

Stakeholders' experiences with school-based immunization programs during the COVID-19 pandemic in the Canadian Maritimes: A qualitative study

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ABSTRACT

Background: School-based immunization programs (SBIP) support access to routine vaccines for adolescents. Across Canada, the COVID-19 pandemic and subsequent public health measures affected SBIP and vaccine uptake. The objectives of this study were to explore 1.) stakeholders' experiences with SBIP and changes to programs during COVID-19 in Nova Scotia, Prince Edward Island and New Brunswick, and 2.) how the pandemic affected parents' and adolescents' vaccine views.

Study design: Semi-structured interviews with decision makers, healthcare providers, teachers, parents and adolescents between February–August 2023.

Methods: The COM-B model and Theoretical Domains Framework informed interview guides. Deductive and inductive analyses saw participant quotes mapped to relevant model components and domains by two coders. Belief statements were generated within each stakeholder group then compared to identify themes and subthemes.

Results: Participants (n = 39) identified five themes: 1) enablers to SBIP delivery, 2) barriers to SBIP delivery, 3) desired changes to SBIP delivery, 4) student anxiety, and 5) vaccination views and changes since the COVID-19 pandemic. Public health measures facilitated more space for clinics, as did taking smaller cohorts of students. School staff-healthcare provider relationships could help or hinder programs, particularly with high turnover in both professions during the pandemic. Adolescents played a passive role in vaccine decision making, with mothers often being the sole decision maker. We did not identify any changes in hesitancy towards routine vaccines since the pandemic.

Conclusions: We identified a range of barriers and enablers to SBIP, many of which were exacerbated by the pandemic. Efforts are needed to ensure SBIP and catch-up programming remains accessible for all adolescents to catch-up on missed vaccines before graduation. Parents and adolescents' vaccination views suggest changes in vaccine coverage since the pandemic may be due to accessibility of services rather than vaccine hesitancy. Future research is needed to engage adolescents in their vaccine decisions.

What This Study Adds:

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- Staff shortages in health and education sectors affected school vaccine programming, and vulnerable adolescents may have missed vaccinations as a result.
- We identified a strong desire among stakeholders to expand school vaccine programming to include a meningococcal B vaccine prior to high school graduation.
- The COVID-19 pandemic did not have a substantial effect on parents' and adolescents' views towards routine vaccines in our sample.

Implications for Policy and Practice:

- There is a need for public health to offer catch-up programming in high schools and the community in upcoming years to reach remaining unvaccinated adolescents prior to graduation.
- Healthcare providers may benefit from engaging with school staff during professional development days to build and sustain interpersonal relationships to support school vaccine clinics.
- Interventions are needed to actively engage adolescents in their vaccine and health decisions to support their transition into young adults.

1. Introduction

As over 98 % of adolescents are enrolled in school across Canada, school-based immunization programs (SBIP) provide an accessible route to vaccination for most adolescents [1]. As healthcare delivery is a provincial/territorial jurisdiction, SBIP in Canada vary in the vaccinations offered, grades they are offered in, and healthcare providers (e.g., registered nurses [RN], licenced practical nurses [LPN], pharmacists) involved in program delivery [2]. Programs are typically offered in adolescence at no cost to families and include at least a meningococcal vaccine, a tetanus, diphtheria and pertussis (Tdap) vaccine and two doses of HPV vaccines [2,3]. SBIP have been associated with improved vaccine uptake compared to community-based services [4]. Despite SBIP benefits, persistent challenges have affected programs, including parental concerns with HPV vaccines [5,6], languishing consent form return [6,7], difficult relationships between health and education sectors [8], and inaccessibility to adolescents not enrolled in school [9]. These challenges can lead to inefficient clinics and interfere with attaining the National Immunization Strategy's goal of 90 % uptake of adolescent vaccines by 2025 [10].

