAT.</p> <p>US FDA-approved HBAT dose for infants (persons aged <1 year) – 10% of the adult dose, regardless of weight. HBAT dose for children (persons aged 1–16 yrs.) – 20%–100% of the adult dose.⁵</p>	<p>While current evidence is limited, the evidence that exists suggests that breastfeeding by an infected mother is not harmful to her infant.⁶</p> <p>It is unlikely that botulinum toxin enters breastmilk because of its large molecular weight.⁶</p> <p>Infants of breastfeeding mothers should be monitored closely for signs and symptoms of botulism such as low muscle tone, a weak cry, gastro-intestinal symptoms or difficulty feeding and swallowing.⁶</p>	<p>Yes. Breastfeeding can continue while receiving the antitoxin HBAT.</p> <p>Infants of breastfeeding mothers should be monitored closely for signs and symptoms of adverse impacts from botulinum antitoxin if given to mother and/or infant including flu-like symptoms, such as fevers, chills, and malaise.⁶</p>

Table 1 continued...

Ebola	Via fluids	Supportive treatment. Vaccine if exposed and not yet symptomatic. ⁷ Breastfeeding women infected with Ebola (or those with high-risk exposures) can also receive Ebanga and Inmazed. ⁸	Supportive treatment.	No. Breastfeeding should be halted if Ebola Virus Disease (EVD) is confirmed in either mother or child, or if either one has confirmed exposure. Expressed breastmilk should be discarded. If mother and child with potential exposure and no symptoms, breastfeeding infants under 6 months may be considered if no alternative options are available. ⁹	No.
Plague	Yes	Antibiotics – ciprofloxacin, streptomycin, levofloxacin, moxifloxacin, gentamicin, and doxycycline. Chloramphenicol is also considered effective but has the potential for serious adverse reactions in infants so other drugs should be used preferentially for breastfeeding mothers.	Antibiotics for children >1 month include gentamicin, streptomycin, ciprofloxacin, levofloxacin. ¹⁰	No. Breastfeeding should be temporarily interrupted until both mother and infant receive antimicrobial treatment or post-exposure prophylaxis (PEP). ¹⁰	Yes. If a mother and infant are both receiving antimicrobial treatment or post-exposure prophylaxis (PEP), then a mother with pneumonic plague may continue to breastfeed safely. ¹⁰ If an infant does not receive antimicrobial treatment or PEP at the same time as the mother, the mother with pneumonic plague should temporarily interrupt breastfeeding until she has received 48 hours of antimicrobial treatment. ¹⁰
Q Fever	No	Antibiotics – doxycycline.	Antibiotics – doxycycline.	Yes. Breastfeeding is safe to continue after exposure. ¹¹	Yes. Breastfeeding is safe to continue during treatment. ¹¹

Table 1 continued...

Smallpox	Yes	Supportive treatment. Vaccinate if exposed and not yet symptomatic. ¹²	Supportive treatment.	If the mother or infant is a confirmed case of smallpox and has symptoms, halt breastfeeding. ¹³ Since people cannot transmit infection until they begin to show symptoms of fever and rash, personal contact between mother and infant can continue, including breastfeeding, until the onset of fever. ¹³ If either mother or infant develops fever, immediate isolation should begin. ¹³	If a mother is exposed to smallpox but does not yet show any symptoms, she may receive a vaccine (JYNNEOS is recommended for breastfeeding women) to prevent smallpox infection. ¹⁴ Once the mother receives the vaccine, breastfeeding can continue with proper infection control to avoid contact with the vaccine site. Mother should temporarily halt breastfeeding from that breast if breast lesions are present. ¹⁴
Tularemia	No	Antibiotics – streptomycin, gentamicin, doxycycline, and ciprofloxacin. ¹⁵	Antibiotics – gentamicin, doxycycline, ciprofloxacin. ¹⁵	Yes. Breastfeeding is safe to continue after exposure.	Yes. Breastfeeding is safe to continue during treatment.

Appendix 2 outlines BMS and re-lactation guidance for use in cases where breastfeeding must be halted or delayed.

Agent/Disease

ANTHRAX

Breastfeeding summary

- Breastfeeding is safe to continue.
- Women with active skin lesions from anthrax on the breast should avoid infant contact with the affected breast and not breastfeed from that breast until 48 hours after appropriate antimicrobial therapy has been initiated.¹⁶

Key facts

- Anthrax is an infectious disease that is caused by the bacteria *Bacillus anthracis* (*B. anthracis*) and is one of the most likely agents to be used in a biological attack.¹
- Microscopic spores produced by these bacteria could easily be put into powders, food, or water.¹
- It could also be released into the air via a plane, truck or the ventilation system of a building, be blown by the wind or carried on people's clothing or other objects.¹
- Anthrax generally is not passed through person-to-person transmission.³

Symptoms

- The incubation period of inhalation anthrax is 1 to 7 days but can be shorter if exposed to a large number of spores.¹⁷
- Symptoms of inhalation anthrax include initial flu-like illness with fever, headache, cough, and fatigue.¹⁸
- By the fourth day after symptom onset, this can progress to severe dyspnoea and shock and is usually fatal if untreated.¹⁸

Treatment

- In the event of a large-scale release of *B. anthracis* spores, the public health response will focus on post-exposure prophylaxis (PEP) to protect the population.
- A combination of antimicrobial PEP for protection during the first 60 days after exposure and a 3-dose vaccination series for long-term protection after exposure to spores is recommended.¹⁸
- For those with a known exposure, a monoclonal antibody treatment called raxibacumab is available that is used in combination with antimicrobial treatment.¹⁹

In the event of mass *B. anthracis* exposure, the recommendations are as follows:

Breastfeeding mothers

- Antimicrobials used for treatment and PEP of systemic anthrax include ciprofloxacin, levofloxacin, moxifloxacin, and amoxicillin.¹⁸
- Ciprofloxacin is considered the best first-line agent of choice for treatment and PEP for breastfeeding women and is safe for infants.⁵ Infants should be monitored for possible side effects of ciprofloxacin such as diarrhoea or thrush when given to either mother or infant.¹⁸ Refer to Appendix 1 for the full list of medications commonly used in treatment of biological attacks.
- Physicians may also prescribe amoxicillin if the strain of anthrax is susceptible to penicillin.¹⁸ Breastfeeding can continue with the use of amoxicillin as it is safe for use with infants and breastfeeding women.²⁰
- Anthrax vaccine (AVA) should be given to all exposed adults, including breastfeeding women at 0, 2 and 4 weeks in combination with a total of 60 days of PEP.¹⁸
- Raxibacumab is a monoclonal antibody indicated for the treatment of adult and pediatric patients with inhalational anthrax due to *B. anthracis* in combination with appropriate antibacterial drugs.¹⁹ It has not been evaluated in breastfeeding women. Given it is a large protein molecule, it is unlikely to be excreted in breastmilk.¹⁹
- Given the unknown impact of raxibacumab on breastmilk, ciprofloxacin remains the best course of treatment for women who wish to continue breastfeeding.

