



BC Centre for Disease Control
An agency of the Provincial Health Services Authority

Communicable Diseases and Immunization Service
655 West 12th Avenue
Vancouver, BC V5Z 4R4

Tel 604.707.2548
Fax 604.707.2515

www.bccdc.ca

Communicable Disease Control Manual

Chapter 2: Immunization

Appendix D - Reducing Immunization Injection Pain

Table of Contents

1. Background Information	3
2. General Considerations	3
2.1 Prior to the Appointment	3
2.2 At the Appointment	4
3. Strategies to Reduce Pain and Anxiety	7
4. Individuals of All Ages	8
4.1 No Aspiration	8
4.2 Most Painful Vaccine Last	8
4.3 Topical Anesthetics	9
4.4 Positioning	12
4.5 Distraction	13
5. Infants and Children < 3 Years of Age	13
5.1 Breastfeeding	13
5.2 Sweet-Tasting Solutions	14
5.3 Distraction	16
5.4 Skin-to-skin Contact	17
5.5 Simultaneous Injections	17
6. Children 3-17 Years of Age	17
6.1 Vibrating Device with Cold	17
6.2 Distraction	18
7. Adults (≥ 18 Years of Age)	19
7.1 Vapocoolants	19
7.2 Breathing Techniques	19
8. Techniques to Reduce the Risk of Fainting	19
8.1 Muscle Tension	20
8.2 Comforting Restraint	21

9. Quick Reference Guide22

10. References23

1. Background Information

Pain associated with vaccine injections is a source of distress for individuals of any age as well as for the immunization provider (1-4). If not addressed, the pain and anxiety associated with immunizations can be related to fear of future procedures, medical fears, and avoidance behaviours including non-adherence with immunization schedules. It is estimated that up to 25% of adults have needle fears and approximately 10% of the adult population have needle phobia (5,6). Many people with needle fears develop them in childhood, and when unmanaged, needle phobia may become generalized to all medical situations. Adults who have needle fears or phobia tend to avoid preventive medical care for themselves and may avoid future immunizations for themselves or their children (1,2,7,8).

Efforts aimed at minimizing pain from medical procedures in childhood have the potential to prevent the development of needle fears and promote consumer satisfaction and trust in health care providers because of more positive experiences for children and their families. Health care providers have an ethical responsibility to relieve pain and prevent suffering (1,9) and the World Health Organization has identified that “personal, family and/or community members’ experience with vaccination, including pain” has an important role in vaccine hesitancy (10). Improving the immunization experience for immunization providers and individuals of all ages has the potential to improve client satisfaction and increase immunization rates.

Pain is subjective; each person feels and expresses pain differently. Every individual learns the meaning of pain through experiences early in life (7). For children, being distressed during a procedure may have a negative impact on the memory of pain. Children who are exposed to repeated painful procedures may develop a conditioned anxiety response that manifests as “pre-procedural anxiety” (7). Research indicates that infants who are exposed to painful experiences develop a sensitization to future pain and may develop altered responses to future pain. For example, studies of infant males who were circumcised as neonates found that those infants exhibited greater pain responses to their 4 and 6 month immunizations than infants who were not circumcised (11). The effect on their future pain response was attenuated when a topical anesthetic was applied before the circumcision. Neonates who were exposed to repeat painful stimuli such as venipuncture or heel prick demonstrated an anticipatory response to the pain.

When immunizing infants and children, it is important to recognize that the parent may also be stressed and may have difficulty knowing how to support their child (12). The immunization experience is an opportunity for health care providers to observe and coach parents in ways to effectively interact with and comfort their child during stressful and painful experiences. Research has shown that parents are concerned about their child’s pain and when given written information on strategies to reduce pain before the immunization appointment, parents can retain the knowledge and utilize it during the immunization (13).

2. General Considerations

2.1 Prior to the Appointment

There are many resources available to assist individuals of all ages prepare for an immunization. For example:

- **ImmunizeBC** @ <https://www.immunizebc.ca/>.
 - ImmunizeBC is a website that provides evidence-based information about immunization to BC residents. Advise clients to review information under each age group in the section titled

“Vaccines for All Ages”. Each age group has information titled “Preparing for a Positive Experience”.

- **CANImmunize** @ <https://www.canimmunize.ca/en/home>.
 - CANImmunize is an immunization resource website that has information related to immunization pain management. It also has an app that can be downloaded so that individuals can record their immunizations.
- **Immunize Canada** @ <https://immunize.ca/learn-about-immunization>.
 - Immunize.ca is a website with information for all ages regarding immunizations, including pain management during immunization.
- HealthLinkBC File 50e “[A Better Immunization Experience for your Child](#)” has information for parents of children of any age regarding strategies to prepare for the immunization as well as decrease immunization pain.

Advise parents that specific discussion about the immunization procedure is appropriate for children > 2 years of age (3). In general, toddlers and preschool age children should be informed about the injection as close to the actual administration of the vaccine as possible. For school age children, one day of advance preparation may be appropriate. Older children may benefit from longer preparation time, but much depends on individual coping styles.

Advise parents that a matter-of-fact, supportive, non-apologetic approach is the most effective. The most helpful parent behaviours have been found to include humour, coaching their child to use coping strategies, distraction, and non-procedural talk with the child (i.e., talking about something other than the immunization) (2,3). Advise parents not to use needles or vaccination as a disciplinary threat.

Give parents realistic information about how much pain is associated with immunization. Partner with them by providing them with techniques they can use to support, distract, and coach their child before, during, and after the immunization (3).

2.2 At the Appointment

Enquire about the client’s previous experiences with needles or other painful medical procedures. This information can be helpful in planning how to approach the visit as individual responses to stress are influenced by temperament, environment, and past experience. If client reports a history of fainting with previous immunizations or injections, refer to [8. Techniques to Reduce the Risk of Fainting](#).

It is the immunization provider’s responsibility to establish an environment that fosters trust and mutual respect and to communicate with clients and parents during the immunization process. When preparing for the immunization, describe what you plan to do. Describing what you plan to do demonstrates respect for the client’s right to know, confidence in their ability to manage, and your interest in dealing with their concerns. Important elements of information include:

- What will be done (i.e., the steps involved in the procedure)
- How it will feel, using words that are explanatory without evoking anxiety (e.g., pressure, squeezing, and poking) (1,2). Avoid words such as shot, pain, hurt and sting.

- Strategies you, the client, and the parent can use to minimize discomfort. Refer to [3. Strategies to Reduce Pain and Anxiety](#).

Research has demonstrated that it is important to provide a verbal signal of the impending *procedure*, rather than the impending *pain* (1). Providing a signal about the impending procedure helps prevent sudden movements and allows the client to initiate coping strategies. When informing the client that the immunization is imminent, it's important to use neutral language whenever possible. Use words such as "here I go" rather than "here comes the sting".

Do not tell individuals that "it won't hurt". Use honest statements such as "there may be a pinch and some pressure that will last a few seconds." It is the immunization provider's responsibility to establish an environment that fosters trust and mutual respect. Telling a child that the immunization won't hurt ("suggestion therapy") has been found to be ineffective at reducing pain during immunization and may lead to a relationship of distrust between the child and health care provider (14).

