

Supplement Article

Overview of a Knowledge Translation (KT) Project to improve the vaccination experience at school: The CARD™ System

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ABSTRACT

Background: Students experience fear, pain, and fainting during vaccinations at school. While evidence-based interventions exist, no Knowledge Translation (KT) interventions have been developed to mitigate these symptoms. A multidisciplinary team—the Pain Pain Go Away Team—was assembled to address this knowledge-to-care gap. This manuscript provides an overview of the methodology, knowledge products, and impact of an evidence-based KT program developed and implemented to improve the vaccination experience at school.

Methods: We adapted knowledge and assessed the barriers to knowledge use via focus group interviews with key stakeholder groups involved in school-based vaccinations: students, nurses, school staff, and parents. Next, we developed project-specific goals and data collection tools and collected baseline data. We then created a multifaceted KT intervention called The CARD™ System (C-Comfort, A-Ask, R-Relax, D-Distract) to provide a framework for planning and delivering vaccinations using a student-centred approach. Selected KT tools from this framework were reviewed in additional focus groups held in all stakeholder groups. The multifaceted KT intervention was then finalized and implemented in stages in two projects including grade 7 students undergoing school vaccinations and impact on student outcomes (e.g., symptoms of fear, pain, dizziness) and process outcomes (e.g., utilization of interventions that reduce student symptoms, vaccination rate) were assessed.

Results: Participants reported that improving the vaccination experience is important. Based on participant feedback, an evidence-based multifaceted KT intervention called The CARD™ System was developed that addresses user needs and preferences. Selected KT tools of this intervention were demonstrated to be acceptable and to improve knowledge and attitudes about vaccination in the stakeholder groups. In two separate implementation projects, CARD™ helped grade 7 students prepare for vaccinations and positively impacted on their vaccination experiences. CARD™ improved vaccination experiences for other stakeholder groups as well. There was no evidence of an impact on school vaccination rates.

Conclusion: We developed and implemented a promising multifaceted KT intervention called The CARD™ System to address vaccination-associated pain, fear, and fainting. Future research is recommended to determine impact in students of different ages and in different geographical regions and clinical contexts.

Keywords: *Vaccination; Pain management; Knowledge translation*

School-based vaccination programs are an efficient way to deliver vaccinations to youth (1). Despite the effectiveness of this venue for vaccinating large numbers of school-aged children, many youth have negative experiences with school vaccinations due to concerns about injection-related pain (2,3). Fear of pain and needles can lead to an increase in pain perception, fainting, and procedure refusal (4). Negative attitudes and experiences can lead to future vaccination hesitancy, noncompliance with vaccination and noncompliance with other health care interventions (4). The Ontario Ministry of Health and Long-term Care's plan to modernize Ontario's immunization system ('Immunization 2020') (5) as well as the 2014 Annual Report of the Chief Medical Officer of Health of Ontario ('Vaccines: the best medicine') (6) specifically identify pain reduction as a key strategic step to an effective immunization system for the province. The World Health Organization also recommends addressing pain mitigation in the school setting (7).

In 2015, we undertook a systematic review of the research evidence for interventions to reduce vaccination-related pain, fear, and fainting. This systematic review served as the evidence base for a Clinical Practice Guideline (CPG) on this topic (8). Knowledge Translation (KT) tools for incorporating the CPG recommendations in the school vaccination context could not be included due to a gap in the evidence base for this practice setting.

The school vaccination setting is complex and involves the interplay of multiple stakeholders that may influence intervention delivery and effectiveness, including health providers, students, school staff, and parents. Individual practitioners are limited in their ability to make changes to how pain and fear are handled in students without involving the other stakeholder groups. Change is required at both the individual health care provider level as well as the system level to address all the potential barriers to best practices (9).

Selected members of the CPG panel partnered with a public health unit (Niagara Region Public Health) and school board (Niagara Catholic District School Board) to undertake a program of research aimed at developing a multifaceted KT intervention tailoring the CPG recommendations for the school setting. The aim was to improve the vaccination experience at school. This article is one in a series of 6 that describe this work (10). The purpose of this article is to provide an overview of the steps involved in the project, key findings, and to serve as the repository for the key tools that have been created. The remaining articles in the series provide more detail regarding the various project steps and findings.

METHODS

Conceptual framework

The project was guided by the Knowledge to Action (KTA) (11) cycle and the Consolidated Framework for Implementation

Research (CFIR) (12). The KTA (11) cycle articulates the translation of research evidence into practice as the interplay between knowledge creation and action. CFIR (12) specifies a list of constructs that positively and negatively influence implementation (e.g., intervention characteristics) and can be used to guide and assess implementation of interventions. An integrated KT approach was used, involving all stakeholders throughout and tailoring knowledge to meet their needs (13).

Pain Pain Go Away Project Team

A multidisciplinary, multi-sectoral group of individuals, the Pain Pain Go Away Team, oversaw the project. The team included 20 members: 3 clinician-scientists (pharmacy-AT, psychology-CMM, medicine-NM) with content expertise in vaccination, pain, fear, and fainting mitigation; 2 clinicians (regional public health school nurse-TM, psychologist-MB); 3 regional public health unit managers (clinical services-AAM, school programs-CdVK, vaccine preventable disease program-LA); 2 policy makers (regional public health unit associate medical officer of health-MMH, provincial ministry of health representative-JC); 1 parent advocate (KR); 2 students (13 and 17 years old-ALTI, ANTI); 2 educators (school educator-EW, public health-CH); 2 KT experts (vaccination promotion-LMB, hospital quality improvement-SF); 1 multimedia producer (CS), and 2 graduate trainees (TF, HW).

Monthly or bimonthly meetings were held with the group to discuss progress of the project and to plan next steps. In addition, three subgroups were created to oversee specific project components: 1) project management, including data collection and analysis; 2) development of the multifaceted KT intervention; and 3) implementation planning and execution. The lead scientist (AT) oversaw the project. Ethical approval was granted by the Research Ethics Board of the University of Toronto.