Infants

- For children over 6 weeks of age who are exposed to anthrax, they should receive PEP for 60 days after exposure as well as the 3-dose AVA series.¹⁸
- The preferred antimicrobial is ciprofloxacin or doxycycline.²¹ As with adults, amoxicillin can be used for penicillin-susceptible strains.²⁰ Infants should be monitored for possible side effects of ciprofloxacin such as diarrhoea or thrush when given to either mother or infant.²⁰
- For children less than 6 weeks of age, they should start immediately on antimicrobial PEP and the vaccine series delayed until the child reaches 6 weeks of age.²¹
- AVA should not be given at the same time as routine childhood vaccinations and should take priority over routine vaccinations since there is no information on the interaction between AVA and routine vaccination series common in childhood.²¹ Routine vaccinations can resume 4 weeks after the last AVA dose.²¹

Breastfeeding safety

- There is no evidence that anthrax can be transmitted through breastmilk, therefore women can continue to breastfeed if exposure is suspected.¹⁶
- Women with active skin lesions from anthrax on the breast should avoid infant contact with the affected

breast and not breastfeed from that breast until 48 hours after appropriate antimicrobial therapy has been initiated.¹⁶

- Expressed breastmilk can be used safely if hygiene and protective precautions were taken during expression, including hand washing and ensuring that no lesions come in contact with pump equipment if using pump.
- Breastfeeding can continue during treatment for anthrax, including while receiving the vaccination series.¹⁶
- Given the safety of the treatment options available, as stated above, there is a very low risk of overtreating the breastfeeding infant because of exposure to medication from the mother. Therefore, dosages remain the same for breastfeeding and non-breastfeeding infants.²¹

BOTULISM

Breastfeeding summary

- It is unlikely that botulinum toxin enters breastmilk because of its large molecular weight.^{6,i} While current evidence is limited, the evidence that exists suggests that breastfeeding by an infected mother is not harmful to her infant.⁶
- Infants of breastfeeding mothers should be monitored closely for signs and symptoms of botulism such as low muscle tone, a weak cry or difficulty feeding and swallowing.
- Breastfeeding can continue while the mother is receiving the antitoxin HBAT.

Key facts

- Botulism is caused by toxins formed by the bacteria *Clostridium botulinum* (*C. botulinum*).⁴
- It is possible to release the toxins of *C. botulinum* into the food supply or air, making people sick through ingestion or inhalation.⁴
- Botulism is not transmitted person-to-person and people do not need to be isolated.⁴

Symptoms

- Signs and symptoms of botulism evolve over a few hours to days.⁴
- Botulism toxin causes symmetric, bilateral flaccid paralysis, beginning with the head and neck muscles and progressing to the trunk, arms, and legs.⁴
- Initial signs and symptoms may include drooping eyelids, blurry vision, difficulty moving the eyes and double vision.⁴
- People with foodborne botulism may also have vomiting, nausea, stomach pain and/or diarrhoea.⁴
- People may have difficulty swallowing and lose their protective gag reflex and use of respiratory muscles. Without treatment, death can result from airway obstruction and respiratory failure.⁴

Treatment

- Treatment includes supportive care (including assisted breathing using a ventilator for breathing difficulties and IV fluids if the person cannot swallow) and early IV administration of botulinum antitoxin heptavalent (HBAT).⁴
- HBAT should be used for the treatment of symptomatic botulism as soon as possible in the case of documented or suspected symptomatic exposure for all age groups, including infants and young children.⁶
- Breastfeeding women should be treated with the same dosage recommendations as the general population. The approved HBAT dose for infants (persons aged <1 year) is 10% of the adult dose, regardless of weight. The HBAT dose for children (persons aged 1-16 years) is 20%-100% of the adult dose.⁶

Breastfeeding safety

- It is unlikely that botulinum toxin enters breastmilk because of its large molecular weight.^{6,i} While current evidence is limited, the evidence that exists suggests that breastfeeding by an infected mother is not harmful to her infant.⁶

ⁱ Medications with a molecular weight >800 daltons are less likely to achieve clinically relevant levels in breastmilk. The molecular weight of botulinum toxin is 150,000 daltons.¹⁰

- Infants of breastfeeding mothers should be monitored closely for signs and symptoms of botulism such as low muscle tone, weak cry or difficulty feeding and swallowing.⁶
- Breastfeeding can continue while the mother is receiving the antitoxin HBAT.
- Although it is not known if the antitoxin HBAT is excreted in breastmilk, its large molecular weight should prevent it from entering breastmilk.^{5,6} HBAT has been found safe to use in infants for botulinum toxin treatment.
- Infants should also be monitored for adverse impacts from botulinum antitoxin if given to mother and/or infant including flu-like symptoms, such as fevers, chills, and malaise.⁵

EBOLA

Breastfeeding summary

- Halt breastfeeding if Ebola Virus Disease (EVD) is confirmed in either mother or child, or if either has confirmed exposure.
- If mother or child has a potential exposure and no symptoms, breastfeeding infants under 6 months may be considered if no alternative options are available.⁹
- Appendix 3 provides comprehensive guidance, including 2020 WHO guidelines for pregnant and breastfeeding women in the context of EVD.

Key facts

- EVD is a rare but highly contagious infectious disease with a case fatality rate of 25-90%.⁷
- EVD spreads through person-to-person transmission via direct contact with bodily fluids (blood, saliva, sweat, etc.) from a person who is sick with or has died from EVD, or from objects that have been contaminated with bodily fluids from a person who is sick with or who has died from EVD.⁷
- A person infected with EVD cannot spread the disease until they develop symptoms.⁷
- Because of its high death rate and easy person-to-person transmission, the Ebola virus has the potential to be used as a bioweapon if dispersed in aerosol form.²²

Symptoms

- The incubation period is between 2 and 21 days.²²
- Initial symptoms can be sudden and include fever, fatigue, muscle pain, sore throat, and headache. This is followed by vomiting, diarrhoea, impaired kidney and liver function and, in some cases, internal and external bleeding.²²

Treatment

- Supportive care, including oral and IV rehydration and treatment of specific symptoms, improves survival.²²
- Two monoclonal antibodies were approved for the treatment of Zaire Ebolavirus (Inmazeb and Ebanga).⁸
- The ERVEBO vaccine has also shown to be effective in protecting people from Zaire Ebolavirus and is approved for individuals over 18 years of age. While the vaccine was not approved for use in pregnant and breastfeeding women, the World Health Organization (WHO) recommends the use of ERVEBO in breastfeeding women in areas experiencing an active EVD outbreak (as a so-called ring vaccination).²³

Breastfeeding safety

- The WHO recommends that breastfeeding should stop if EVD is confirmed in either a breastfeeding mother or a breastfed child.⁹ The infant or child should be separated from the mother and infants younger than 6 months should be provided donor human milk or a breastmilk substitute.⁹ The children should be monitored closely for 21 days post-exposure.⁹
- Separation of mother and child and temporary halting of breastfeeding is ideal from a transmission risk perspective. However, if the infant is under 6 months old and no safe alternatives are available, or if the infant cannot be cared for, the option not to separate and the continuation of breastfeeding can be considered.⁹
- If a breastfeeding woman who is recovering from EVD wishes to continue or resume breastfeeding, she should be supported to do so.⁹

- Following recovery from EVD, if a woman wants to resume breastfeeding, she should wait for two consecutive negative Ebola virus breastmilk tests (separated by 24 hours) before resuming.⁹ See Appendix 2 for guidance on supporting mothers with re-lactation.
- According to the WHO, data is not available to assess the impact of the ERVEBO vaccine on breastmilk, on a mother's milk production or its effects on the breastfed child.²³ As stated above, while the vaccine was not approved for use in pregnant and breastfeeding women, the WHO recommends the use of ERVEBO in breastfeeding women in areas experiencing an active EVD outbreak (as a so-called ring vaccination).²³
- The health benefits of breastfeeding should be considered alongside the mother's clinical need for the vaccine as well as potential adverse events from the vaccine or the mother's risk from or susceptibility to the Ebola virus.⁹

PLAGUE

Breastfeeding summary

- If a mother and infant are both receiving antimicrobial treatment or PEP, then a mother with pneumonic plague may continue to breastfeed.¹⁰
- If an infant does not receive antimicrobial treatment or PEP at the same time as the mother even if the infant was not initially exposed, the mother with pneumonic plague should temporarily interrupt breastfeeding until they have both received 48 hours of antimicrobial treatment, given that pneumonic plague can spread person-to-person through large respiratory droplets.¹⁰