Infants and children:

In addition to the above strategies, it is important to acknowledge that the immunization experience can be stressful for both the parent and the child. It is the health care provider's responsibility to support and, if necessary, educate the parent regarding appropriate ways to support their child during the experience. Coach parents in ways to decrease pain and anxiety in their child during the immunization. Suggest that parents:

- Stay calm and speak in a calm and soft tone of voice
- Not use words that focus the child's attention on the needle such as "It'll be over soon, and you'll be okay."
- Answer their child's questions honestly (e.g., "You need the vaccine to stay healthy. The medicine will be put in your arm with a needle. You will feel a quick poke.")
- Talk about things that can focus the child's attention on a fun event (e.g., an outing to the park, a fun or interesting activity done at home or school, something the child learned or did that made the parent proud, or an upcoming event the child is excited about)
- Use humour when talking with the child
- Re-direct the child's attention to the distraction strategy as needed

Depending on the age of the child, the immunizer may also:

- Provide privacy and prepare the immunization out of sight of the child. If the child asks to see the needle, explain you will show it after the procedure.
- Acknowledge the client/child's feelings and encourage parents to do the same. For example, consider use of phrases such as "you look worried/scared"; or "let's talk about some of the things we can do to make this better for you".
- Provide limited, realistic choices and let the child decide (e.g., "Would you like to use your right or left arm?" or "Would you like to look at this book or blow the pinwheel while I give you the vaccine?"). Offering realistic choices creates a setting where the child can maintain some personal control and contributes to an atmosphere of mutual respect.
- Manage the time and set limits. If the child is visibly upset and cannot calm him or herself, or cannot be safely and comfortably restrained, acknowledge their effort and offer a rest period. If there is no other alternative, reschedule the immunization.

Advise parents that parental reassurance, empathy, and apologies offered **before** the immunization are associated with increased stress in the child (15). It is thought these behaviours and the parent's tone of voice focus the child's attention on the procedure and cue them to realize something unpleasant is about to happen with the result that they feel more distress.

Researchers believe that it is appropriate for parents to acknowledge the child's pain by saying things such as "it's okay" or "I know it hurts", once or twice, right **after** the needle. However, pain researchers also suspect that parents who verbally reassure too much following a stressful experience tend to do this instead of trying other strategies (e.g., distraction) that help a child regulate more quickly and are using a tone of voice that children only hear in times of distress (1). After the immunization, encourage parents to calmly cuddle their child, briefly acknowledge their child's pain, and then use a normal voice to talk to their child about mundane things such as describing what is going to happen next with them (e.g., dress them, take them home, etc.).

Encourage the child's effort throughout the immunization process. After the immunization, acknowledge the child's effort and perseverance and encourage the parent to comfort their child and acknowledge their efforts. For example, encourage parents to use phrases such as "I know that was hard for you and I'm proud of you, that you did it", or "I really liked how you took lots of deep breaths while the nurse gave you the vaccine". Positive recognition after the procedure will help a child feel good about the skills they learned during the procedure.

Parent behaviours that may increase the child's distress include threatening, bribing, shaming, or manipulating the child. If you encounter a parent using these behaviours during an appointment, the most helpful response is to offer empathy to the parent, state a neutral fact or principle and offer hope (e.g., "This must be frustrating for you. Immunizations are important but are not emergencies. I think we can work this out.").

In situations where the immunization provider assesses the child to be extremely distressed and the immunization provider is uncomfortable with the behaviour of the parents towards the child (i.e., the parent is threatening, blaming, or shaming the child), it is the responsibility of the immunization provider to stop the immunization, re-evaluate, and adjust the plan.

This may include:

- Assessing the techniques that have been used to this point and determining if any additional/different techniques may be more effective
- Deferring the immunization temporarily
- Making a plan with the parent regarding how/when they will return with the child
- Considering with the parent the option of having another health care provider do the immunizations in a different setting

If the parent resists the above suggestions and insists upon having the child immunized that day, explain that as a health care provider you are bound by a code of ethics that prohibits you from providing care under these circumstances.

In a setting where a child is being immunized without a parent present (e.g., school) and the child is extremely distressed, it is the immunization provider's responsibility to assess whether the immunization can be safely and ethically administered. If the immunization is to be deferred, the provider should contact the parent and discuss a plan for immunization with the parent present.

If a parent presents with more than one child, immunize the most anxious one first (usually the eldest). The needle is the focus of the child's fear and watching while someone else is immunized may increase fear and anxiety.

3. Strategies to Reduce Pain and Anxiety

Recommendations for reducing pain and anxiety associated with immunization have been updated to reflect interventions that are effective across the lifespan. The strategies are evidence-based and have been grouped into sections according to age of the client being immunized:

- Individuals of all ages
- Infants and children < 3 years of age
- Children 3-17 years of age
- Adults ≥ 18 years of age

In each age category, the strategies reflect best practice in 5 domains (1):

- Procedural interventions (e.g., injection techniques, order of injections)
- Physical interventions (e.g., breastfeeding before and during immunization, positioning)
- Pharmacological interventions (e.g., topical anesthetics, sweet-tasting solutions)
- Psychological interventions (e.g., distraction, verbal communication of information)
- Process interventions (e.g., education of immunizing clinicians, clients, and parents)

It is not necessary or practical to implement all strategies with each client. However, certain strategies (e.g., no aspiration with injection, inject the most painful vaccine last) are easy to implement and can be used with all clients. While each strategy has been demonstrated to be effective in reducing immunization injection pain independently, research has found that the effect is significantly increased when two or more strategies are combined (e.g., sweet-tasting solution and non-nutritive sucking) (16). In most cases, health care provider judgement is required to determine which strategies are most practical and appropriate with each immunization encounter. A comprehensive approach includes at a minimum:

- Use of effective strategies to prevent and reduce pain and anxiety
- A comfortable environment
- Preparation of the client and/or parent before the procedure
- Presence of calm adults who can coach children during the immunization

The evidence-based strategies in this section are based on the HELPinKids & Adults 2.0 (expanded and updated): Clinical Practice Guideline for Reducing Pain during Vaccine Injections in Children and Adults (1) released in 2015. There are some significant changes to the guideline from the original HELPinKids guideline released in 2010. For example, the guideline now includes recommendations for clients of all ages and strategies that lack evidence to support their use have been removed (e.g., rapid injection and tactile stimulation).

There are a number of commercially available products that parents may choose to bring to the appointment, hoping to reduce the pain and anxiety experienced by their child during the immunization. It is the health care provider's role to assess whether the potential effectiveness of the product is based on research and the evidence provided in this guideline. If use of the product is not supported by the evidence, the health care provider may explain to parents that there isn't evidence supporting the use of the product and inform parents of other strategies that are evidence-based. If the parent still wants to use

the product, the health care provider must assess whether use of the product will interfere with safe administration of the vaccine. If not, it is the health care provider's decision whether to integrate use of the product.

Prophylactic Oral Analgesia:

Prophylactic oral analgesia (e.g., acetaminophen or ibuprofen) is not recommended.

Advise parents that oral analgesics are only recommended for use in managing adverse events (e.g., fever and pain) if they occur *after* immunization (2). There is currently no demonstrated benefit of administering oral analgesics for the prevention of immunization injection pain. Recent studies indicate that there is a possibility that administration of prophylactic oral analgesics prior to immunization or at the time of immunization may decrease vaccine immunogenicity (17-20). The clinical significance of this finding is unclear.

4. Individuals of All Ages

Strategies described in this section have been shown to be effective when immunizing clients of any age.

4.1 No Aspiration

Perform all vaccine injections without aspiration (1).