Step 1: Identifying potential areas for intervention and published guidelines

In previous work within the Knowledge Creation cycle of the KTA (11), we undertook primary studies to identify student perceptions of school vaccinations, analgesic practices, and the impact of pain and fear on vaccine acceptance (2,3,14,15). These studies demonstrated that: 1) fear of injection-related pain is prevalent in students; 2) interventions to mitigate fear and pain are under-prioritized and suboptimally utilized; and 3) concerns about needle-related pain contribute to vaccine refusal. We carried out a knowledge synthesis and developed a CPG (8) with recommendations for reducing pain, fear and fainting during vaccination. Template tools were created to assist clinicians with implementation of the recommendations; however, they were not specific to the school vaccination context.

Step 2: Adapt knowledge to local context and assess barriers to knowledge use

We tackled the Action cycle of the KTA framework and used a multicomponent strategy to develop tools and processes for the local school vaccination context. This included: 1) focus groups with stakeholders to learn about their experiences and obtain feedback on template tools; 2) determination of what outcomes to measure and the manner of their assessment; and 3) examination of current policies and practices.

We identified interventions from our CPG (8) that could be adapted for the school vaccination context and created template KT tools. We then carried out focus group interviews with four different types of stakeholders: students, parents, school staff and public health nurses. Within each focus group, participants were asked to share experiences with school vaccinations, strategies used, as well as challenges and facilitators of a positive

vaccination experience. Participants were also asked to provide detailed oral and written feedback on template KT tools and implementation strategies. These focus groups provided us with key themes regarding the barriers and facilitators faced in daily practice related to pain and fear management specific to the Niagara context (16). A cause-and-effect (fishbone) diagram was developed to describe current practice (Figure 1).

A concurrent separate activity involved identification of the project outcome indicators and monitoring tools by the project team. First, a list of prioritized outcomes was created based on our CPG (8) (Table 1). Then monitoring tools were refined or developed to track these outcomes (Supplementary Appendices 1–6) and included: 1) tool feedback survey; 2) knowledge survey; 3) student vaccination symptom survey (i.e., pain, fear, and dizziness-precursor of fainting); 4) nurse vaccination intervention documentation checklist; 5) intervention fidelity

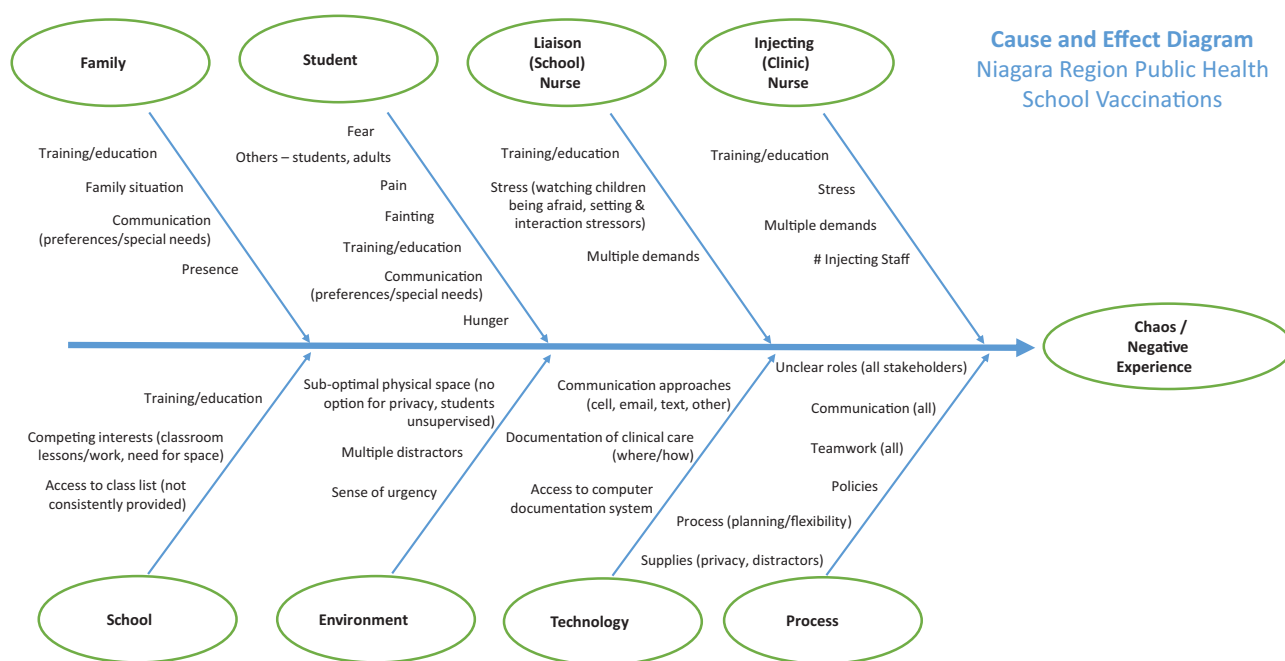
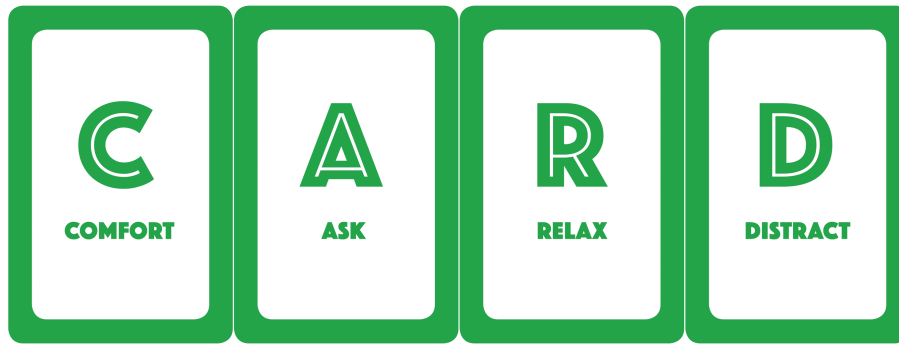


Figure 1. The figure is also available online as a full-sized, downloadable resource.