Key facts

- Plague is an infectious disease that is caused by the bacterium *Yersinia pestis* (*Y. pestis*).
- Plague is considered one of the most serious biological threats due in part to its low infectious dose, high case fatality rate in untreated infection and history of use as an agent of bioterrorism.²⁴
- Pneumonic plague can occur after inhalation of *Y. pestis* after an intentional release in the air.^{24,ii}
- Pneumonic plague can spread person-to-person through large respiratory droplets between the close contacts of symptomatic individuals.²⁴

Symptoms

- The incubation period of pneumonic plague is 2 to 4 days (range 1 to 6 days) after exposure.²⁴
- Symptoms include fever, headache, weakness, and pneumonia with shortness of breath, cough, and chest pain.²⁴
- The pneumonia may cause respiratory failure and shock.¹⁵ Without treatment, pneumonic plague is usually fatal.²⁴

Treatment

- Pneumonic plague is treatable with antibiotic therapy which should be started within 24 hours of patients showing symptoms and should be continued for 10-14 days.²⁴
- Preventative antibiotics may be given to people, including breastfeeding women, infants, and young children, who have had known contact with infected patients and should be given for 7 days.¹⁰ People with suspected exposure should be monitored and started on antibiotics immediately if symptoms start.
- Given the risk of person-to-person transmission through respiratory droplets, standard respiratory infection precautions should be used (masks, gloves, eyewear, hand hygiene).¹⁰
- Commonly available antimicrobials are effective for the treatment of pneumonic plague including ciprofloxacin, streptomycin, levofloxacin, moxifloxacin, and doxycycline and gentamicin.²⁴ Chloramphenicol is also considered effective as an alternative treatment option.¹⁰ Refer to Appendix 1 for a full list of medications commonly used in biological attacks.
- Dual therapy with two distinct classes of antimicrobials is recommended for treatment of plague after an intentional release of *Y. pestis*.¹⁰

ⁱⁱ Less common types of the plague include bubonic and septicemic plague, but those forms are usually not associated with bioweapon attacks.

Breastfeeding safety

- If a mother and infant are both receiving antimicrobial treatment or PEP, then a mother with pneumonic plague may continue to breastfeed.¹⁰
- The risk of transmitting *Y. pestis* through breastmilk is believed to be low.¹⁰ However, given the risk of person-to-person transmission of pneumonic plague, if an infant does not receive antimicrobial treatment or PEP at the same time as the mother, mothers with pneumonic plague should temporarily interrupt breastfeeding until they have received 48 hours of antimicrobial treatment.¹⁰ Regular expression of breastmilk is recommended, and the expressed milk can be given to infants during this period of time.¹⁰
- Most antimicrobials recommended for *Y. pestis* treatment or prevention (including ciprofloxacin, streptomycin, levofloxacin, moxifloxacin, doxycycline, and gentamicin) are safe for use in breastfeeding mothers.²⁰
- Chloramphenicol should be avoided in breastfeeding mothers if possible.²⁵ If a mother must receive chloramphenicol during breastfeeding, it is important to monitor the infant for gastro-intestinal disturbances and to monitor the mother for changes in milk supply.²⁵ In some cases, it might be necessary to temporarily interrupt breastfeeding if the infant shows adverse effects while a mother is taking chloramphenicol.²⁵ Appendix 1 provides a full list of medications and breastfeeding safety.

Q FEVER

Breastfeeding summary

- Breastfeeding is safe to continue.

Key facts

- Q fever is caused by infection with the bacteria *Coxiella burnetii* (*C. burnetii*).²⁶ *C. burnetii* is considered a possible biothreat as it can be aerosolised, only requires a small amount to be infectious, and is resistant to heat, drying and many common disinfectants.²⁶
- While Q fever can be incapacitating, the fatality rate is very low.²⁶
- Person-to-person transmission is extremely rare.²⁶

Symptoms

- Acute Q fever is typically a mild flu-like disease and can include headache, rash, and joint pain.
- Severe symptoms include pneumonia, hepatitis, and myocarditis.²⁷

Treatment

- Q fever can be treated with a 2-week course of doxycycline for both adults and for infants and young children.²⁶

Breastfeeding safety

- There have not been any documented cases of transmission of Q fever through breastfeeding.
- The European Center for Disease Control recommends that women continue breastfeeding except in very rare cases of chronic Q fever that warrant the long-term treatment of the mother.¹¹
- Breastfeeding is safe to continue while taking doxycycline.²⁰ Appendix 1 provides a full list of medications and breastfeeding safety.

SMALLPOX

Breastfeeding summary

- If the mother or infant is a confirmed case of smallpox (and shows symptoms), halt breastfeeding.¹²
- Since people cannot transmit infection until they begin to show symptoms of fever and rash, personal

contact between mother and infant can continue, including breastfeeding, until the onset of fever.¹² If either mother or infant develops fever, immediate isolation should begin.

- If a mother is exposed to smallpox, but does not yet show any symptoms, she may receive a vaccine to prevent smallpox infection.¹⁴ Once the mother receives the vaccine, breastfeeding can continue with proper infection control to avoid contact with the vaccine site. A mother should temporarily interrupt breastfeeding from that breast if breast lesions are present.¹²

Key facts

- Smallpox is an infectious disease caused by the variola virus.
- Although smallpox no longer exists in nature, it is considered a serious threat if used as a bioweapon.
- Smallpox is primarily spread person-to-person via infectious respiratory droplets during close contact with those who are symptomatic of the disease.
- Fluid from lesions, contact with scabs and contaminated objects such as bandages, bedding and clothing can also be a source of spread.²⁸
- Smallpox is fatal in 30% of cases.²⁸

Symptoms

- The incubation period for smallpox ranges from 7-17 days.²⁹
- During this time, the exposed person is not contagious and will likely show no symptoms.²⁹
- Early symptoms include high fever, fatigue, and severe back pain.²⁹ A few days later, the virus causes a rash with bumps full of clear liquid which later fill with pus. The lesions will scab over and eventually dry and fall off. The rash most often begins on the face and hands and then spreads to the rest of the body.²⁹
- A person remains infectious until the lesions resolve, scabs fall off, and a fresh layer of skin has formed.²⁹

Treatment

- There is no cure for smallpox, but vaccination can be used to prevent infection from developing if given up to 4 days after a person has been exposed to the virus.
- In a smallpox emergency, a ring vaccination strategyⁱⁱⁱ will likely be used to vaccinate those most at risk. This ensures that everyone who has been or could have been exposed to a patient with smallpox receives the vaccine.¹²
- There are three available smallpox vaccines – Imvamune (JYNNEOS), ACAM2000, and APSV.^{30, iv} The vaccines do not contain the variola virus, the virus responsible for smallpox.
- ACAM2000 and APSV are ‘replication-competent vaccines’ which means they use live, infectious vaccinia virus (which is not a smallpox virus) that protects against smallpox disease.³⁰ This means that the vaccine replicates vaccinia virus in the human body and the vaccinia virus can potentially be spread to others if someone comes into contact with a blister on the skin while the blister is healing.^v
- JYNNEOS is a weakened virus vaccine (called attenuated) and is non-replicating, meaning it cannot replicate in the human body. JYNNEOS uses a technology similar to chickenpox or MMR vaccines and has fewer side effects and risks than ACAM2000 or APSV and cannot easily spread the vaccinia virus to others.¹⁴

Breastfeeding safety

- Since people cannot transmit infection until they begin to show symptoms of fever and rash, personal contact between mother and infant can continue, including breastfeeding, until the onset of fever.¹³ If either mother or infant develops fever, immediate isolation should begin.
- Breastfeeding women who are exposed to smallpox or at high risk for smallpox infection should ideally be vaccinated with the JYNNEOS vaccine.^{14,31}
- Currently, ACAM2000 and APSV are not recommended for use in breastfeeding women.³² If ACAM2000 is used, breastfeeding women should be counselled on proper infection control to avoid passing on the vaccinia virus from the vaccination site to breastfeeding infants.¹² Mothers should be advised to consistently use protective bandages to cover the vaccination site, wear long-sleeved clothing, wash hands thoroughly

ⁱⁱⁱ Ring vaccination strategy vaccinates the contacts of confirmed patients and people who are in close contact with those contacts.