Aspiration is not recommended as there are no data to document its necessity prior to subcutaneous or intramuscular injection of vaccines (2,21,22). There are no large blood vessels at the recommended injection sites. Not aspirating before injection has been demonstrated to reduce pain at the injection site because there is less contact time between the needle and tissue and less lateral movement of the needle. For more information, refer to [Appendix B - Administration of Biological Products, 14.1 Intramuscular \(IM\) Injection Route](#).

Rapid injection is no longer included with this recommendation for a variety of reasons. There is insufficient evidence supporting the effect on pain; subcutaneous injection technique does not support rapid injection; and there is increased potential for error with landmarking and correct site selection when providers are attempting rapid injection (1).

4.2 Most Painful Vaccine Last

Inject the most painful vaccine last (1).

Inject the most painful vaccine last when administering multiple vaccine injections sequentially (23) (e.g., give INFANRIX hexa® and NEISVAC-C® before PREVNAR® 13; when PREVNAR® 13 and MMR II® are given at the same visit, give MMR II® last). It is important to note that this recommendation is brand-specific. There is limited evidence-based information available regarding painfulness of many vaccines (2). When clinicians are aware that one vaccine causes more pain upon injection, that vaccine should be administered after other less painful vaccines.

Studies have indicated that when 2 vaccines were injected sequentially, injection of the least painful vaccine first not only reduced pain from the first injection, but also reduced pain from both injections. This finding is consistent with other pain research which has found a relationship between increased pain perception and repeated painful stimulation.

4.3 Topical Anesthetics

Provide information to adults and caregivers of infants and children about the use of topical anesthetics (1,2).

Suggest parents combine topical anesthetics before immunization with breastfeeding during vaccine injections for infants and children \leq 2 years of age.

There are several topical anesthetic products available for purchase. Examples are:

- Lidocaine/prilocaine (e.g., EMLA® is a eutectic mixture of 2.5% lidocaine and 2.5% prilocaine and is available as a cream or patch)
- Tetracaine (e.g., Ametop™ gel is 4% tetracaine)
- Lidocaine (e.g., Maxilene 4™ or Maxilene 5™ cream contain 4% and 5% lidocaine respectively)

Advise clients to apply the topical anesthetic according to the manufacturer's instructions found on the product label or the product insert. After application, it is advisable to use a pen to trace the edges of the product. This will let the immunizer see where the product was applied. Whenever a topical anesthetic is applied, it must be removed before proceeding with the immunization. For more detailed information on use, refer to [Table 1: Summary of Considerations for Use of Topical Anesthetics](#).

Topical anesthetics have been found to cause transient local skin reactions (e.g., pallor and/or erythema). The presence of a transient local skin reaction does not affect the effectiveness of the topical anesthetic. Discuss this possibility to assist clients and parents in distinguishing between this reaction and a local reaction to the vaccine.

For more information regarding the use of topical anesthetics in children, refer parents to [HealthlinkBC File 50h Numbing Creams and Patches for Immunizations](#). Research has shown that parents are able to apply topical anesthetics correctly when trained to do so and would pay the additional cost of the agents to reduce their child's pain.

Rationale for use of topical anesthetics:

There is strong evidence supporting the effectiveness of topical anesthetics in preventing pain in individuals \leq 12 years of age. There is moderate evidence supporting their use in individuals $>$ 12 years of age (1,24-26). Topical anesthetics are safe and effective for infants and children (3).

Studies have demonstrated that topical anesthetics do not interfere with the immune response to several vaccines [i.e., DTaP-IPV-Hib (Pentacel®), hepatitis B (Recombivax®) and MMR (MMR II®)] (27,28). Considering this body of research, there is no reason to suspect there would be a risk of decreased immune response to other vaccines.

Topical anesthetics act by inhibiting the generation and transmission of pain impulses across nerve endings located in the dermis. They decrease the pain as the needle penetrates the skin and reduce the underlying muscle spasm associated with this pain. Given that there is a cumulative effect when infants or children are exposed to sequential painful stimuli, prevention of the initial painful stimulus (needle puncture through the skin) decreases the overall pain experience. Topical anesthetics have been well-studied and found to be effective in reducing vaccine injection pain in infants and children.

Considerations for use of topical anesthetics:

Topical anesthetics may be more effective in some individuals than others. Factors that may influence effectiveness include the level of anxiety, age, temperament, and genetic variability.

The inappropriate use of topical anesthetics (e.g., applying more than the recommended amount, leaving the product in place for longer than the recommended time, or applying the product to non-intact skin) can lead to serious side effects such as methemoglobinemia, seizures, irregular heartbeat and difficulty breathing. Very rarely, these reactions have occurred even after correct application of these products. Neonates are at increased risk of methemoglobinemia. Refer to [Table 1: Summary of Considerations for Use of Topical Anesthetics](#).

Table 1: Summary of Considerations for Use of Topical Anesthetics

Topical Anesthetic	Considerations
<p>EMLA® (2.5% lidocaine and 2.5% prilocaine) cream or patch</p>	<ul style="list-style-type: none"> • Should be applied at least 60 minutes before immunization. Local analgesia is achieved after a 60 minute application under an occlusive dressing. • EMLA® cream should be covered with an occlusive dressing. • Depth of analgesia is 3 mm after 1 hour of application. • Local analgesia persists for at least 2 hours after removal of cream. • Neonates are at increased risk of methemoglobinemia as a result of exposure to prilocaine. Methemoglobinemia is a clinical condition in which more than 1% of hemoglobin in blood has been oxidized to the ferric form. The principal sign is cyanosis because the oxidized hemoglobin is incapable of transporting oxygen. Studies have found that the risk of methemoglobinemia is low in infants exposed to recommended dosages of prilocaine. In full term neonates, single doses ranging from 0.5 to 2 grams applied for 30 to 180 minutes have not been reported to cause methemoglobinemia (29,30). • Children should be monitored during product use. • The safety of EMLA® during pregnancy has not been established. • Contraindicated for: <ul style="list-style-type: none"> ○ Individuals who are sensitive to local anesthetics of the amide type or to any ingredient of EMLA® ○ Individuals with congenital or idiopathic methemoglobinemia ○ Infants ≤ 12 months of age who require treatment with methemoglobin-inducing agents (e.g., sulphonamides) ○ Preterm infants (i.e., < 37 weeks gestational age) ○ Care should be used when applying EMLA® to individuals with atopic dermatitis (eczema) or other skin conditions. A more rapid and greater absorption through the skin may occur. A shorter application time should be used.
<p>Ametop™ gel (4% tetracaine)</p>	<ul style="list-style-type: none"> • Should be applied 30-45 minutes before immunization. • Local analgesia persists for 4-6 hours. • Contraindicated for: <ul style="list-style-type: none"> ○ Infants < 1 month of age and premature infants ○ Individuals who are allergic to local anesthetics of the ester type • Do not use on broken skin.
<p>Maxilene cream (available in 4% and 5% lidocaine)</p>	<ul style="list-style-type: none"> • Should be applied 30-60 minutes before immunization. • It is recommended that the cream be covered with an occlusive substance (e.g., clear, plastic wrap) to prevent children from ingesting it orally. • Consult a physician regarding use in children < 2 years of age.

4.4 Positioning

Advise children and adults to sit up during immunization (unless the client has indicated a history of fainting during or following immunization, in which case they should be supine) (1,2).