Table 1. Outcome indicators for the project

Category	Measures
Clinical/patient	Student fear, pain, dizziness (precursor of fainting), fainting, and returns to clinic because feeling unwell
Clinic Process	Flow of events/workflow during vaccination, utilization of interventions, vaccine compliance/procedure success
Acceptability (students, parents, school staff, nurses)	Understandability, quantity, and quality of education
Satisfaction (students, parents, school staff, nurses)	Vaccination experience, value, and effectiveness of education
Attitudes (any stakeholder group)	Attitudes about pain, fear, and vaccination
Knowledge (any stakeholder group)	Knowledge about effective interventions for pain, fear, and fainting
Competence	Health provider education; skill competency



THE CARD SYSTEM

These four strategies will help you with your vaccination. Use the suggestions on the back to fill in the cards. Cut them out and carry them with you so you can remind yourself wherever you are.



<p>WHAT DISTRACTIONS WILL YOU USE?</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>WHAT WILL YOU DO TO RELAX?</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>WHAT WILL YOU ASK?</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>HOW WILL YOU BE COMFORTABLE?</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>
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HOW TO DISTRACT YOURSELF

- Talk to someone.
- Play video games.
- Read books.
- Play music.
- Rub your arm.
- Sing.
- Allow yourself to daydream.

HOW TO RELAX

- Do belly breathing (pretend to blow out a candle).
- Do some self-talk (tell yourself you can handle this).
- Have a friend with you.
- Have a family member or trusted adult with you.
- Have privacy.

QUESTIONS TO ASK

- What will happen on my turn?
- What vaccine am I getting?
- Can I ...
 - get the vaccine in a private room?
 - use numbing creams or patches?
 - bring my friend?
 - bring a family member?
 - bring a trusted adult?
 - look at the needle?

HOW TO GET COMFORTABLE

- Wear short sleeves, or something that lets you show your upper arm easily for the needle.
- Eat a snack.
- Bring a favourite item.
- Sit up in a chair.
- Make your arm loose or jiggle (like cooked spaghetti).
- Tense your stomach and leg muscles if you get dizzy.

Figure 2. The figure is also available online as a full-sized, downloadable resource.

checklist; and 6) process checklist. Qualitative methods (informal feedback/debriefs, focus group interviews) were selected as the approaches to evaluate satisfaction and supplement quantitative data.

An audit was conducted to benchmark current practices and included documentation of pain and fear interventions used

during vaccinations and student symptom scores. From these audits, the group identified goals for improvement. Separately, existing policies and processes of delivery in the school-based vaccine program were reviewed by the implementation team to examine alignment with identified needs, preferences, and opportunities for change.

Preparing for vaccinations at school:

A guide for school staff

Vaccines are medicines that teach the body to recognize germs that cause diseases. If the body comes in contact with the germs in the future, it will be able to stop them.

Most vaccines are given with a needle. This can be painful or scary for some children and may discourage them from getting vaccinated. Use this factsheet to help prepare students for a vaccination at school.

Before clinic day

- Teachers attend student education sessions by the school nurse and reinforce messages.
- Teachers help with the completion, return and safe storage of the signed consent form by the student and legal guardian.
- Teachers work with students and the school nurse to identify and accommodate student requests from the **CARD** system.
- Teachers practise the **CARD** system (**C**omfort, **A**sk, **R**elax, **D**istract) with students to help them cope during vaccination:

C Comfort

- The student can ...
 - sit upright during the needle.
 - wear short sleeves, or something that lets them show their upper arm easily.
 - relax their arm.

A Ask

- Ask the student about their preferences to make the needle more comfortable. For example, does the student want to ...
 - bring a friend or a trusted adult?
 - get the needle in a private room?
 - use numbing creams or patches? These are medicines that dull the pain where the needle enters the skin. These take some time to work, so parents need to plan ahead.

R Relax

- The student can take deep belly breaths before, during and after the needle. This is like blowing up a balloon or blowing out candles. The belly should move out when breathing in and move in when breathing out.

D Distract

- The student can talk to someone or bring an object to get their mind off the needle (for example, music, game or book). Some students like to look at the needle – this is OK too. The student can let the nurse know their preferences.



Figure 3a. The figure is also available online as a full-sized, downloadable resource.

Step 3: Selecting and tailoring intervention tools and processes for the local context

The results from Step 2 coupled with our CPG recommendations (8) were used to inform the development of an evidence-based multifaceted KT intervention called The **CARD**TM System (C-Comfort, A-Ask, R-Relax, D-Distract). **CARD**TM provides a framework for planning and delivering vaccinations using a student-centered approach. Each letter of the word (i.e., C, A, R, and D) represents a different category of interventions that can help guide planning and delivery of vaccinations

in order to optimize the student experience and coping. Important vaccination planning activities include: 1) securing appropriate spaces for vaccination clinics such as the school library, 2) confirming that these spaces are available and that individuals are aware of upcoming vaccination days, 3) educating students using **CARD**TM educational resources, and 4) having students select their preferred coping strategies using the student **CARD**TM pamphlet. Important vaccination day activities include: 1) setting up the clinic to minimize visual cues that promote fear and spreading of fear to others, 2) visiting

On clinic day

- Allow time for a snack before vaccination.
- Use the **CARD** system to make the needle more comfortable: Allow students to bring supplies they need to distract themselves, such as personal devices.
- Foster a calm environment. Work with the nurse to help children stay calm and ensure an orderly flow through the vaccination clinic.
- Identify for the nurse any students that have special requests (such as privacy or the company of a friend during vaccination).
- Monitor students when they return to class and send any students who are feeling unwell back to the nurse with a buddy.



Serious adverse events following a vaccine

If a student experiences a serious adverse event after the nurse has left the school, follow school protocol (call emergency services or send student home with recommendation to contact family physician).

Some signs and symptoms of serious adverse events may include, but are not limited to:

- Flushed face, hives, and/or itching
- Swelling of the eyes, lips, face or tongue
- Difficulty breathing
- Dizziness and/or headache
- Nausea and/or vomiting

**For more information, talk to your school nurse or contact:
Niagara Region Public Health Vaccine Preventable Disease Program
905-688-8248 ext. 7425
Toll free: 1-888-505-6074**



aboutkidshealth
Trusted answers from The Hospital for Sick Children

SickKids

Figure 3b. The figure is also available online as a full-sized, downloadable resource.

the classroom to introduce clinic staff and remind students of CARDTM, 3) identifying and triaging students with fear and special requests, and 4) using CARDTM during interactions with students.