^{iv} APSV is currently listed as an investigational vaccine only. The two main vaccines being used are ACAM2000 and JYNNEOS.

^v The vaccinia virus can cause localised skin lesions, fever, swollen lymph nodes, malaise, and body aches.

before handling infants and avoid infant contact with the vaccination site until the vaccine site has healed.¹² Clothing and towels that come in contact with the vaccination site should be separated from other household laundry and washed separately.

- It is not known whether the vaccinia virus (in the smallpox vaccine) is excreted in breastmilk. Given the well-known infant and maternal benefits of breastfeeding and the small potential risk for transmission of the vaccinia virus to infants via breastmilk, breastfeeding should continue.¹⁴ If there is a cutaneous breast lesion that is suspicious for vaccinia virus infection after vaccination, it is recommended that women temporarily interrupt breastfeeding from that breast until the breast lesion heals.¹⁴

TULAREMIA

Breastfeeding summary

- Breastfeeding is safe to continue.

Key facts

- Tularemia is a potentially serious illness that is caused by the bacterium *Francisella tularensis* (*F. tularensis*).³³
- Because *F. tularensis* is extremely infectious, a small number of organisms can cause disease and therefore could be used as a bioweapon.³³
- The most likely route of infection for this bacterium to be used as a bioweapon would be via aerosolisation.³³
- People who inhale the bacterium develop pneumonic tularemia with symptoms of severe respiratory illness which can be fatal if not treated quickly.¹⁵
- Tularemia is not spread from person-to-person and people with tularemia do not need to be isolated.¹⁵

Symptoms

- The incubation period for tularemia is often 3 to 5 days but can range from 1-14 days.³³
- Illness ranges from mild to life-threatening and usually includes a high fever.
- Patients with pneumonic tularemia present with cough, chest pain, and difficulty breathing.³³

Treatment

- Tularemia is treated with antibiotics, most commonly streptomycin, gentamicin, doxycycline, or ciprofloxacin.¹⁵
- Treatment duration should be 10-21 days.¹⁵

Breastfeeding safety

- Because tularemia is not spread person-to-person, it is safe for mothers to continue breastfeeding after exposure and/or while receiving antibiotic treatment for tularemia.
- Antibiotics used to treat tularemia are all considered safe for women to receive while breastfeeding.²⁰ Please refer to Appendix 1 for a full list of medications and breastfeeding safety.

CONCLUSION

This guidance note is considered a living document. Currently, the guidance presented is based on the most recent research and evidence. As more information and research become available regarding the treatment of breastfeeding women who are exposed to biological agents, we will continue to update as needed. If women need to temporarily interrupt breastfeeding, Appendix 2 provides resources for support and guidance.

Appendix

Appendix 1: Medications commonly used in the treatment of biological agents and use in breastfeeding women

Antimicrobial Agent	US National Library of Medicine – LACTMED ²⁰	Briggs' Pregnancy and Lactation ³⁴	Dr. Hales – Medication and Mother's Milk ³⁵	EmbryoTox – Germany ³⁶
Amoxicillin	Acceptable to use	Compatible	L1: Limited data – compatible	Safe during breastfeeding
Ampicillin	Acceptable to use	Compatible	L1: Limited data – compatible	Safe during breastfeeding
Chloramphenicol	Alternate drug is preferred	Limited human data – potential toxicity	L4: Limited data – probably hazardous	Contraindicated during breastfeeding
Ciprofloxacin	Acceptable to use if monitoring infants for diarrhoea or thrush	Limited human data – potential toxicity over time	L3: Limited data – probably compatible	Acceptable during breastfeeding
Doxycycline	Short-term use (less than 21 days) is acceptable. Avoid prolonged use because of possible staining of the infant's dental enamel	Compatible	L3: Limited data – probably compatible	Acceptable during breastfeeding
Gentamicin	Acceptable to use	Compatible	L2: Limited data – probably compatible	Acceptable during breastfeeding
Levofloxacin	Acceptable to use with monitoring infants for diarrhoea or thrush.	Limited human data – probably compatible	L2: Limited data – probably compatible	Acceptable during breastfeeding
Moxifloxacin	Little information is available on the use of moxifloxacin during breastfeeding Acceptable to use if monitoring infants for diarrhoea or thrush. Preferable to use an alternative drug for which safety information is available	Limited human data – probably compatible	L3: No data – probably compatible	Acceptable during breastfeeding
Raxibacumab	Because raxibacumab is a large protein molecule, the amount in milk is likely to be very low. It is also likely to be partially destroyed in the infant's gastrointestinal tract and absorption by the infant is probably minimal. Until more data becomes available, should be used with caution during breastfeeding	No data	L3: No data – probably compatible	No data
Streptomycin	Acceptable to use with monitoring infants for diarrhoea or thrush	Compatible	L3: Limited data – probably compatible	Use with caution

Appendix 2: Support if breastfeeding needs to be temporarily interrupted³⁷

The vast majority of mothers can and should breastfeed, just as the vast majority of infants can and should be breastfed. Only under exceptional circumstances can a mother's milk be considered unsuitable for her infant. For those few health situations where infants cannot, or should not, be breastfed, the choice of the best alternative – expressed breast milk from an infant's own mother, breast milk from a healthy wet-nurse or a human-milk bank or a breast-milk substitute fed with a cup, which is a safer method than a feeding bottle and teat – depends on individual circumstances.

Relaction

If breastfeeding is temporarily interrupted, mothers and infants need support to protect their breastmilk supply and re-lactate once they are ready to resume breastfeeding.

During any temporary interruption of breastfeeding, women should be supported to maintain their breastmilk supply through frequent breastmilk expression (either through hand expression or pump).^{vi} Expressing breastmilk is also important to avoid discomfort and breast infections. Women should be supported to increase their breastmilk supply and re-lactate once they are ready to resume breastfeeding. If mothers have breastmilk that was expressed and stored before the exposure, this can be used to feed the infant. If breastmilk is frozen, thaw the sealed bag/contained of milk in a bowl of warm water from a safe source (tap or bottled depending on emergency). An easily cleaned cup (i.e., open, without a teat or spout) should be used to feed the infant expressed breastmilk (see below). If breastmilk expressed before the biological attack is not an option, infants should be fed with an appropriate breastmilk substitute if available.

Important links:

<https://www.lli.org/increasing-breastmilk-supply/>

<https://www.unicef.org.uk/babyfriendly/maximising-breastmilk-and-re-lactation-guidance/>

<https://abm.me.uk/breastfeeding-information/relactation/>

Artificially fed or non-breastfed infants

For infants being fed breastmilk substitutes, ready-to-use infant formula and powdered infant formula already in the home or manufactured before the biological attack are suitable for consumption.

If infants under 6 months of age are being fed breastmilk substitutes, mothers and caregivers should be advised to use ready-to-use infant formula (RUIF) if this is available. RUIF carries the least risk for formula-fed infants during a biological attack. If RUIF is not available, then powdered infant formula (PIF) should be used. PIF should be made using bottled water. If this is not possible, tap water can be used if the local authorities say it is safe. For infants over 6 months of age, alternative milks (such as ultra-high temperature milk, fermented milk or yogurt, pasteurised or boiled full-cream animal milks or reconstituted evaporated milk) may be used instead of RUIF and PIF.