Advise parents to hold their infant or young child on their lap in a seated or semi-seated position during immunization. Ensure the position is comfortable for the infant/child and the parent and the limb to be immunized is in an appropriate position for the immunization provider (1,2). Do not place infants and children in a supine position during immunization.

- Infants and young children who are being breastfed or held skin-to-skin for immunization should be held in a position that supports breastfeeding or skin-to-skin and allows the immunizer access to the limb(s) being immunized.
- In rare circumstances where an infant is not held during the immunization, encourage parents or care providers to hold and pat or rock the infant after the immunization (1).

Rationale:

Studies have demonstrated that compared to a supine position, parental holding (for infants) and sitting up (for all other ages) are associated with reduced pain during immunization. This may be because parental holding and sitting up are associated with a greater sense of personal control and reduced anxiety which in turn reduces the perception of pain.

Considerations for holding/restraining children:

Have parents hold the child in a position that ensures the immunization can be administered without undue risk of needle stick injury to the child or parent/caregiver. To view examples of comforting restraint, refer to [8.2 Comforting Restraint](#). The age and developmental stage of the child are important considerations when assessing the appropriate use of “comforting restraint”. Toddlers are likely to react negatively to being held still but will need to be comfortably restrained by the parent. The preschool or school age child may exhibit signs of extreme distress and verbally express a fear of needles. A discussion of the strategies that will be used to reduce pain during the immunization is an important step for anxious children, but children this age may still need assistance to remain still.

The situation in which a child is being forcibly restrained to receive an immunization presents an ethical dilemma to the immunization provider. Immunization providers practice under the guidance of various professional codes of ethics. An element common to these codes of ethics is the provision of safe, compassionate, competent and ethical care. It is not ethical or compassionate, and could at times be unsafe, to force an individual to receive an immunization. It is the immunization provider’s responsibility to assess the situation and appropriateness of the restraint being provided.

Restraint should be provided with the goal of assisting the child to remain as still as possible for the procedure, not to overpower the child. Advise the parent to not restrain the child until you are ready to administer the vaccine. The longer the child is restrained the greater the loss of personal control and hence increased anxiety.

4.5 Distraction

Distraction is an effective strategy with all ages. There are many theories about why distraction is effective including: the gate-control theory that suggests the parts of the brain that process painful stimuli are less active when the person is distracted; and the limited-attention capacity theory which suggests that when some attention is directed to a distracting task, there are less resources available within the brain to pay attention to the pain (3,31). The distraction strategy may invoke behaviours such as laughing that are not compatible with distress.

Studies have demonstrated that distraction is most effective when it is interactive and when the child is actively engaged in the distraction strategy (32).

The World Health Organization recognizes the value of distraction with all age groups and recommends that when topical anesthetics are not affordable or available, the use of distraction should be optimized (2).

Age-appropriate distraction strategies are discussed under each age category in the following sections.

5. Infants and Children < 3 Years of Age

Refer to strategies described in [4. Individuals of All Ages](#).

5.1 Breastfeeding

Recommend that infants and children who are breastfeeding be breastfed before, during and after immunization (1,2,25,33-35).

Ensure an adequate latch has been achieved before proceeding with the immunization.

Breastfeeding is a multi-dimensional intervention that combines feeding with maternal holding and skin-to-skin contact. Research indicates that breastfeeding during immunization may reduce pain and distress through the combined effect of:

- Presence of a comforting person
- Diversion of attention (sucking and distraction)
- Physical sensation of skin-to-skin contact with mother
- Sweet taste of breast milk and other substances in the milk [e.g., tryptophan (a precursor of melatonin) which has been reported to increase the concentration of β -endorphins, thereby producing analgesia and relaxation]

Any theoretical concern that breastfeeding during immunization may cause the infant to associate breastfeeding with pain has not been demonstrated in research. Given that vaccine injections are not common, breastfeeding would not be a reliable cue for the infant of an upcoming painful procedure.

For infants and children ≤ 2 years who are not breastfeeding for the immunization, advise parents to either:

- Feed by another method (e.g., expressed breastmilk or formula by bottle) during immunization. This may provide some of the same effects as breastfeeding in the immunization setting (e.g., being held by a comforting person, sucking, and ingestion of sweet-tasting solution); or
- Offer non-nutritive sucking options such as a pacifier or child's own finger/thumb

5.2 Sweet-Tasting Solutions

For infants who are not breastfeeding before and during immunization, advise parents that a sucrose solution administered before immunization is effective for reducing immunization pain in infants and children ≤ 2 years of age (1-3,25,36-41).

Administration of a sweet-tasting solution may be combined with non-nutritive sucking. If the infant routinely uses a pacifier, encourage the parent to offer the pacifier to the infant after administration of the sucrose solution.

When an infant is receiving rotavirus vaccine and injectable vaccine(s), administer the rotavirus vaccine first. One study using Rotarix® vaccine (which contains sucrose) has shown that the vaccine has the same analgesic effect as a sucrose solution (42). Although a similar study with RotaTeq® has not been conducted, RotaTeq® contains sucrose at a concentration that would be expected to provide an analgesic effect. A study using both rotavirus vaccines which did not differentiate the effect of one or the other, but did examine use prior to or following receipt of injectable vaccines demonstrated that injection-induced pain in infants was reduced when rotavirus vaccine was provided before, as opposed to after, injectable vaccines (43). When rotavirus vaccine is administered, there is no need to provide a separate dose of a sweet-tasting solution.

The analgesic effect of a sucrose solution has been demonstrated to last for up to 5-10 minutes following its administration. Due to the duration of its effect, it is expected to mitigate immunization injection pain when multiple injections are administered (44).

If the use of sucrose is a standard practice in the specific workplace and will be administered by the immunization provider, obtain consent before proceeding. Document the parental consent and the administration of the sucrose solution in the infant's record.

Options for the provision of oral sucrose solution:

It is a Health Authority and individual provider decision whether pre-packaged sucrose solution is available at the clinic. There are many products available to clinicians, including Ora-sweet® and Toot-sweet™.

If pre-packaged oral sucrose will not be made available, parents may be advised regarding the possibility of mixing their own oral sucrose solution and bringing it with them to the clinic.

Advise parents and caregivers who plan to mix their own sucrose solution that the recommended dose is 2 mL of 24% strength (weight/volume) which is equivalent to 1 teaspoon of sugar dissolved in 10 mL (2 teaspoons) of water (only 2 mL of the resulting solution will be administered). Remind them that Health Canada recommends that all water given to infants be sterilized before administration (45). To ensure water for infants is safe and pathogen-free, advise parents and caregivers to:

- Use cold tap water.
- Bring water to a rolling boil.
- Continue to boil for 2 minutes.
- Let cool.

Refer parents to [HealthlinkBC File 50e A Better Immunization Experience for Your Child](#) for instructions on making an oral sucrose solution.

If the parent will be administering the sucrose solution, instruct them to administer it as follows: place a few drops on the infant's tongue, allow them to mouth/suck and swallow the solution, and then repeat the procedure until the recommended dose (i.e., 2 mL) has been administered. If it is assessed that the infant has spit out most of the dose, administer another dose. If the parent administers the oral sucrose solution, consent does not need to be documented in the immunization record, though providers may choose to note that oral sucrose was given for the information of future providers.

Rationale for sweet-tasting solution:

The use of a sucrose solution to prevent pain during minor medical procedures has been endorsed by the Canadian Pediatric Society and the American Academy of Pediatrics (46).