On vaccination day, nurses explicitly ask students about their level of fear and what 'CARDS they want to play' to help them cope. They then support students in their choices. With CARDTM, students are invited to actively participate in their health care and *play/select* specific strategies within the four different letter categories according to their preferences. For example, a student may choose to play an 'A' and Ask to be vaccinated in private rather than in front of their peers and/

or 'D' and bring an electronic device to serve as a Distraction. Afterwards, students are asked about their vaccination symptoms (i.e., fear, pain, dizziness). Importantly, with CARDTM, bundling of interventions is possible in that students can play *multiple CARDS at the same time*. CARDTM allows students to take charge of their pain and fear and choose interventions that meet their individual needs.

Two student team members were integral to development of this KT intervention and associated resources. The role of each of them will be briefly described. The first one (ANTI, 17 years old) created the name CARDTM to capture the principles of the KT intervention in an engaging and intuitive framework for

Preparing children for school vaccinations:

A parent's guide

Vaccinating your child at school is convenient and effective. Vaccines are medicines that teach the body to recognize germs that cause diseases. If the body comes in contact with the germs in the future, it will be able to stop them.

Most vaccines are given with a needle. This can be painful or scary for some children and may discourage them from getting vaccinated. Use this factsheet to help prepare your child for a vaccination. It includes information about what to expect and how to be ready.

Talk to your child about...

- What will happen: "You will get a vaccine to keep you healthy. The vaccine goes in your arm with a needle."
- How the needle will feel: "There may be a pinch, some pushing or pressure for a few seconds. It bothers some kids, but others think it is ok."
- How your child can increase comfort using the **CARD** system (**C**omfort, **A**sk, **R**elax, **D**istract): "The nurse will do some things so that the needle doesn't bother you. You can do some things too. Use the **CARD** system. We can practise at home."

The CARD system:

C Comfort

- Your child can sit upright during the needle and relax the arm.

A Ask

- Ask your child how to make the needle more comfortable. For example, does your child want to ...
 - bring a friend or a trusted adult with them?
 - get the needle in a private room?
 - use numbing creams or patches? These are medicines that parents can buy at the pharmacy without a prescription. They dull the pain where the needle enters the skin. They take some time to work, so plan ahead. They're safe for all ages.

R Relax

- Your child can take deep belly breaths before, during and after the needle. This is like blowing up a balloon or blowing out candles. The belly should move out when breathing in and move in when breathing out.

D Distract

- Your child can talk to someone or bring an object to get their mind off the needle (for example, music, game or book). Some children like to look at the needle – this is OK too. Your child can let the nurse know his or her preferences.



Figure 4a. The figure is also available online as a full-sized, downloadable resource.

users. Both students were involved in creating two videos that addressed student-prioritized educational gaps (i.e., procedural preparation and coping with pain, fear, and fainting) (16). The first video (4 minutes) (<https://youtu.be/z57vTpb19wQ>) provides basic information about vaccines; this video instructs students on what a vaccine is and how it works, side effects of vaccines, and the process for school-based vaccinations, including consent and what will happen on the day of vaccination. The second video (7 minutes) (<https://youtu.be/c41HvgEKQSk>) instructs students in the CARD™ mnemonic. Vignettes of

students undergoing vaccination with demonstrations of the different interventions are included. Both student team members scripted the videos and the second student team member (ALTI, 13 years old) narrated them.

Three separate companion pamphlets were developed to complement the videos for students, school staff, and parents, respectively (Figures 2–4). A poster was also created for schools (Figure 5). The student CARD™ pamphlet includes examples of strategies for each letter of the word and fill-in-the-blank spaces so that students can record the interventions they want

Special tip for children who get dizzy or faint during needles

Your child can sit and tense their leg and stomach muscles until they feel warm in the face like they are blushing (10-15 seconds). Then they can release the muscle back to normal for 20-30 seconds. Repeat 5 times. Do not tense the arm where the needle goes in - keep it loose and jiggly.

Prepare your child...

- Sign the permission form with your child and return it to the school. Your child will be asked to agree again on the day of vaccination.
- Work with your child, public health department and school if you have any questions or if you are using strategies from the **CARD** system that require planning (such as privacy, numbing creams or patches).

Tips for your child on vaccination day...

- Try to eat something before vaccination.
- Wear short sleeves or something easy to pull up so that the upper arm can be reached easily.
- Use the **CARD** system to make needles more comfortable: **C**omfort, **A**sk, **R**elax, **D**istract. Bring any supplies you need, such as something to distract the mind or numbing cream.
- Be calm and positive and help other children who might be nervous.

What can you expect after the needle?

- Sometimes there are minor side effects like pain, swelling or redness of the arm. This is normal and does not last very long (a few minutes to a few days). It should not prevent your child from doing any activities.
- If you notice a change in your child's health that worries you, contact your healthcare provider or public health department.

**For more information , talk to your school nurse or contact:
Niagara Region Public Health Vaccine Preventable Disease Program
905-688-8248 ext. 7425
Toll free: 1-888-505-6074**



Figure 4b. The figure is also available online as a full-sized, downloadable resource.

to use for their upcoming vaccination. The parent and school staff pamphlets include information regarding vaccination and CARD™. Of note, videos and pamphlets were selected as the primary delivery methods for education of stakeholders to comply with preferences as well as maximize the standardization of messaging and enhance portability (e.g., feasible access across settings).

A toolkit was created for The CARD™ System to support implementation. Identified opportunities for integration and alterations in existing workflow processes and activities were

discussed and a preliminary implementation plan was proposed. A summary of components of the toolkit, targeted stakeholder group, and time of implementation relative to vaccination are described in Table 2. Of note, one of the included tools is a template communication and planning checklist to be used by nurses in clinic planning and execution that incorporates The CARD™ System (Figure 6).