An easily cleaned cup (i.e., open, without a teat or spout) should be used to feed the infant breastmilk substitutes and expressed breastmilk. Bottles, teats or cups with a lid are hard to clean in an emergency. Using bottles, teats or cups with a spout may also limit the successful restarting of breastfeeding as they reduce suckling.

Important links:

UNICEF BMS Procurement 2021: <https://www.unicef.org/media/100911/file/BMS-Procurement-Guidance-Final-June-2021.pdf>

Safe preparation, storage, and handling of powdered infant formula – guidelines:

<https://apps.who.int/iris/handle/10665/43659>

<https://www.ennonline.net/attachments/93/pif.pdf>

<https://www.ennonline.net/attachments/545/poster-preparing-formula-in-care-settings.pdf>

How to prepare for cup feeding at home:

<https://www.ennonline.net/attachments/543/safe-prep-cup-feeding-leaflet.pdf>

If bottle feeding is necessary careful preparation and use is critical:

<https://www.ennonline.net/attachments/542/safe-prep-bottle-feeding-leaflet.pdf>

For more information on the supporting infants dependent on breastmilk substitutes and the resources needed, please see: <https://www.ennonline.net/ifecoregroupinfographicseries>

Infant Feeding in Emergencies Core Group, Infant Feeding in Emergencies Operational Guidance for emergency relief staff and programme managers Version 3.0 – October 2017, Emergency Nutrition Network, 2017.

<http://www.ennonline.net/operationalguidance-v3-2017>

^{vi} The parts of the breast pump in contact with breastmilk need to be carefully cleaned after each use with water from a safe source. Where this cannot be done, hand expression is recommended. Please see standard breast pump guidelines: <https://www.cdc.gov/healthywater/hygiene/healthychildcare/infantfeeding/breastpump.html>

Appendix 3: Specific Resources for Ebola

1. Guidelines for the management of pregnant and breastfeeding women in the context of Ebola virus disease <https://apps.who.int/iris/bitstream/handle/10665/330851/9789240001381-eng.pdf>
2. Supporting non-breastfed children as part of an Ebola response https://www.enonline.net/attachments/3729/Supporting-non-breastfed-children-as-part-of-an-Ebola-response_26Nov2020.pdf

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GUIDANCE NOTE:

INFANT AND YOUNG CHILD FEEDING IN THE FIRST THREE DAYS AFTER A NUCLEAR POWER PLANT ACCIDENT



This document was developed by the Infant Feeding in Emergencies (IFE) Core Group¹ Sub-Working Group on Infant and Young Child Feeding in Emergencies (IYCF-E) in the context of chemical, biological, radiological and nuclear threats. This document is for healthcare workers and emergency response planners and provides interim operational guidance to inform emergency plans and responses on appropriate infant and young child feeding (IYCF)² in the first three days³ after a nuclear emergency caused by an accident at a nuclear power plant (NPP) in the context of the current Ukraine crisis.⁴ **It does not cover IYCF in the context of nuclear warfare.**⁵ Recommendations are provided in this document for breastfed and non-breastfed infants. Recommendations for breastfed infants are applicable to infants who are exclusively breastfed, mixed fed (i.e., receiving both breastmilk and breastmilk substitutes) and infants over six months of age and young children who are receiving complementary foods alongside breastmilk. The recommendations are based on the best available knowledge and full consideration of the risks associated with internal contamination by radioactive materials in the first three days after an incident at an NPP as well as the importance of breastfeeding. The recommendations of other organisations may focus primarily on the risk of exposure to radioactive materials without fully balancing the risks of morbidity and mortality associated with not breastfeeding. This guidance should be used in conjunction with existing guidance for the general public, healthcare workers and policy makers. For more information, please contact ife@enonline.net.

¹ <https://www.enonline.net/ife>

² Children below two years of age.

³ Caesium and radioactive iodine are the radioactive materials that present health risks after a nuclear emergency. However, the impact of the release of caesium is managed in the medium to long term, therefore this radioactive material is not covered in this guidance note that focuses on the first three days after an NPP accident. For more information on caesium, please see **Appendix 2**.

⁴ This guidance note is based on a factsheet developed by the IFE Core Group Sub-Working Group on infant and young child feeding in emergencies in the context of chemical, biological, radiological and nuclear threats which is available upon request.

⁵ For information on what to do in the event of a nuclear weapon, an improvised nuclear device, a radiological exposure device or a dirty bomb, please see: <https://www.cdc.gov/nceh/radiation/emergencies/moretypes.htm#red>

1 In the event of an accident at a nuclear power plant (NPP), people are likely to be concerned about continuing breastfeeding.

In the case of an abnormal event at an NPP, radioactive materials may be released into the environment (WHO, 2011).⁶ In such circumstances, breastfeeding women are likely to be concerned about potentially transmitting radioactive materials to their infants through breastmilk. After the nuclear accident in Fukushima, Japan in 2011, many mothers switched from breastfeeding to formula feeding because of this concern despite being advised by the health authorities to continue breastfeeding (Ishii et al, 2016).

Breastfeeding provides infants with hydration, comfort, connection and high-quality nutrition. It protects them against disease and provides food security. This protection and security are critical in conflict and disaster contexts when there is often a lack of access to clean water, electricity, food supplies and healthcare. Breastfeeding is also important for maternal health and caregiving capacity. It is critically important to provide caregivers with clear and accurate information, reassurance and guidance⁷ to protect, promote and support appropriate infant and young child feeding (IYCF) in the event of a nuclear emergency and to ensure that women do not stop breastfeeding unnecessarily.⁸

2 The potential transfer of radioactive iodine to infants through breastmilk may only be a concern in extreme circumstances such as for local populations near the area most affected by a radioactive release.

Following an NPP event of concern, communication to the general public will indicate protective and other response actions that groups of people within a specified area should take. There is no concern of transferring radioactive materials through breastmilk among mother-infant pairs who do not live in the specified areas (WHO, 2022a). Any risk is mainly limited to situations with a large release of radioactive materials, specifically a large release of radioactive iodine (WHO, 2022a). Caesium also presents health concerns, but the impact of the release of caesium is managed in the medium to long term, therefore this radioactive material is not covered in this guidance note that focuses on the first three days after an NPP accident.⁹ Areas of concern (called emergency zones and distances)¹⁰ and protective and other response actions are established at the preparedness stage and described in each NPP's protection strategy for nuclear and radiological emergencies (IAEA, 2013; IAEA, 2017; IAEA, 2021).

3 The risk of mothers absorbing or being exposed to radioactive iodine can be reduced to minimise the potential exposure to an infant through breastmilk.

For women who live in emergency zones and distances, there are actions that can be taken to reduce exposure to radioactive iodine and therefore the risk to both mother and infant. What actions to take and by whom will be communicated to the general public by the responsible authorities.

⁶ For an infographic on the main dangers of a nuclear power plant accident, please see: https://www.cdc.gov/nceh/multimedia/infographics/nuclear_power_plant_accidents.html

⁷ For information on how to conduct remote IYCF-E counselling, please see: <https://iycfehub.org/document/practical-guidelines-for-conducting-and/> and <https://kayaconnect.org/course/info.php?id=4089>

⁸ For suggested key messages for parents and caregivers, please see **Appendix 1**.

⁹ For more information on caesium, please see **Appendix 2**.

¹⁰ Emergency zones and distances are site specific and described in each NPP's protection strategy for nuclear and radiological emergencies. Emergency zones are areas where comprehensive arrangements are put in place at the preparedness stage to enable the prompt implementation of urgent protective and other response actions in the event of an NPP accident of concern. The emergency distances are areas in which actions may need to be taken during the response but for which only limited arrangements are put in place in advance. For more information on emergency zones and distances, please see: IAEA (2013) Emergency preparedness and response: Actions to protect the Public in an Emergency due to severe condition at a light water reactor. Vienna. IAEA.