The COVID-19 pandemic and subsequent public health measures (PHM) required schools to switch from in-person to online or hybrid learning to minimize disease transmission [11]. This shift away from in-person learning disrupted SBIP across Canada [12]. Vaccine coverage drastically decreased across the country, including completed HPV uptake rates dropping to single digit percentages in Ontario (5.8 %) and Alberta (5.6 %) in 2019/2020 [13,14]. However, efforts to describe the pandemic's effects on SBIP in the Maritimes has yet to occur. The Maritime provinces (i.e., Nova Scotia [NS], Prince Edward Island [PEI] and New Brunswick [NB]) experience higher rates of rural living and poverty compared to other regions in Canada [15,16], which further highlight the importance of accessible SBIP services. SBIP in NS offer HPV, Tdap, meningococcal quadrivalent conjugate (i.e., Men-C-ACYW-135) and hepatitis B vaccines in Grade 7 (i.e., adolescents aged 12–13), while PEI offers HPV vaccines in Grade 6 (i.e., aged 11–12) and Tdap and Men-C-ACYW-135 in Grade 9 (i.e., aged 14–15), while NB offers HPV and Tdap vaccines in Grade 7 and Men-C-ACYW-135 and a Varicella catch-up program to adolescents in Grade 9 [3,17–20]. The Maritimes also experienced lower COVID-19 caseloads per-capita throughout 2020–2021, and higher compliance with PHM compared to other parts of the country [11,21]. As there are an estimate 210,000

adolescents aged 10–19 years in the Maritimes as of 2023, this represents a substantial part of the population who may be missing key vaccinations offered through SBIP [22]. Therefore, it is important to understand COVID's effect on SBIP delivery and vaccine decisions in this context.

While school closures limited the accessibility of vaccine services and played a role in decreases in vaccine coverage seen in Canada, vaccine hesitancy may have also affected uptake. Vaccine hesitancy is defined as “the delay in acceptance or refusal of vaccination despite availability of vaccination services” [23]^(page 4163). Parents have been hesitant towards COVID-19 vaccines for themselves and their children [24]; however, recent research has shown that the pandemic had minimal impact on parents' attitudes towards routine early childhood vaccines [25]. It is critical to understand how the COVID-19 pandemic may have affected Maritime parents' and adolescents' views towards routine vaccines offered in SBIP.

Vaccinating against COVID-19 and other routine vaccines during the pandemic has emphasized the importance of understanding vaccine behaviours. Applying behavioural science theories to this field can help determine the mechanisms driving specific behaviours to explain past, and predict future, vaccine practices and mitigate vaccine hesitancy [26]. To support the systematic application of behaviour science theory, Michie et al. (2014) synthesized 19 frameworks into the Behaviour Change Wheel (BCW) [27]. The Capability, Opportunity, Motivation-Behaviour model (COM-B), the core of the BCW, posits behaviours are driven by a person's capabilities (i.e., physical or psychological), opportunities (i.e., social or environmental) and motivations (i.e., reflective or automatic) [27]. The Theoretical Domains Framework (TDF), comprised of 14 domains, maps onto the COM-B to further identify individual, social and environmental barriers and enablers to engaging in a behaviour [28]. The COM-B and TDF have been applied in vaccine behaviour studies [29,30]; however, to our knowledge there has yet to be a study exploring the effects of COVID-19 on SBIP using behavioural science. The objectives of this study were to explore 1) stakeholders' experiences with SBIP and changes to programs during COVID-19, and 2) how the pandemic affected parents' and adolescents' vaccine views.

2. Methods

2.1. Study design

This exploratory qualitative study included semi-structured interviews with stakeholders as part of a broader mixed methods study describing the effects of the COVID-19 pandemic on SBIP in the Canadian Maritimes [31]. This study was informed by the Atkins et al. (2017) guide for applying the TDF to behaviour change research [28]. Ethics approval was obtained from Dalhousie University's Health Sciences Research Ethics Board (reference: 2022–6395).

2.2. Study participants, eligibility criteria & recruitment

Convenience and stratified purposive sampling were used to recruit participants. Participants were eligible if they were a member of one of five stakeholder groups: government decision makers, education sector (e.g., teachers, school administrators), healthcare providers (e.g., nurses), parents (e.g., parents, caregivers or legal guardians), or adolescents (e.g., those aged 12 and up) and spoke English as a primary or additional language. Adolescents were only eligible to participate as a dyad with their parent and were not interviewed independently. Participants also had to have been eligible for, or involved in, SBIP between the 2018/2019–2022/2023 school years in one of three Maritime provinces to capture how the pandemic affected services and vaccine decision making.