With respect to implementation timing, it is important to note that in many jurisdictions, public health nurses already routinely visit schools to plan vaccination clinics, educate



THE CARD SYSTEM

These four strategies can help you with your vaccination.



HOW TO GET COMFORTABLE

Wear short sleeves, or something that lets you show your upper arm easily for the needle.

Eat a snack.

Bring a favourite item.

Sit up in a chair.

Make your arm loose or jiggle (like cooked spaghetti).

Tense your stomach and leg muscles if you get dizzy.

QUESTIONS TO ASK

What will happen on my turn?

What vaccine am I getting?

Can I ...

- get the vaccine in a private room?
- use numbing creams or patches?
- bring my friend?
- bring a family member?
- bring a trusted adult?
- look at the needle?

HOW TO RELAX

Do belly breathing (pretend to blow out a candle).

Do some self-talk (tell yourself you can handle this).

Have a friend with you.

Have a family member or trusted adult with you.

Have privacy.

HOW TO DISTRACT YOURSELF

Talk to someone.

Play video games.

Read books.

Play music.

Rub your arm.

Sing.

Allow yourself to daydream.



Figure 5. The figure is also available online as a full-sized, downloadable resource.

students about vaccination and distribute consent forms; this typically occurs 1-4 weeks prior to vaccination clinics. The current standard of practice in Niagara Region Public Health consists of vaccine education that focuses on information about

the diseases and vaccines. Guided by student learning needs identified in extant literature and the results from Steps 1 and 2, we proposed reducing the amount of time allocated to diseases and vaccines and adding information about what will happen

SAMPLE TEMPLATE CHECKLIST FOR PUBLIC HEALTH FOR INTERVENTION SCHOOL CLINICS

All items below are being tracked as part of planning, executing and fidelity checks. Associated time for key activities will also be tracked using public health usual time management processes.

School: _____ Phone: _____
 Principal: _____ Fax: _____
 Contact Person: _____ School Nurse: _____

	Procedures	Rd #1	Rd #2
1.	<p>Clinic planning: Contacted principal via e-mail, phone call or face-to-face to organize information for immunization clinic (late August)</p> <p><input type="checkbox"/> Date confirmed for clinics: _____</p> <p><input type="checkbox"/> Date and time for immunization teaching (if not organized with teacher): _____, Date, time and person scheduled with: _____</p> <p><input type="checkbox"/> Allowing 1 period or 2 periods? _____</p> <p><input type="checkbox"/> Time of am recess: _____ Time of lunch: _____</p> <p><input type="checkbox"/> Room of clinic: _____ Space/Room to accommodate privacy (this includes a space for the student to lay down if necessary, room for 3-4 individuals and no clear (see-through) walls/windows): _____</p> <p><input type="checkbox"/> Principal agreed to have equipment available for clinic day (tables, chairs, gym mats, gym balls).</p> <p><input type="checkbox"/> Space/room and how to accommodate students waiting: _____</p> <p><input type="checkbox"/> Supplies available to occupy students while waiting: _____</p> <p><input type="checkbox"/> Reviewed educational materials with principal (e.g., videos, slides, pamphlets)?</p> <p><input type="checkbox"/> Distributed educational material to Principal for school staff and set up time for staff to review material (videos, other) – e.g., staff meeting, other. Date/time: _____</p> <p>Principal confirmed procedures to accommodate:</p> <p><input type="checkbox"/> electronic devices (If No, alternative – e.g., school ipads) Yes/No</p> <p><input type="checkbox"/> parent support</p> <p><input type="checkbox"/> peer support</p> <p><input type="checkbox"/> topical anesthetics</p> <p><input type="checkbox"/> food availability</p>		

Figure 6a. The figure is also available online as a full-sized, downloadable resource.

during vaccination (procedural information) and how to cope (pain, fear, and fainting mitigation strategies). On vaccination day, proposed changes focused on planning for a suitable clinic environment and processes, including; minimizing visual cues that elicit fear, and implementing student-directed interventions to minimize pain, fear, and fainting.

Within the Action cycle of the KTA framework, the next step consisted of finalizing the multifaceted KT intervention and implementation plan. Focus group interviews were repeated with all stakeholder groups to solicit feedback about the key KT tools (two videos, three pamphlets) and implementation approaches (17). Feedback was overwhelmingly positive. In addition, evaluation of the impact of the KT tools on conceptual knowledge and attitudes about fear and pain demonstrated significant improvements post review of the KT tools.

Minor edits were made to the videos and pamphlets to address feedback.

Discussions were held with the implementation planning and execution team to identify priorities and create an action plan. Informed by the fishbone diagram, existing policies and work processes were collaboratively reviewed and altered to align with the proposed changes. Then, the implementation plan and KT tools were presented to the entire project team and approved. An educational workshop was prepared to train relevant front-line public health unit staff (i.e., injecting [and charge] nurses, school liaison nurses) involved in school vaccinations. Managers and researchers were present and delivered aspects of the program. The training included review of: rationale for the project, scientific evidence, alignment with organizational values/mission, relevant policies and work processes,