If radioactive iodine is inhaled or ingested, it collects in the thyroid gland resulting in internal contamination (WHO, 2022b; IAEA, 2013).^{11,12} However, taking prescribed oral potassium iodide (KI) tablets or an oral KI solution can protect the thyroid gland from absorbing radioactive iodine (WHO, 2022b; IAEA, 2013). KI is safe for breastfeeding women, infants and young children (WHO, 2017) but should not be taken unless advised by the responsible authorities to do so. KI taken by mothers is transferred into breastmilk but the dosage is not enough to fully protect the infant (WHO, 2022b) so both non-breastfed and breastfed infants should take KI if directed to do so by the responsible authorities. Breastfeeding women, infants and young children are among the groups most likely to benefit from taking KI (WHO, 2017) and are the highest priority groups for receiving KI tablets and/or oral solution in a nuclear emergency (IAEA, 2018).

When KI administration is necessary, the responsible authorities will define the geographic area of concern, who within that area should take KI and when and how they should take it (WHO, 2022b).¹³ People should never leave their place of shelter in search of KI. Other forms of iodine should never be taken as a substitute for KI tablets and/or oral solution. The best time to take KI is less than 24 hours before and up to two hours after the expected onset of exposure (WHO, 2017; IAEA, 2013). The sooner KI can be taken in this timeframe, the better. It is still helpful to take KI up to eight hours after exposure to radioactive iodine as some protection from radioactive iodine will still be provided (WHO, 2017). Infants and young children should take KI in an oral solution. Once the emergency phase has passed, infants who have been given KI should have their thyroid hormone levels evaluated (WHO, 2022b).

See **Appendix 3** for more information on KI doses for breastfeeding women, infants and young children.

Exposure to radioactive iodine can also be reduced by following other protective and other response actions such as evacuation under appropriate circumstances,¹⁴ sheltering in place,¹⁵ actions to reduce the accidental ingestion of radioactive iodine,¹⁶ the prevention of the ingestion of potentially contaminated food and the decontamination of individuals (IAEA, 2013). If decontamination¹⁷ is required, breastfeeding women should be advised to wash the breast and nipple with soap and warm water. If KI is required but not available, the mother infant pair should be prioritised for other protective and other response actions.

4 Breastfeeding is strongly recommended in most circumstances.

The risk of internal contamination by radioactive iodine is low for both mothers and infants who have taken KI as directed by the responsible authorities. Therefore, mothers should be strongly encouraged to continue breastfeeding (WHO, 2022b). Even without the administration of KI, if other protective and other response actions are in place, such as sheltering in a building where it has been possible to seal all windows and doors and evacuation under appropriate circumstances,¹⁸ exposure to radioactive iodine is significantly reduced (Lyu et al, 2021) and women should be strongly encouraged to continue breastfeeding. These recommendations take into consideration the low possibility of exposure to radioactive iodine following a nuclear emergency and the known positive effects of breastfeeding.

¹¹ Internal contamination occurs when people swallow or breathe in radioactive materials or when radioactive materials enter the body through an open wound or are absorbed through the skin.

¹² For an infographic on radiation exposure versus contamination, please see: <https://www.cdc.gov/nceh/radiation/emergencies/resourcelibrary/infographics.htm>

¹³ The population that needs KI tablets in the event of a nuclear emergency is context-specific and a part of the emergency plans developed by each NPP.

¹⁴ People should not evacuate unless instructed to do so by the responsible authorities.

¹⁵ <https://www.cdc.gov/nceh/radiation/emergencies/getinside.htm>

¹⁶ Actions to prevent accidental ingestions include: (a) not drinking, eating or smoking and keeping hands away from mouths until the hands are washed, (b) not letting children play on the ground, and (c) not conducting activities that could result in the creation of dust that could be ingested.

¹⁷ https://www.cdc.gov/nceh/radiation/emergencies/selfdecon_wash.htm#:~:text=Gently%20blow%20your%20nose%2C%20

¹⁸ People should not evacuate unless instructed to by responsible authorities.

5 If exposure or uptake of radioactive iodine cannot be reduced, the risks of interrupting versus continuing breastfeeding need to be considered before breastmilk substitutes are used.

It may be reasonable to consider interrupting breastfeeding temporarily if:

- The mother-infant pair live in an emergency zone or distance that is required to take protective and other response actions;¹⁹
- **AND** KI is not available if recommended by the responsible authorities;
- **AND** other recommended protective and other response actions such as evacuation under appropriate circumstances²⁰ and sheltering in a building where it has been possible to seal all windows and doors are not possible;
- **AND** the mother has breastmilk expressed before the nuclear emergency or a breastmilk substitute *in her place of shelter*;
- **AND** the mother has access *in her place of shelter* to hygienic preparation equipment: Safe water, soap, sterilisation of preparation/feeding tools and the ability to boil water and then cool to 70 degrees Celsius for reconstitution in the case of powdered infant formula.²¹

It is only when all these conditions are met that interrupting breastfeeding during a nuclear emergency should be considered. If the mother does not meet all the above conditions, breastfeeding should continue (see Appendix 5).

Before breastfeeding is temporarily interrupted, the relative risks of any additional exposure to radioactive iodine for the infant through breastmilk²² versus the risks of interrupting breastfeeding need to be considered on a case-by-case basis. Interrupting breastfeeding is a last resort option. It places infants at increased risk of serious illness and food insecurity, impairs maternal health and wellbeing and weakens maternal caregiving capacity. These risks are increased in emergencies as the resources needed to use breastmilk substitutes with an adequate level of safety (including access to safe/uncontaminated water, hygiene and sanitation facilities and healthcare) could be unavailable or difficult to obtain (IFE Core Group, 2021; IFE Core Group, 2017).²³ Breastfeeding should be interrupted for as short a time as possible but the responsible authorities will provide context-specific advice.

6 Breastfeeding women need support following a nuclear emergency. If breastfeeding is temporarily interrupted, mothers and infants need support to protect their breastmilk supply and guidance from the responsible authorities about when to resume breastfeeding.

Breastfeeding women should be advised how to protect themselves and their infants from exposure to and the absorption of radioactive iodine. Strong public health messaging on the safety of breastfeeding needs to be provided in situations with a limited risk of internal contamination by radioactive iodine because protective actions were taken or due to the distance away from the NPP accident. Women should be provided with

¹⁹ Emergency zones and distances are site specific and described in each NPP's protection strategy for nuclear and radiological emergencies.

²⁰ People should not evacuate unless instructed to do so by the responsible authorities.

²¹ For more information on supporting infants dependent on breastmilk substitutes and the resources needed, please see: <https://www.enonline.net/ifecoregroupinfographicseries>

²² For more information on exposure to radioactive iodine and KI (including side effects), please see: WHO. (2017). Iodine thyroid blocking: guidelines for use in planning for and responding to radiological and nuclear emergencies. Available at: <https://www.who.int/publications/i/item/9789241550185>

²³ For infographics on the early initiation of breastfeeding during emergencies, preventing and managing inappropriate donations of breastmilk substitutes, planning and managing artificial feeding interventions during emergencies and supporting infants dependent on artificial feeding during emergencies, please see: <https://www.enonline.net/ifecoregroupinfographicseries>

information on the conditions in which temporarily interrupting breastfeeding might be considered including the resources they need to have in place prior to pausing breastfeeding (please see section 5). During any temporary interruption of breastfeeding, women should be supported to protect their breastmilk supply through frequent breastmilk expression (either through hand expression or pump).²⁴ Expressing breastmilk is also important to avoid discomfort and breast infections. Breastmilk expressed during a nuclear emergency should be stored in a sealed container in a refrigerator or freezer until further advice is provided by the responsible authorities.²⁵ Women should be supported to increase their breastmilk supply and resume breastfeeding when recommended by the responsible authorities.