There is abundant evidence supporting the effectiveness of sucrose in reducing infant pain. By activating the sweet taste receptors, a sucrose solution is believed to stimulate the release of endogenous opioids and act as a distraction.

A sucrose solution is specifically indicated as an analgesic for the management of acutely painful medical interventions. It prevents pain only when given **prior** to a painful procedure. **Discuss with parents that sucrose solutions are appropriate for acute procedural pain only and would not be effective or appropriate for use at home as a comfort measure for their infant.**

The use of a sucrose solution as an analgesic does not conflict with the World Health Organization/UNICEF definition of exclusive breastfeeding (i.e., "Exclusive breastfeeding means giving a baby only breast milk, and no other liquids or solids, not even water. Drops or syrups consisting of vitamins, mineral supplements or medicines are permitted.") (47).

There is no evidence to support the theoretical concern that the use of a sucrose solution to prevent pain during minor procedures contributes to childhood obesity, dental caries, or parental misuse of the solution. There is proof that not managing pain causes hypersensitivity to pain. This hypersensitivity may lead to vaccine non-compliance, needle fear, and phobia.

To place the amount of sucrose babies are exposed to with oral sucrose solutions in perspective, there are 480 mg of sucrose in 2 mL of a 24% sucrose solution. To compare with the products listed below, this equates to 1200 mg of sucrose in 5 mL of a 24% sucrose solution. This is considerably less than the amount of sucrose ingested by infants when given several commonly used antibiotics, oral vaccines or oral analgesics. See the following examples:

- Advil Pediatric drops 200 mg/5 mL (Dye Free, Grape and Fruit Flavour) made by Pfizer: contains 3,000 mg of sucrose/sorbitol per 5 mL
- Apo-amoxicillin 125 mg/5 mL made by Apotex: contains 2,300-2,400 mg of sucrose/5 mL

- Teva-amoxicillin 125 mg/5 mL made by Teva: contains 3,075 mg total carbohydrates (sucrose) per 5 mL
- Teva-cephalexin 125 mg/5 mL made by Teva: contains 2,970 mg of sucrose per 5 mL
- ROTARIX® oral vaccine contains 1,073 mg sucrose per 1.5 mL; would contain 3,575 mg per 5 mL
- RotaTaq® oral vaccine contains 1,080 mg sucrose per 2.0 mL; would contain 2,700 mg per 5 mL

Contraindications to sucrose solutions:

The following are contraindications to sucrose solutions:

- Infants with known fructose or sucrose intolerance
- Critically ill infants receiving intravenous analgesia or sedation
- Infants with necrotizing enterocolitis
- Infants with gastric/bowel dysfunction.

In infants receiving intravenous analgesia or sedation, a sucrose solution is not indicated as the infant is already receiving analgesia. In addition, intravenous opioid analgesic agents would compete to bind with the same opioid receptor sites as the endogenous opioids produced by the sweet taste of the sucrose solution, rendering the sucrose solution ineffective.

Infants with necrotizing enterocolitis or who have gastric or bowel dysfunction may experience gut trauma relating to the osmolarity of sucrose solutions. This can cause damage and may initiate a pathological process that could lead to necrotizing enterocolitis in susceptible infants. Necrotizing enterocolitis is almost exclusively a disease process that affects premature or seriously ill infants and is unlikely to affect infants seen in the public health setting.

A large proportion of the research on sucrose and related contraindications comes from the neonatal intensive care settings, where clients are likely to be getting multiple medications and are at risk of necrotizing enterocolitis. These contraindications have been extrapolated to the public health setting but are much less likely to be relevant to a non-hospitalized infant seen in the clinician's office.

5.3 Distraction

Clinician and/or parent guided distraction is an effective evidence-based strategy. However, other strategies such as breastfeeding before and during immunization, topical anesthetics, and sucrose solutions have been demonstrated to be more effective in this age group. Distraction may be combined with other strategies, paying careful attention to not interfering with the more effective techniques.

Distraction strategies in this age group include toys, bubbles, singing, directing the infant's attention to something in the environment that may be of interest to them, or a video (on computer screen or parent's hand-held electronic device) (32,48). Research has indicated that video distraction is an effective intervention in this age group (1). However, the Canadian Pediatric Society recommends against any screen time for children < 2 years of age (49). The immunization provider may provide this information to parents and allow them to determine whether they would like to use this distraction strategy.

5.4 Skin-to-skin Contact

Recommend skin-to-skin contact during vaccine injections for infants ≤1 month of age (1).

Also known as kangaroo care, it is recommended that infants ≤ 1 month of age be dressed only in a diaper and be held prone on mother's bare chest. This only applies if the infant is not breastfed. Breastfeeding is preferable to skin-to-skin contact for breastfeeding infants.

5.5 Simultaneous Injections

There is some evidence that simultaneous injections decrease distress in infants receiving multiple immunizations at a single visit. The benefit of possibly reducing pain by decreasing sensitization and anticipatory distress may be outweighed by the stress of being approached by 2 clinicians at one time. Research has found no evidence of benefit for using simultaneous injections in children 1-10 years of age (inclusive) (1).

Infants ≤ 12 months of age: When possible, simultaneous, rather than sequential injections may be beneficial.

Children > 1-10 years of age (inclusive): Use sequential, rather than simultaneous injections.

Individuals > 10 years of age: When possible, offer the choice of simultaneous or sequential injections.

6. Children 3-17 Years of Age

Refer to strategies described in [4. Individuals of All Ages](#)

6.1 Vibrating Device with Cold

Apply a vibrating device with cold during immunization of children 3-17 years of age (inclusive).

Researchers have demonstrated a positive effect on pain reduction when a vibrating device with an ice pack attached was applied to a site just above the injection site during the immunization (1,50). There are a number of devices available for purchase. One example, Buzzy®, comes with frozen "wings" (an ice pack) that will stay frozen for 10 minutes at room temperature. The frozen wings part of the device is applied to the injection site for 30-60 seconds, then moved up the limb and secured. The vibration is then turned on for the duration of the injection.

Another study used a multi-faceted approach whereby a vibrating device was applied to the arm not being immunized, an external tactile device was pressed on the skin of the arm being immunized, and a vapocoolant was sprayed on the immunization site immediately before the injection (51). In addition, a study found that parents can be trained to administer the multi-faceted approach (52), thereby increasing the feasibility for implementation by health care providers.

The use of vapocoolants alone in this age group is not recommended for a number of reasons (1):

- Research has not demonstrated a benefit
- There are a number of other strategies that have strong evidence of effectiveness (e.g., topical anesthetics)
- Some children may find the cold uncomfortable and therefore focus more on the immunization procedure and potentially increase the sensation of pain at the injection site

6.2 Distraction

Verbal distraction has been demonstrated to be effective in this age group. Coach parents to distract their child by talking, singing, counting or discussing other objects in the room. Video and music distraction may also be effective and easy to implement if families bring their own music and headphones to the immunization appointment (1,32).

Specific distraction strategies include:

Toddler – toys, bubbles, pinwheels, pop-up books, singing, party-blowers, kaleidoscopes, directing the toddler’s attention to something in the environment that may be of interest to them, non-procedural talk

School-age – toys, stories, videos, books, joking, music, counting, non-procedural talk, directing the child’s attention to something in the environment

Adolescents – games, videos, joking, music (personal headphones), non-procedural talk.