<p>Principal agreed to place immunization teaching date and immunization clinic dates on:</p> <ul style="list-style-type: none"> <input type="checkbox"/> School calendar. <input type="checkbox"/> Short newsletter insert. <input type="checkbox"/> PA announcement to be made on the day prior to and on the day of clinic. <input type="checkbox"/> Send e-mail blast to grade ___ students' families prior to clinic date to include reminders. <input type="checkbox"/> Principal e-mail template provided. <input type="checkbox"/> Principal stated he/she wishes staff can participate during clinic by: _____ (e.g., identify students with special needs, practice and review CARD with students) <input type="checkbox"/> Communicated with injecting charge nurse via e-mail. <input type="checkbox"/> Parent support during clinic – organization and/or presence. <input type="checkbox"/> Updated nurse's checklist and e-mailed to the vaccinating charge RN. Charted information on EMR/Profile. 		
<p>2. Organized immunization teaching:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Contacted teacher(s) to organize date of immunization teaching (if not completed with principal). Date/time: _____ <input type="checkbox"/> Organized a date for a second visit after teaching for Q&A and check consent forms. Date/time: _____ <input type="checkbox"/> Reviewed with teacher: <ul style="list-style-type: none"> <input type="checkbox"/> Layout of presentation discussed. <input type="checkbox"/> Review materials with teacher prior to teaching. <input type="checkbox"/> Teacher states the number of students in classroom. (specify per class and total in school for applicable grades) Grade __: # _____ Grade __: # _____ <input type="checkbox"/> Teacher provided class list. <input type="checkbox"/> Teacher to change class activity for vaccination clinic day to a non-stressful activity (e.g., playing a movie, working on a fun activity etc.) <input type="checkbox"/> Charted information on EMR/Profile. 		
<p>3. In-class teaching:</p> <ul style="list-style-type: none"> <input type="checkbox"/> All materials brought to teaching. <input type="checkbox"/> Class teacher present during teaching. (specify per class and total in school for all applicable grades) Grade __: # _____ <input type="checkbox"/> Engaged in teaching. Yes/No If No, explain: _____ Grade __: # _____ <input type="checkbox"/> Engaged in teaching. Yes/No. If No, explain: _____ <input type="checkbox"/> Education provided to students about vaccination and CARD system. <input type="checkbox"/> Number of students that received education? _____ Students that were absent? _____ 		

Figure 6b. The figure is also available online as a full-sized, downloadable resource.

videos, pamphlets, and point of care resources. Detailed case scenarios were incorporated into the training to allow for discussion and practice. During the training, nurses provided additional comments (captured in focus groups) (17) and then the implementation plan was finalized.

Step 4: Implementing interventions and monitoring knowledge use and outcomes

The next step in the Action cycle included executing the multifaceted KT intervention to promote awareness and uptake of the interventions during school-based vaccinations. We rolled out the implementation in two phases. In the initial phase, we undertook a limited implementation of CARD™ whereby we showed the two videos and student pamphlet (Figure 2) to some grade 7 students in a Toronto school in a focus group

prior to and after their school vaccinations and monitored knowledge use, acceptability, and impact on the vaccination experience (18).

In the second phase, we implemented the entire multifaceted KT intervention program (The CARD™ System) for grade 7 vaccinations in a controlled clinical trial involving 10 Niagara region schools (5 CARD intervention schools and 5 control schools without any changes to usual care) and evaluated impact on all prioritized outcomes. We demonstrated improvements in student symptoms (e.g., fear, dizziness) and increased utilization of interventions to reduce student symptoms (e.g., distractions, peer support). There was satisfaction with the KT intervention and support for continuing it beyond the project. There was no evidence of an impact on vaccination rate (19,20).

<ul style="list-style-type: none"> <input type="checkbox"/> All case scenarios (practice) reviewed? If NO, which did you review? _____ <input type="checkbox"/> Time allowed for Q&A. <input type="checkbox"/> Questions by students regarding needle fear. # _____ <input type="checkbox"/> CARD pamphlets filled in by students. # _____ <input type="checkbox"/> Teacher reminded of return visit date for consent checking and extra Q&A period. (explain: _____) <input type="checkbox"/> Note made of which students were absent during teaching. Subject number of absent students (for tracking purposes): _____ <input type="checkbox"/> Asked teacher to review information with students who are absent. <input type="checkbox"/> Logged the "C", "A", "R," "D" requests by each student in the classroom to flag highly anxious students, topical anesthetic use, privacy, and friend requests. <input type="checkbox"/> Logged self-identified and teacher-identified students who are anxious/worried about the upcoming school vaccinations. <input type="checkbox"/> Communicated to injecting charge nurse post teaching. <input type="checkbox"/> Charted information in EMR/Profile. 		
<p>4. Consent Check/ Extra Q & A:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Revisited classroom to check consents. Date: _____ <input type="checkbox"/> Reviewed CARD with students absent from teaching. <input type="checkbox"/> Reviewed case scenarios not reviewed in initial teaching. <input type="checkbox"/> Secretary provided 2 class lists per class. <input type="checkbox"/> Reviewed consents for blue/black pen, signatures from both student and parent/guardian, teacher's name, and that all boxes are filled out whether answer is "yes or no". <input type="checkbox"/> Consents organized in alphabetical order. <input type="checkbox"/> Worked with teacher to flag students who have anxiety, special needs, require privacy or peer support in regards to the vaccine. <input type="checkbox"/> Flagged student consent forms of those who have anxiety about the vaccine. <input type="checkbox"/> Extra Q&A provided for students? <input type="checkbox"/> Follow up with teacher if they were able to provide vaccine information to absent students from in-class teaching. <input type="checkbox"/> Reminded students about immunization clinic protocols and procedures, to wear a short sleeved shirt, eat breakfast prior to clinic, bring distraction aids and CARD. <input type="checkbox"/> Remind principal to send out e-mail blast to parents. <input type="checkbox"/> Provided template email to principal. <input type="checkbox"/> Numbered consents with Subject number (for tracking purposes). <input type="checkbox"/> Charted information in EMR/Profile. 		
<p>5. Clinic Day setup:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Collected consent forms from classroom teacher to assist injecting charge nurse in organizing and allowing injecting nurse to make phone calls if necessary. <input type="checkbox"/> Brought distraction kit to clinic. <input type="checkbox"/> Brought 2 emergency kits to clinic to accommodate for private space. 		

Figure 6c. The figure is also available online as a full-sized, downloadable resource.

Postimplementation feedback led to the creation of a separate 12-minute educational video after the completion of the project targeted to public health and school staff about CARD™ (<https://youtu.be/FXj6ELi4BVg>). In it, the different elements of CARD™ are reviewed and demonstrated, including vignettes of students undergoing vaccination using the CARD™ approach. This video is intended to be used as an additional resource to support CARD™ training and implementation.

SUMMARY

Our 2015 CPG provides recommendations for reducing pain, fear, and fainting associated with vaccine injections (8); however, included KT tools do not address how to implement the recommendations in school-based vaccination clinics. Guided by the KTA (11) and CFIR (12) frameworks, we used an

integrated KT approach (13) and worked with the relevant stakeholders to identify ways to embed the CPG (8) into school-based vaccination programs.