Participants were recruited primarily through social media posts (e.g., Meta, Twitter/X) and professional networks between February 1st–July 31st, 2023. During this time, the WHO declared COVID-19 was no longer a public health emergency [32]. Most provincial PHM were removed in schools and no school closures were experienced. Of note, a meningococcal B (men-B) outbreak occurred at two NS universities in autumn 2022, resulting in three cases and two deaths [33].

2.3. Screening procedures

Interested participants were directed to a consent form and screening survey in REDCap [34]. The screening survey collected socio-demographic details and preferred day(s) and time(s) to complete the interview. Participants who selected the parent stakeholder option were also asked if their adolescent would be interested in participating in an interview as a dyad, in addition to completing a five-item 5C survey to gauge vaccine hesitancy [35]. The short 5C scale is a validated tool to measure five constructs associated with vaccine hesitancy: confidence, complacency, convenience, calculation and collective responsibility [35]. One item is associated with each construct and scored on a scale of 1 (strongly disagree) to 7 (strongly agree) [35]. Higher confidence and calculation scores are associated with more positive vaccine views, while higher complacency, collective responsibility and convenience scores indicate more negative views [35]. The lead researcher used screening details to coordinate interviews.

2.4. Interview guides

Two semi-structured interviews guides were developed: one for health and education sector participants, and one for parent and adolescent participants. Question structure was adapted from existing guides informed by the COM-B and TDF, with questions and prompts linked to each COM-B component and TDF domain [36]. Questions and prompts were informed by literature reviews and an environmental scan associated with the broader study. Both guides included questions to elicit perceptions of SBIP service delivery, with the parent/adolescent guide including additional vaccination views and decision-making questions. The screening survey and interview guides were pilot tested by the lead researcher with three members from corresponding stakeholder groups to ensure question clarity. Minor revisions were made to the wording of two interview questions before data collection.

2.5. Interview procedures

All interviews were conducted by the lead researcher, a female doctoral candidate, with eight years of experience conducting qualitative data collection. The interviewer took field notes before, during and/or after interviews. Adult participants provided informed, written consent, while adolescent participants provided informed, verbal assent to the interviewer prior to the interview.

Study aims were reviewed, and participant questions answered prior to the interview. Interviews were audio-recorded and conducted via

Microsoft Teams or telephone. Interviews conducted in Teams were automatically transcribed, while phone interviews were transcribed by a hired transcriptionist. Transcripts were reviewed by the interviewer for clarity and to remove identifying details. Following the interview, each participant received a \$30 gift card as an honorarium.

2.6. Data analysis

Transcripts were analyzed using deductive and inductive analyses in NVivo 12 for Mac (QSR International, Australia). Deductive analysis used directed content analysis to map participant quotes to the COM-B and TDF [37]. Transcripts were read initially to gain a sense of interview content and participant's responses [37]. Upon second read-through, relevant participant quotes were coded to one or more COM-B components and associated TDF domains [28]. The lead researcher coded all transcripts, with a research assistant coding 30 % of transcripts in duplicate to enhance reliability of coding and findings [28]. A codebook was developed throughout analysis to track content associated with each component and domain. Coders met consistently to resolve discrepancies, with updates added to the codebook following each meeting.

Following deductive COM-B and TDF mapping, inductive thematic analysis was conducted by the lead researcher to identify belief statements within each stakeholder group. A belief statement is "a collection of responses with similar underlying belief that suggest a problem and/or influence of the beliefs on the target implementation problem" [28]^(Page 12). Belief statements were then compared across stakeholders to generate themes and subthemes. Themes were selected using three criteria: frequency of identification across participants, conflicts within the theme, and strength of beliefs informing the theme [28,38]. Themes were reviewed with the research assistant and team to achieve consensus.