Have children ≥ 3 years of age engage in slow, deep breathing/blowing out during immunizations.

Simple breathing exercises with a toy are effective at significantly reducing immunization pain and distress (31). Examples include:

- Advise children to take a deep breath at the time of the injection.
- Have the child blow a party blower, pinwheel, or bubbles.
- Ask the child to “show me how you blow out candles on a birthday cake”.

Capture the child’s attention before the immunization and keep the child’s attention on the distraction strategy during the immunization. Provide verbal and physical (i.e., pointing) reminders for the child to assist them with continuing to pay attention to the distraction strategy. Re-direct the child’s attention back to the distraction strategy if their attention wanders to the immunization.

Maintain a positive attitude, stay focused on the child, and interact with the child throughout. When engaging in non-procedural talk with the child, attempt to discuss something of interest and enjoyment for the child (e.g., favorite toy, funny thing their pet did, favorite superhero). Acknowledge the child’s effort in engaging in distraction behaviours.

7. Adults (≥ 18 Years of Age)

Refer to strategies described in [4. Individuals of All Ages](#)

7.1 Vapocoolants

Consider application of vapocoolant to adults only.

Vapocoolants are products applied topically to the immunization site immediately before injection. There is a rapid cooling effect on the skin that has been shown to reduce immunization injection pain (1,24,53). The effect is transient and dissipates within one minute of application.

Vapocoolants are not recommended for use in individuals <18 years of age. There is a lack of observed benefit of vapocoolants and a variety of other safe and effective strategies for use in this age group.

7.2 Breathing Techniques

Suggest breathing interventions such as taking a deep breath and holding it or coughing during the immunization (1,24).

8. Techniques to Reduce the Risk of Fainting

Seat every client prior to immunization.

If client appears anxious pre-immunization or describes a history of fainting with previous immunization, have them lie down for the immunization if possible. If client appears pale and displays signs of fainting pre-immunization, advise them to lie down and apply a cold wet cloth to their face.

To reduce the likelihood of fainting (and the possibility of injuries), consider the following measures to lower stress in those awaiting immunization:

- Seat every client prior to immunization
- Maintain a comfortably cool room temperature and if possible, plenty of fresh air
- Avoid long line ups in mass immunization clinics
- Prepare biological product(s) out of view of recipients
- Provide privacy during immunization
- If client is anxious and pale, have them lie down with legs elevated
- Apply cold wet cloth to face

8.1 Muscle Tension

Suggest muscle tension as an option for individuals ≥ 7 years of age with a history of fainting.

Muscle tension is recommended for individuals who have reported a history of fainting reactions to previous immunizations or similar procedures (1). It should begin before the immunization and continue for several minutes after the immunization or until the individual is no longer feeling prodromal signs of fainting.

Muscle tension may involve cyclically tensing and releasing a set of muscles repeatedly until the perceived sensation of fainting is reduced. Examples of muscle tension include leg tensing, leg crossing (i.e., crossing legs and tensing leg, buttock and abdominal muscles), arm tensing (i.e., tensing both arms by one hand gripping the other and abducting), or hand grip (i.e., tightly gripping a ball or other object in dominant hand). Alternatively, individuals can hold the tension as long as possible or until the symptoms of fainting diminish (54,55).

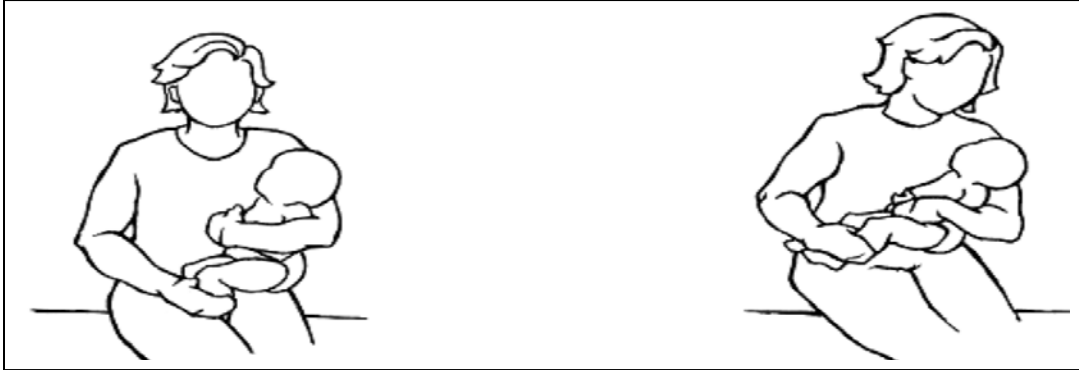
Individuals may need instructions on using this technique prior to beginning the immunization.

Rationale:

Muscle tension has been demonstrated to be effective in preventing fainting (syncope) in individuals with a history of fainting when implemented before signs of syncope develop or during the prodromal period preceding a fainting episode (54,56,57). The purpose of muscle tension is to increase blood pressure and cerebral blood flow in the event of a vasovagal response associated with an immunization. Fainting during immunization is primarily attributed to a vasovagal response which is usually associated with an extreme fear of blood and needles.

8.2 Comforting Restraint

Examples of comforting restraint positioning for injection in the vastus lateralis:



Examples of comforting restraint positioning for injection in the deltoid:



9. Quick Reference Guide

Age of Client	Strategies to prevent pain
All ages	<p>The strategies below apply to clients of all ages:</p> <ul style="list-style-type: none"> • Perform vaccine injections without aspiration. • Inject the most painful vaccine last. • Provide information regarding the use of topical anesthetics before immunization. • Positioning: <ul style="list-style-type: none"> ○ Advise parents to hold their infants or young child on their lap during immunization. ○ Advise children and adults to sit up during immunization. • Distraction: <ul style="list-style-type: none"> ○ Select an age appropriate distraction strategy.
Infants and children < 3 years	<p>In addition to strategies for all ages:</p> <ul style="list-style-type: none"> • Provide simultaneous injections for infants ≤ 12 months of age. • Recommend that infants and children who are breastfeeding be breastfed before and during immunization. • Recommend skin-to-skin contact during immunization for infants ≤ 1 month of age who aren't breastfeeding. • Advise parents regarding sweet-tasting solutions options before immunizations for infants ≤ 2 years who are not breastfeeding. • Distraction strategies in this age group include toys, bubbles, singing, directing the infant's attention to something in the environment or a video that may be of interest to them.
Children 3-17 years	<p>In addition to strategies for all ages:</p> <ul style="list-style-type: none"> • Apply a vibrating device with cold during immunization. • Distraction strategies in this age group include toys, games, music, non-procedural talk, slow deep breathing or breathing exercises with a toy.
Adults ≥ 18 years	<p>In addition to strategies for all ages:</p> <ul style="list-style-type: none"> • Consider application of a vapocoolant immediately before immunization. • Suggest breathing techniques during immunization.