In this manuscript, we provided an overview of the project and described our approach to creating a multifaceted KT intervention (The CARD™ System) that translates our CPG (8) recommendations to the school vaccination context. This involved adapting knowledge to the local context, assessing barriers to knowledge use, selecting, tailoring and implementing interventions, and evaluating knowledge use and impact on the vaccination experience and other vaccination program delivery outcomes.

The CARD™ System is a framework for planning and delivering vaccinations that promotes student-centred care and coping. CARD™ integrates procedural information and a simple mnemonic to teach students about how to cope with

<ul style="list-style-type: none"> <input type="checkbox"/> Ensured food is available (e.g., food program, or faint kit). Where is the food available? _____ <input type="checkbox"/> Ensured mats and gym balls are available for main clinic and private room. <input type="checkbox"/> Clinic room is same as what was planned with Principal. If not, specify: _____ <input type="checkbox"/> Separated clinic tables/workstations that are in main clinic space so that students are not too close to one another <input type="checkbox"/> Set up tables so that clinic stations have children facing away from each other. <input type="checkbox"/> Dispersed table dividers and distraction kit items among clinic stations. <input type="checkbox"/> Put opaque covering (e.g., paper) for clinic door windows. <input type="checkbox"/> Put sign on door to prevent interruptions (e.g., "library closed for vaccine clinic"). <input type="checkbox"/> When clinic was ready to commence, visited classroom(s) to introduce nursing staff, review clinic processes and CARD, answer last minute questions, remind students to bring any distraction aids, and confirm CARD choices. <input type="checkbox"/> Worked with teacher to identify/confirm students with special requests (e.g., privacy, peer support, other). <input type="checkbox"/> Organized students based on which should be accommodated for vaccines first based on CARD pamphlet request log (e.g., fearful students first, those students who require privacy, those students who have placed topical anesthetic etc.). <p>School Staff involvement:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Discussed with school staff how they will assist the clinic. <input type="checkbox"/> Roles of school staff include: <ul style="list-style-type: none"> <input type="checkbox"/> Identifying students with special needs. Yes/No <input type="checkbox"/> Sending students to and from the clinic. Yes/No <input type="checkbox"/> Being available to support the students as needed. Yes/No <input type="checkbox"/> Practice and review CARD system with students. Yes/No <input type="checkbox"/> Minimize distress-promoting behaviours. Yes/No <input type="checkbox"/> Minimize clinic interruptions. Yes/No <input type="checkbox"/> Charted information in EMR/Profile. <p>Vaccination procedure:</p> <ul style="list-style-type: none"> <input type="checkbox"/> Supported the clinic by organizing the students, facilitated the flow of the clinic and monitored student's pre and post immunization, and supported nurses when required. (Students to return to classroom directly after immunization with partner, if in private- one nurse to escort student back to classroom). <input type="checkbox"/> Managed and distracted students in waiting area (attempt to de-escalate nervous energy, dissuade inappropriate conversations among students). <input type="checkbox"/> Asked each child to rate their fear on a 0-3 scale before immunizing. <input type="checkbox"/> Asked each child which CARD strategies he/she would like to use. <input type="checkbox"/> Asked students to fill in Student symptom survey with student symptoms. <input type="checkbox"/> Filled out the Nurse checklist for each student with vaccination details. <input type="checkbox"/> Charted students that returned to clinic because they were feeling unwell. <input type="checkbox"/> Students returned to class in pairs after completing symptom survey. <input type="checkbox"/> Nurses debriefed after end of clinic (specify who participated). 		
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Figure 6d. The figure is also available online as a full-sized, downloadable resource.

pain, fear and fainting during vaccination. Key tools from this project are being shared to facilitate uptake more broadly (Table 2, Supplementary Appendix Figures). While developed within the southern Ontario context, intervention components are transferable to other health units and settings. The two videos, for example, can be shown to students in classrooms without public health nurses present (as was done in our first implementation project; described in a subsequent article in this series) (18). When arranging for clinics, nurses can ensure that physical spaces and processes are used that are conducive to reducing fear, including; minimizing visually fearful cues, securing a private space for students that do not wish to be vaccinated in front of peers, and enabling students to use distractions. On the day of vaccination, injecting nurses can bring table top posters/dividers and distraction agents. They can ask students about their level of fear immediately before vaccination and use the language of CARD™ to

interact with and coach them during vaccination. The appealing language facilitates communication among students and adults and enables all to become engaged partners in the pain management process (21). Addressing student concerns about pain and fear also demonstrates to them that nurses care and contribute to building trusting relationships (22).

Even if students are not vaccinated at school, they can benefit from education about CARD™. They learn skills for coping with pain, fear and fainting. They also learn how to support others, including their peers or siblings, who are being vaccinated at school. It is important to note that CARD™ is not specifically intended for students with needle phobia; these individuals typically require the expertise of providers trained in anxiety disorders (e.g., psychologists) before they can undergo vaccine injections.

Some additional resources are required to deliver CARD™, primarily related to personnel time allocated for vaccination

Table 2. Components of the multifaceted Knowledge Translation (KT) intervention (The CARD™ System)