3. Results

3.1. Sample characteristics

Thirty-five participants completed the screening survey. One potential participant did not schedule an interview, and two did not attend scheduled interviews. Seven parent participants completed an interview as a dyad with their adolescent, resulting in a final sample of 39 participants across 32 interviews. All interviews were completed between February 13th– August 4th, 2023, and lasted between 22 and 74 min (mean [m]: 29.5 min; standard deviation [SD]:10.9).

Full participant details are described in Table 1. Adult participants' ages ranged from 22 to 62 (m: 43.6; SD: 8.4), while adolescents' ages ranged from 12 to 17 (m:14.9; SD: 1.5). All adolescent participants were eligible for SBIP vaccines during the COVID-19 affected school closures (i.e., 2019/2020, 2020/2021 and/or 2021/2022 school years) and all parent participants had at least one child eligible for vaccines during these school years. Most healthcare providers were nurses and had between 8 months and 40 years of healthcare experience (m: 20.8 years; SD: 10.5). All education sector participants were teachers. Participants ranged across the five stakeholder groups and provinces (Table 2), with the majority being female (n = 35; 90 %), and from the parent (n = 13; 33 %) or healthcare provider (n = 11; 28 %) stakeholder groups. There were slightly more participants from NS (n = 17; 44 %) compared to NB (n = 12; 31 %) or PEI (n = 10; 26 %).

Parent 5C scores indicated generally positive views towards vaccines (Additional File 1). All parent participants identified as female, and two parents were hesitant towards HPV vaccines. One parent-adolescent dyad homeschooled their child, and another dyad homeschooled during the pandemic to reduce the risk of contracting COVID-19.

3.2. Themes

Five themes were identified across the stakeholders and provinces: 1)

Table 1
Summary of participant characteristics.

Variable	Total (n = 39)
Stakeholder Group	
Adolescent	7
Teacher	6
Government Decision Maker	2
Healthcare Provider	11
Parent	13
Gender	
Female	35
Male	4
Ethnic Group	
Caucasian	38
Indigenous	1
Province	
Prince Edward Island	10
Nova Scotia	17
New Brunswick	12
Area of Residence	
Rural	31
Urban	8
Highest Education Level Attained (Adult participants; n=28)	
High School or equivalent	3
College or equivalent	8
University-Bachelor's degree or equivalent	11
University- Master's or PhD or equivalent	6
Parent Group- Marital Status (n=13)	
Single	2
Married	9
Missing data	2
Parent Group- # of Children (n=13)	
1	2
2	6
3	3
4	1
Missing data	1
Healthcare Provider Role (n=11)	
Registered Nurse	6
Licensed Practical Nurse	4
Pharmacist	1

enablers to SBIP delivery, 2) barriers to SBIP delivery, 3) desired changes to SBIP delivery, 4) student anxiety, and 5) vaccination views & changes since the COVID-19 pandemic (Fig. 1). Themes mapped to five of the six COM-B components and 10/14 corresponding TDF domains (Table 3). There were no substantial differences in themes across provinces. Themes identified across stakeholder groups are described below and shown in Table 4.

4. Enablers to SBIP delivery

4.1. Existing enablers to SBIP

The leading perceived benefit to SBIP delivery across stakeholders was equitable vaccine access for adolescents. Education participants described the convenience of offering the programming at school, despite disruptions to the school day, while decision makers, healthcare provider and parent participants described the challenges (e.g., transportation, costs) families could experience if the programs were not offered at school.

Table 2
Participants stratified stakeholder group and province of residence.

	Healthcare Provider	Government Decision Maker	Teacher	Parent	Adolescent	Total
Nova Scotia (NS)	5	1	2	6	3	17
New Brunswick (NB)	3	0	2	4	3	12
Prince Edward Island (PEI)	3	1	2	3	1	10
Total	11	2	6	13	7	39

“I think it’s critical that they’re offered in schools to provide all students equal access to those vaccines.” (Decision Maker_PEI_01)

Access to vaccines at schools was important within the Maritimes context, where adult stakeholders described the lack of general practitioners across provinces prior to, and throughout, the pandemic. Participants described SBIP supported access to routine health services without many of the barriers to primary or community care.