10. References

1. Taddio A, McMurtry CM, Shah V, Pillai Riddell R, Chambers CT, Noel M et al. HELPinKids&Adults 2.0 (expanded and updated): Clinical Practice Guideline for Reducing Pain during Vaccine Injections in Children and Adults. CMAJ [Internet]. 2015 Aug 18. [Cited 2017 October 6]. Available from: <http://www.cmaj.ca/content/suppl/2015/08/24/cmaj.150391.DC1/150391-guide-7-at.pdf>.
2. World Health Organization. Report to SAGE on reducing pain and distress at the time of vaccination [Internet]. Geneva: World Health Organization; 2015 Mar 31 [cited 2017 Oct 6]. 49 p. Available from: http://www.who.int/immunization/sage/meetings/2015/april/1_SAGE_latest_pain_guidelines_March_24_Final.pdf.
3. Schechter NL, Zempsky WT, Cohen LL, McGrath PJ, McMurtry CM, Bright NS. Pain reduction during pediatric immunizations: evidence-based review and recommendations. Pediatrics. 2007 May;119(5):e1184-98.
4. Ives M, Melrose S. Immunizing children who fear and resist needles: is it a problem for nurses? Nurs Forum. 2010 Jan-Mar;45(1):29-39.
5. Hamilton JG. Needle phobia: a neglected diagnosis. J Fam Pract. 1995 Aug;41(2):169-175.
6. National Advisory Committee on Immunization. Canadian Immunization Guide [Internet]. Evergreen ed. Ottawa (ON): Public Health Agency of Canada; 2012 [updated 2017 Nov 3]. Part 1- Key Immunization Information: Vaccine Administration Practices; [cited 2018 Mar 9]; p. 8. Available from: <https://www.canada.ca/en/public-health/services/publications/healthy-living/canadian-immunization-guide-part-1-key-immunization-information/page-8-vaccine-administration-practices.html#tech>.
7. Taddio A, Chambers CT, Halperin SA, Ipp M, Lockett D, Rieder MJ, Shah V. Inadequate pain management during routine childhood immunizations: the nerve of it. Clin Ther. 2009;31 Suppl 2:S152-67.
8. Taddio A, Ipp M, Thivakaran S, Jamal A, Parikh C, Smart S et al. Survey of the prevalence of immunization non-compliance due to needle fears in children and adults. Vaccine. 2012;30(32):4807-12.
9. Canadian Nurses Association. Code of Ethics for Registered Nurses [Internet]. 2017 ed. Ottawa (CA): Canadian Nurses Association; c2017 [cited 2018 Feb 13]. 60 p. Available from: <https://cna-aaiic.ca/html/en/Code-of-Ethics-2017-Edition/files/assets/basic-html/page-1.html>.
10. SAGE Working Group on Vaccine Hesitancy. Report of the SAGE Working Group on Vaccine Hesitancy [Internet]. Geneva: World Health Organization; 2014 Nov 12 [cited 2018 Feb 3]. 63 p. Available from: http://www.who.int/immunization/sage/meetings/2014/october/SAGE_working_group_revised_report_vaccine_hesitancy.pdf?ua=1.
11. Taddio A, Katz J, Ilersich AL, Koren G. Effect of neonatal circumcision on pain response during subsequent routine vaccination. Lancet. 1997 Mar 1; 349(9052):599-603.
12. Parvez E, Stinson J, Boon H, Goldman J, Shah V, Taddio A. Mothers' beliefs about analgesia during childhood immunization. Paediatr Child Health. 2010 May;15(5):289-93.
13. Taddio A, Ipp M, Vyas C, Parikh C, Smart S, Thivakaran S et al. Teaching parents to manage pain during infant immunizations: laying the foundation for better pain management practices. Clin J Pain. 2014 Nov;30(11):987-94.
14. Taddio A, Ilersich AF, Ilersich AN, Wells J. From the mouth of babes: Getting vaccinated doesn't have to hurt. Can J Infect Dis Med Microbiol. 2014 Jul;25(4):196-200.
15. Manimala MR, Blount RL, Cohen LL. The Effects of Parental Reassurance Versus Distraction on Child Distress and Coping During Immunizations. Children's Health Care. 2010 Jun;29(3):161-177.

16. Cohen LL. A multifaceted distraction intervention may reduce pain and discomfort in children 4–6 years of age receiving immunisation. *Evid Based Nurs*. 2010 Feb;13(1):15-16.
17. Wysocki J, Center KJ, Brzostek J, Majda-Stanislawski E, Szymanski H, Szenborn L et al. A randomized study of fever prophylaxis and the immunogenicity of routine pediatric vaccinations. *Vaccine*. 2017 Apr 4;35(15):1926-35.
18. Sil A, Ravi MD, Patnaik BN, Dhingra MS, Dupuy M, Gandhi DJ et al. Effect of prophylactic or therapeutic administration of paracetamol on immune response to DTWP-HepB-Hib combination vaccine in Indian infants. *Vaccine*. 2017 May 19;35(22):2999-3006.
19. Prymula R, Habib A, Francois N, Borys D, Schuerman L. Immunological memory and nasopharyngeal carriage in 4-year-old children previously primed and boosted with 10-valent pneumococcal non-typeable Haemophilus influenzae protein D conjugate vaccine (PHiD-CV) with or without concomitant prophylactic paracetamol. *Vaccine*. 2013 Apr 12;31(16):2080-88.
20. Falup-Pecurariu O, Man SC, Neamtu ML, Chicin G, Baciuc G, Pitic C et al. Effects of prophylactic ibuprofen and paracetamol administration on the immunogenicity and reactogenicity of the 10-valent pneumococcal non-typeable Haemophilus influenzae protein D conjugated vaccine (PHiD-CV) co-administered with DTPa-combined vaccines in children: An open-label, randomized, controlled, non-inferiority trial. *Hum Vaccin Immunother*. 2017 Mar 4;13(3):649-660.
21. Doyle GR, McCutcheon JA. Clinical Procedures for Safer Patient Care [Internet]. Victoria (BC): BCcampus; 2015 [cited 2017 Oct 6]. 723 p. Available from: <https://opentextbc.ca/clinicalskills/>.
22. Hamborsky J, Kroger A, Wolfe S, editors. Epidemiology and Prevention of Vaccine-Preventable Diseases [Internet]. 13th ed. Washington D.C.: Public Health Foundation; 2015. Chapter 6: Vaccine Administration. [updated 2015 Sep 8; cited 2017 Oct 6]; [about 29 p.]. Available from: <https://www.cdc.gov/vaccines/pubs/pinkbook/vac-admin.html>.
23. Ipp M, Parkin PC, Lear N, Goldbach M, Taddio A. Order of vaccine injection and infant pain response. *Arch Pediatr Adolesc Med*. 2009 May;163(5):469-72.
24. Hogan ME, Kikuta A, Taddio A. A systematic review of measures for reducing injection pain during adult immunization. *Vaccine*. 2010 Feb 10;28(6):1514-1521.
25. Dilli D, Kucuk IG, Dallar Y. Interventions to reduce pain during vaccination in infancy. *J Pediatr*. 2009 Mar;154(3):385-90.
26. Cassidy KL, Reid GJ, McGrath PJ, Smith DJ, Brown T, Finley GA. A randomized double-blind, placebo-controlled trial of the EMLA patch for the reduction of pain associated with intramuscular injection in four to six year old children. *Acta Paediatr*. 2001 Nov;90(11):1329-36.
27. Halperin BA, Halperin SA, McGrath P, Smith B, Houston T. Use of lidocaine-prilocaine patch to decrease intramuscular injection pain does not adversely affect the antibody response to diphtheria-tetanus-acellular pertussis-inactivated poliovirus-Haemophilus influenzae type b conjugate and hepatitis B vaccines in infants from birth to six months of age. *Pediatr Infect Dis J*. 2002 May;21(5):399-405.
28. Halperin SA, McGrath P, Smith B, Houston T. Lidocaine-prilocaine patch decreases the pain associated with the subcutaneous administration of measles-mumps-rubella vaccine but does not adversely affect the antibody response. *J Pediatr*. 2000 Jun;136(6):789-94.
29. Taddio A, Ohlsson A, Einarson TR, Stevens B, Koren G. A systematic review of lidocaine-prilocaine cream (EMLA) in the treatment of acute pain in neonates. *Pediatrics*. 1998 Feb;101(2):E1.
30. Weise K, Nahata M. EMLA for painful procedures in infants. *J Pediatr Health Care*. 2005 Jan-Feb;19(1):42-47.
31. Sparks L. Taking the "ouch" out of injections for children: Using distraction to decrease pain. *MCN Am J Matern Child Nurs*. 2001 Mar-Apr;26(2):72-78.