CARD™ resources	Description of resource	Implementation	Implementation
		Prior to vaccination	On vaccination day
Video 1 – What you need to know about vaccines at school	4-min video describing vaccination and the process for school vaccination clinics. This video is shown to students by school nurse* at school during a classroom lesson (https://youtu.be/z57vTpb19wQ)	+	–
Video 2 – The CARD™ System: Play your power CARD™	7-min video describing CARD™ with vignettes of students demonstrating the different interventions. This video is shown to students by school nurse* at school during a classroom lesson (https://youtu.be/c41HvgEKQSk)	+	–
Slide presentation	Overview of vaccines offered during school clinics and practice case scenarios for CARD™ reviewed with students by school nurse* at school during a classroom lesson	+	–
Factsheets for students	CARD™ pamphlet with fill-in-the blank space for students to record preferred interventions. This pamphlet is reviewed with students by school nurse* at school during classroom teaching and is used for clinic planning (Figure 2)	+	+ / –
Factsheets for school staff	CARD™ and vaccine process pamphlet given by school nurse* to teachers and other school staff (Figure 3)	+	–
Posters for school	CARD™ poster given by school nurse* to teacher for classroom (Figure 5)	+	+
Factsheets for parents	CARD™ and vaccine process pamphlet given to students by school nurse* to bring home with vaccine consent forms (Figure 4)	+	–
Point of care tool for nurses	Communication and planning checklists for pre-vaccination day (e.g., securing a private space, permission for use of personal electronic devices, vaccination day reminders) and vaccination day (e.g., separate waiting and vaccination area, triaging students, using CARD™ during vaccination) activities to be used by school nurse* and injecting nurse (Figure 6)	+	+
Assessment and management	Assessment of student level of fear prior to vaccination and implementation of student-selected CARD™ strategies during vaccination by injecting nurse	–	+
Table poster/divider	Table poster/divider with picture of the word ‘CARD’ to obstruct needle preparation by injecting nurses and serve as cue to students and injecting nurses to discuss and use CARD™	–	+
Distraction toolkits	Distraction toolkits for all vaccine clinic workstations – contents include spinners, bubble pens, pipe cleaners	–	+
Presence of school nurse	School nurse* presence at all vaccine clinics (familiar face for students and school staff); assist with clinic flow, support students and injecting nurses, liaise with school staff	–	+
Audit and Feedback from vaccine clinics	Student symptom survey (pain, fear, dizziness-precursor of fainting) (Supplementary Appendix 3); Injecting nurse checklist of interventions used, number of injections administered (Supplementary Appendix 4) Process issues documentation checklist, including number of students returning to clinic because feeling unwell (Supplementary Appendix 6)	–	+

Table 2. *Continued*

CARD™ resources	Description of resource	Implementation	Implementation
		Prior to vaccination	On vaccination day
Internal Champions	School nurse* and injecting nurse assigned to study to network with team members to promote best practices, answer project questions, liaise with managers regarding project	+	+
Training material resources for front-line public health staff	Resource Binder used for training session with school nurses* and injecting nurses. Includes: scientific evidence, alignment with organization mission/values, policies and work processes, video links, slide presentation, point of care tools, pamphlets, case scenarios, contact information of project champions, certificate of attendance	+	-
Video 3 – Improving the vaccination experience at school **	12-min training video for public health and school staff describing CARD™, including; planning and vaccination day activities with vignettes of students undergoing vaccination and testimonials (https://youtu.be/FXj6ELi4BVg)	+	-

+ = Yes; - = No.

*School nurses are nurses that are assigned to individual schools. They are familiar with the physical layout of the schools and have a working relationship with school staff and students. They typically organize and attend the first vaccination clinic. Some public health units may not have a school nurse and other individuals would carry out these activities.

**This video was created at the end of the project to support future training and implementation.

planning (securing adequate spaces and conditions, education of students, planning for student requests) and photocopying CARD™ pamphlets for students. We note, however, that after the project was completed, Niagara Region Public Health adopted CARD™ across the entire school vaccination program, including approximately 150 schools, without any commensurate changes to staffing levels.

Involvement of external stakeholders is highly recommended to optimize implementation success. To this end, we suggest that public health units providing school vaccination services review their current processes and work with the different stakeholders in their communities, particularly school staff, to determine how best to incorporate these recommendations in their school vaccination programs to improve the vaccination experience at school. School staff can assist with delivery of the education (e.g., if public health nurses are not present in the school and/or students are absent during public health classroom lessons) and reinforce learning.

Finally, it is important to note that this multifaceted KT intervention is consistent with accepted frameworks for health care (patient-centred care, UNICEF's ladder of participation) (23,24) and education (25) that call for student involvement. It also addresses students' most pressing concern about vaccination—the needle. Students learn to manage fear and pain which represent important life skills.

In the next five papers in this series, we describe the details of the development and testing of this multifaceted KT intervention for the school vaccination setting (16–20). By sharing the

processes, key tools and findings from this project, we hope to inform others looking for an evidence-based KT intervention to improve vaccination delivery with a model to use. CARD™ can be tailored to children of different ages and across geographical and medical settings where vaccinations (and other needle procedures) are undertaken. Individuals and organizations wishing to customize CARD™ for their own setting, including the interventions included in the different categories, are encouraged to contact investigators for additional information and to use tools (see also aboutkidshealth.ca/CARD).

SUPPLEMENTARY DATA

Supplementary data are available at *Paediatrics & Child Health Online*.

ACKNOWLEDGEMENTS

The authors thank the students and parents who participated in this project. We also thank the staff at Niagara Region Public Health and The Niagara Catholic District School Board for their commitment to improving the quality of care provided at their respective organizations.

Funding Information: This project was funded by the Canadian Institutes of Health Research Knowledge to Action Grant (KAL-147564).

Potential Conflicts of Interest: AT reports Section 9 Trademark No. 924835 for CARD. LMB reports that Immunize Canada received grants from Pfizer Canada, Merck Canada, GSK Canada, Seqirus Canada and Sanofi Pasteur outside the submitted work. There are no other disclosures. All authors have submitted the ICMJE Form for

Disclosure of Potential Conflicts of Interest. Conflicts that the editors consider relevant to the content of the manuscript have been disclosed. *Pain Pain Go Away Team*: Tamlyn Freedman BAS¹, Tori McDowall RN⁶, Horace Wong MSc¹, Kate Robson⁷, Christine Halpert RN MA⁸, Evelyn Wilson MAEd BPHE⁹, Jocelyn Cortes RN¹⁰, M. Mustafa Hirji MD MPH⁶, Cathryn Schmidt², Srdjana Filipovic PhD², Melanie Badali PhD¹¹ ¹Leslie Dan Faculty of Pharmacy, University of Toronto, Toronto, Ontario; ²The Hospital for Sick Children, Toronto, Ontario; ⁶Niagara Region Public Health & Emergency Services, Thorold, Ontario; ⁷Canadian Family Advisory Network; ⁸British Columbia Centre for Disease Control; ⁹Ontario Institute for Studies in Education, University of Toronto; ¹⁰Ontario Ministry of Health and Long-Term Care; ¹¹AnxietyBC, Vancouver, British Columbia

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