7 Breastmilk that was expressed and stored before the nuclear emergency is safe for use.

Breastmilk that was expressed and stored before the emergency will not be affected by external radiation (HSE & IRR, 2015). If breastmilk is frozen, it is safe to thaw in a sealed bag in a bowl of warmed bottled water or to thaw in a refrigerator overnight. If this is not possible, it should be thawed in a sealed bag in warmed tap water if the responsible authorities advise that tap water is safe to consume (CDC, 2022c). An easy-to-clean cup (i.e., open, without a teat or spout) should be used to feed the infant expressed breastmilk as bottles, teats or cups with a lid are hard to clean in an emergency (IFE Core Group, 2017; WHO & FAO, 2007).²⁶

8 Infants who need to use breastmilk substitutes can use ready-to-use infant formula (RUIF) or powdered infant formula (PIF) that were already in the home or manufactured before the nuclear emergency.

If infants *under* six months of age are being fed breastmilk substitutes, mothers and caregivers should be advised to use RUIF if this is available in their place of shelter. RUIF carries the least risk for formula-fed infants during a nuclear emergency. If RUIF is not available, then PIF can be used (CDC, 2022c). PIF should be made by boiling bottled water and then cooling to 70 degrees Celsius before mixing. If this is not possible, tap water can be boiled and then cooled to 70 degrees Celsius if the responsible authorities advise that tap water is safe for consumption.²⁷ PIF and RUIF already manufactured before the nuclear emergency are suitable for consumption. PIF and RUIF stored in the home that were opened before the nuclear emergency are still suitable for consumption. Caregivers should not dilute breastmilk substitutes or make their own homemade recipes for breastmilk substitutes. For information on increasing breastmilk supply, please see **Appendix 4**.

²⁴ The parts of the breast pump in contact with breastmilk need to be carefully cleaned after each use with water from a safe source. Where this cannot be done, hand expression is recommended. Please see standard breast pump guidelines: <https://www.cdc.gov/healthywater/hygiene/healthychildcare/infantfeeding/breastpump.html>

²⁵ Breastfeeding women should not take lactation suppressants but instead express and store breastmilk in a sealed container in a fridge or freezer until further advice is provided by the responsible authorities. For more information on storing breastmilk, please see: https://www.cdc.gov/breastfeeding/recommendations/handling_breastmilk.htm#:~:text=Freshly%20expressed%20or%20pumped%20milk,to%2012%20months%20is%20acceptable

²⁶ For more information on cup feeding, please see: <https://www.lli.org/cup-feeding/#:~:text=A%20BABY%20NOT%20FED%20AT,for%20average%20time%20per%20feed>

²⁷ For information on the safe storage and preparation of powdered infant formula, please see 1) WHO. (2007). Safe preparation, storage, and handling of powdered infant formula: Guidelines. WHO & FAO. Geneva 2) The infant formula instruction leaflet for mothers in Ukrainian, Russian and English – <https://www.humanitarianresponse.info/en/operations/ukraine/document/infant-formula-instruction-leaflet-mothers-ukrainian-russian-and-english>

²⁸ This includes cow, goat, buffalo, sheep and camel milk.

²⁹ Evaporated milk is suitable for consumption once it has been reconstituted or once water (from a safe source) has been added for infants over six months of age as evaporated milk is simply milk without its water content. However, condensed milk is not suitable for consumption as it contains other unsuitable ingredients.

For infants over six months of age, alternative milks that were already in the home before the nuclear emergency (such as ultra-high temperature milk, fermented milk or yogurt, pasteurised or boiled full-cream animal milks²⁸ or reconstituted evaporated (but not condensed) milk²⁹) may be used instead of RUIF and PIF (IFE Core Group, 2017).

If there are concerns that feeding equipment and supplies may be contaminated with radioactive materials, damp cloth or towel should be used to wipe these before opening and consuming. All used cloths or towels should be put in a plastic bag or other sealable container and placed away from people and pets (CDC, 2022c). An easy-to-clean cup (i.e., open, without a teat or spout) should be used to feed the infant as bottles, teats or cups with a lid are hard to clean in an emergency (IFE Core Group, 2017; WHO & FAO, 2007).³⁰

9 All food and drinks in the home or that were packaged before the nuclear emergency are safe for consumption by all in the household including breastfeeding mothers and infants over six months of age.

All food and drinks that were packaged and sealed before the nuclear emergency, such as those that are tinned or plastic-wrapped, are safe for consumption by breastfeeding women and infants over six months of age (CDC, 2022a; Ready, 2022; WHO, 2022a). All food (including fruits and vegetables which are important for complementary feeding) and drinks that are inside the building (opened or unopened), for example stored in a refrigerator, freezer, cupboard or drawer, are also safe for consumption (CDC, 2022a; Ready, 2022). Food from the garden should not be consumed until the responsible authorities determine it is safe to do so (CDC, 2022a; IAEA, 2013). Hands should be washed with warm water and soap after touching anything potentially contaminated and before eating and drinking (IAEA, 2013). If there are concerns that a container or package may be contaminated with radioactive materials, a damp cloth or towel should be used to wipe it before opening and consuming the contents. All used cloths or towels should be put in a plastic bag or other sealable container and placed away from people and pets (CDC, 2022a).

³⁰ For more information on cup feeding, please see: <https://www.llli.org/cup-feeding/#:~:text=A%20BABY%20NOT%20FED%20AT,for%20average%20time%20per%20feed>

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Appendix

Appendix 1: Key messages on IYCF after an accident at an NPP in the context of the current Ukraine crisis

Below are sample key messages for responding organisations that cover key messages for parents and caregivers on IYCF in the first three days after a nuclear emergency caused by an accident at an NPP in the context of the current Ukraine crisis. These messages should be used together with existing communication materials developed for the general public.

Table 1: Sample key messages for parents and caregivers

Subject	Key messages
Protective actions to be taken upon the advice of the responsible authorities	<ul style="list-style-type: none"> You and your baby should take potassium iodide (KI) if advised by the local authorities. The local authorities will provide all the information on when KI should be taken, how and by whom. To avoid negative side effects, take only the dose that is recommended for you and/or your baby. Do not substitute KI with other products that contain iodine.
Breastfed infants	<ul style="list-style-type: none"> If you have followed the recommendations from the local authorities, such as sheltering in a building where it has been possible to seal all windows and doors, taking KI and giving KI to your baby, there is very little risk that you could pass radioactive iodine to your baby through breastmilk. Breastfeeding remains the best option for you and your baby, it helps to protect your baby from falling sick amongst other benefits. This protection is especially important during emergencies when there is a lack of access to clean water and electricity.
When breastfeeding is not an option	<ul style="list-style-type: none"> Temporary alternatives include breastmilk expressed before the nuclear emergency or ready-to-use infant formula or powdered infant formula. Expressed breastmilk or infant formula, if available, should be fed to your baby with a cup or spoon as bottles and teats are difficult to keep clean. If you were breastfeeding and you need to stop temporarily, protect your breastmilk supply and prevent breast infection by expressing breastmilk (either through hand expression or pump). Store expressed breastmilk until the local authorities provide further advice.
Complementary feeding	<ul style="list-style-type: none"> All food and drinks that were packaged and sealed before the nuclear emergency, such as those that are tinned or plastic-wrapped, are safe for consumption. All food items inside the home (opened or unopened) before the nuclear emergency, for example stored in a refrigerator, freezer, cupboard or drawer, are safe to use. Do not eat foods from the garden until the local authorities determine it is safe to do so.