32. Chambers CT, Taddio A, Uman LS, McMurtry CM. Psychological interventions for reducing pain and distress during routine childhood immunizations: a systematic review. *Clin Ther.* 2009;31 Suppl 2:S77-S103.
33. Tansky C, Lindberg CE. Breastfeeding as a Pain Intervention When Immunizing Infants. *J Nurse Pract.* 2010 Apr;6(4):287-95.
34. Efe E, Ozer ZC. The use of breast-feeding for pain relief during neonatal immunization injections. *Appl Nurs Res.* 2007 Feb;20(1):10-16.
35. Razek AA, El-Dein NAZ. Effect of breast-feeding on pain relief during infant immunization injections. *Int J Nurs Pract.* 2009 Mar 23;15(2):99-104.
36. Kassab M, Sheehy A, King M, Fowler C, Foureur M. A double blind randomised-controlled trial of 25% oral glucose for pain relief in 2-month old infants undergoing immunisation. *Int Journal Nurs Stud.* 2012 Mar;49(3):249-256.
37. ePOPS [Internet]. Vancouver (BC): BC Children's Hospital and BC Women's Hospital + Health Centre; c2018. Sucrose as a Procedural Analgesic for Infants up to 12 Months of Age. 3 p. Available from: <http://policyandorders.cw.bc.ca/resource-gallery/Documents/BC%20Children's%20Hospital/CC.06.25%20Sucrose%20as%20a%20Procedural%20Analgesia%20in%20Infants%20up%20to%2012%20Months%20of%20Age.pdf>
38. Harrison DM. Oral sucrose for pain management in infants: Myths and misconceptions. *J Neonatal Nurs.* 2008 Apr;14(2):39-46.
39. Hatfield L. Sucrose decreases infant biobehavioral pain response to immunizations: A randomized control trial. *J Nurs Scholarsh.* 2008 Sep;40(3):219-25.
40. Hatfield LA, Gusic ME, Dyer AM, Polomano RC. Analgesic properties of oral sucrose during routine immunizations at 2 and 4 months of age. *Pediatrics.* 2008 Feb;121(2):e327-34.
41. Stevens B, Yamada J, Ohlsson A, Haliburton S, Shorkey A. Sucrose for analgesia in newborn infants undergoing painful procedures. *Cochrane Database Syst Rev.* 2016 Jul 16;7:CD001069.
42. Taddio A, Flanders D, Weinberg E, Lamba S, Vyas C, Ilersich AF et al. A randomized trial of rotavirus vaccine versus sucrose solution for vaccine injection pain. *Vaccine.* 2015 Jun;33(25):2939-43.
43. Yin HC, Shih WM, Lee HL, Yang HJ, Chen YL, Cheng SW et al. Comparison of iatrogenic pain between rotavirus vaccination before and after vaccine injection in 2-month-old infants. *Hum Vaccin Immunother.* 2017 May 4;13(5):1136-1140.
44. Taddio A, Shah V, Katz J. Reduced infant response to a routine care procedure after sucrose analgesia. *Pediatrics.* 2009 Mar;123(3):e425-9.
45. Health Canada [Internet]. Ottawa (ON): Health Canada; [modified 2018 Oct 11]. Recommendations for the Preparation and Handling of Powdered Infant Formula (PIF); [modified 2010 Feb 15; cited 2017 Oct 15]; [about 4 pages]. Available from: <https://www.canada.ca/en/health-canada/services/food-nutrition/healthy-eating/infant-feeding/recommendations-preparation-handling-powdered-infant-formula-infant-feeding.html>.
46. Canadian Paediatric Society [Internet]. Ottawa (ON): Canadian Paediatric Society; c2001-2016. Prevention and management of pain in the neonate: An update; [updated 2017 Jan 30; cited 2018 Mar 4]; [about 4 pages]. Available from: <https://www.cps.ca/en/documents/position/prevention-management-pain-neonate>.
47. World Health Organization. Infant and Young Child Feeding Counselling: An Integrated Course [Internet]. Geneva: World Health Organization; 2006 [cited 2017 Oct 15]. 514 p. Available from: http://apps.who.int/iris/bitstream/10665/43567/3/9789241594769_eng.pdf.
48. Cohen LL. Reducing infant immunization distress through distraction. *Health Psychol.* 2002 Mar;21(2):207-11.
49. Canadian Paediatric Society [Internet]. Ottawa (ON): Canadian Paediatric Society; c2001-2016. Screen time and young children: Promoting health and development in a digital world; [updated 2017 Nov 29;

- cited 2018 Mar 4]; [about 12 pages]. Available from: <https://www.cps.ca/en/documents/position/screen-time-and-young-children>.
50. Canbulat Sahiner N, Inal S, Sevim Akbay A. The effect of combined stimulation of external cold and vibration during immunization on pain and anxiety levels in children. *J Perianesth Nurs*. 2015 Jun;30(3):228-35.
 51. Berberich F, Landman Z. Reducing immunization discomfort in 4- to 6-year-old children: a randomized clinical trial. *Pediatrics*. 2009 Aug;124(2):e203-9.
 52. Franck LS, Berberich FR, Taddio A. Parent participation in a childhood immunization pain reduction method. *Clin Pediatr (Phila)*. 2015 Mar;54(3):228-35.
 53. Mawhorter S, Daugherty L, Ford A, Hughes R, Metzger D, Easley K. Topical vapocoolant quickly and effectively reduces vaccine-associated pain: results of a randomized, single-blinded, placebo-controlled study. *J Travel Med*. 2004 Sep-Oct;11(5):267-72.
 54. van Dijk N, Quartieri F, Blanc JJ, Garcia-Civera R, Brignole M, Moya A, Wieling W. Effectiveness of physical counterpressure maneuvers in preventing vasovagal syncope: the Physical Counterpressure Manoeuvres Trial (PC-Trial). *J Am Coll Cardiol*. 2006 Oct 17;48(8):1652-7.
 55. Ost LG, Sterner U. Applied Tension. A specific behavioral method for treatment of blood phobia. *Behav Res Ther*. 1987;25(1):25-9.
 56. Vogele C, Coles J, Wardle J, Steptoe A. Psychophysiologic effects of applied tension on the emotional fainting response to blood and injury. *Behav Res Ther*. 2003 Feb;41(2):139-55.
 57. Brignole M, Croci F, Menozzi C, Solano A, Donateo P, Oddone D et al. Isometric arm counter-pressure maneuvers to abort impending vasovagal syncope. *J Am Coll Cardiol*. 2002 Dec;40(11):2053-9.