Appendix 2: Caesium and breastfeeding women, infants and young children

The impact of the release of caesium during a nuclear emergency is managed in the medium to long term through evacuation, the removal or immobilisation of soil and by banning the consumption of local produce. There is no substance that can be taken to block caesium uptake. Prussian Blue is used for decontamination and is safe for children above two years of age. A safe dose of Prussian Blue for children under two years of age has not yet been determined (CDC, 2021; US Department of Health and Human Service, 2022). Caesium can be transferred from the mother to the infant through breastmilk; however, exposure is unlikely if protective actions such as monitoring caesium levels in local food and water and controlling their distribution and consumption are in place. It is unknown if Prussian Blue can also be transferred from the mother to the infant through breastmilk. Any breastfeeding mother requiring medical care due to exposure to caesium should temporarily interrupt breastfeeding while under care and follow expert guidelines (IAEA, 2018).

Appendix 3: KI doses for breastfeeding women, infants and young children

When advised by the responsible authorities, breastfeeding women, infants and young children should take KI in age-specific doses (see **Table 2**). Breastfeeding women can take doses recommended for adults (WHO, 2017). Unless otherwise instructed, breastfeeding women and neonates (birth to 1 month of age) should only take a single dose of KI due to the risk of iodine-induced side effects such as iodine-induced transient hyper- or hypo- thyroidism and allergic reactions (WHO, 2022b; IAEA, 2013). Only in the event of an extreme exposure incident will a second dose of KI be recommended by the responsible authorities. If the responsible authorities recommend a second dose of KI, breastfeeding infants should be monitored and mothers should follow expert guidelines (FDA, 2001). Breastfeeding should only be temporarily interrupted if the mother has access to breastmilk expressed before the nuclear emergency or an appropriate breastmilk substitute and the required hygienic preparation equipment (please see section 5).³¹ For an infographic on how to take KI, please see: <https://www.cdc.gov/nceh/radiation/emergencies/resourcelibrary/infographics.htm>

Table 2: Recommended dosage of stable iodine according to age (WHO, 2017)

Age group	Fraction of 100mg tablets	Fraction of 50mg tablets
Neonates (birth to 1 month)	$\frac{1}{8}$ *	$\frac{1}{4}$ *
Infants and young children (1 month to 3 years)	$\frac{1}{4}$ *	$\frac{1}{2}$ *
Children 3 to 12 years	$\frac{1}{2}$	1
Adults, adolescents (over 12 years) and breastfeeding women	1	2

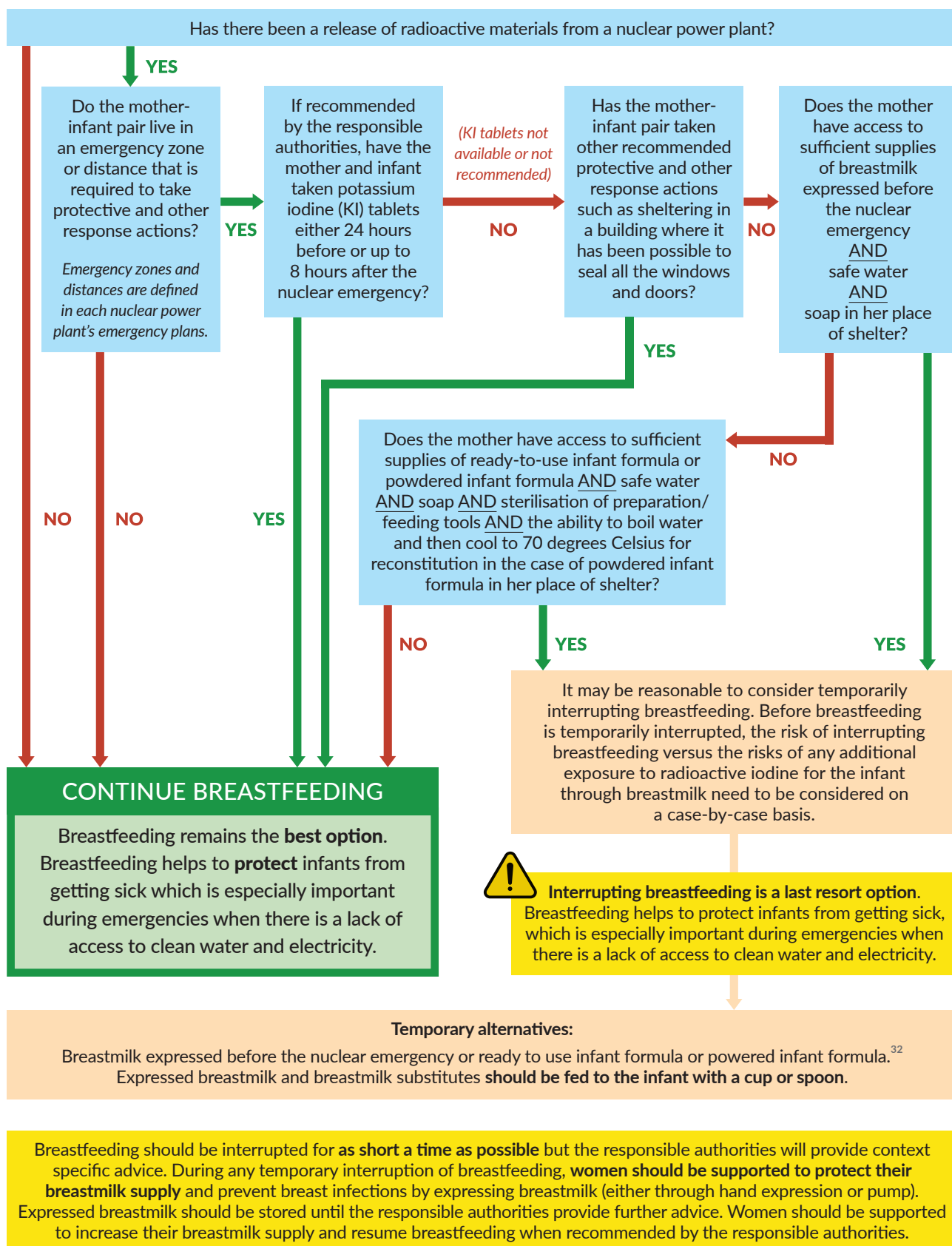
*Use oral KI solution

Appendix 4: Resources on increasing breastmilk supply

- La Leche League International increasing breastmilk supply poster available in multiple languages including Russian and Ukrainian
<https://www.llli.org/increasing-breastmilk-supply/>
- La Leche League International resuming breastfeeding after an interruption
<https://www.llli.org/breastfeeding-info/relactation/>
- La Leche League International drip drop feeding, method for moving towards breastfeeding poster
<https://www.llli.org/wp-content/uploads/Drip-Drop-Method-Colour-Poster-1.pdf>
- WHO, relactation review of experiences and recommendations for practice
http://apps.who.int/iris/bitstream/handle/10665/65020/WHO_CHS_CAH_98.14.pdf?sequence=1
- Save the Children, TOPS, USAID, IYCF-E toolkit including information on supporting relactation
https://resource-centre-uploads.s3.amazonaws.com/uploads/a._how_to_help_a_woman_relactate.doc

³¹ For more information on the supporting infants dependent on breastmilk substitutes and the resources needed, please see: <https://www.enonline.net/ifecoregroupinfographicseries>

Appendix 5: Decision tree for healthcare workers: Advising breastfeeding mothers on breastfeeding practices in the first three days after an NPP accident in the context of the current Ukraine crisis



³² For more information on the supporting infants dependent on breastmilk substitutes and the resources needed, please see: <https://www.enonline.net/ifecoregroupinfoographicseries>



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