“The state of healthcare in NS sometimes makes it more difficult to actually get into a family doctor or get into a clinic to make those appointments. So for it be conveniently offered at school is great.” (Parent_NS_05)

Teachers described being a trusted source for information for students and parents. Healthcare provider and decision maker participants echoed the importance of parental relationships with teachers, saying SBIP improved the perceived safety of vaccines and SBIP delivery for parents and students.

“I know parents trust me and I’ve won trust with them over the years ... and I sent home this form, do you know what I mean? Like, I think that actually is a benefit to even out a tiny bit of reluctance ... it’s a positive when there’s trust built with the school and the teachers.” (Teacher_NS_02)

Parent participants highlighted the benefits of their children getting vaccinated among friends, as it offered a level of support as parents were not present.

“If they’re getting it done with their friends, I think, they’re just gonna go with it and get it done. So I do like that it’s in the school system for that purpose, for sure, because then they just do it.” (Parent_PEI_01)

Adolescents described feeling reassured their peers were going through the same process and enjoyed getting a break from classes together.

“It’s just like cause like you’re not like going in alone. And it’s just like your friends are with you, I guess. So it kind of feels better knowing that everyone else is also going through it.” (Adolescent_NS_06)

4.2. Positive impacts of COVID-19 on SBIP

PHM implemented to control COVID-19 transmission had some positive effects on SBIP delivery, chiefly attaining the additional space required for clinics. Healthcare provider participants noted school staff were willing to provide bigger spaces to facilitate clinics to comply with PHM. Healthcare provider participants described the additional space helped demonstrate the efficiency of SBIP when provided adequate resources, which was often a struggle prior to the pandemic.

“... immunizations within a gym or a big auditorium-like setting, you can get like 10–15 stations in there. Plus recovery, plus the waiting area and do your masking, hand sanitize and put them through the whole little loop of things. It just makes it a better experience for all.” (Healthcare Provider_NS_04)

Taking smaller cohorts of students to SBIP clinics was another benefit among healthcare provider and teacher participants. As many schools across the Maritimes used a cohort system, where smaller groups of students attended school in-person on rotating days to comply to PHM,

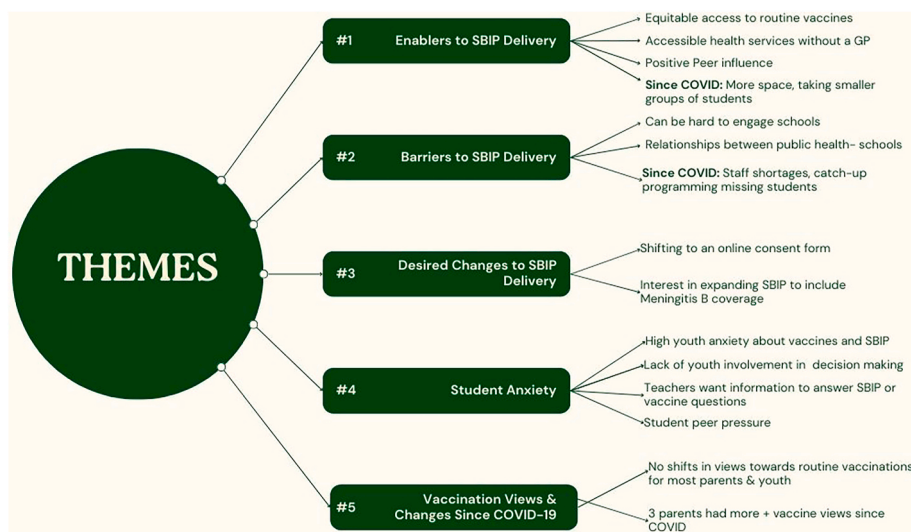


Fig. 1. Qualitative Analysis Coding Tree

sending smaller student groups to clinics was perceived to reduce anxiety as there were shorter wait times to get vaccinated.

“... that’s another thing COVID taught us was don’t bring 20 kids down anymore and have them waiting in the hallway. If I have five immunizers, bring five kids down.” (Healthcare Provider_NS_03)

5. Barriers to SBIP delivery

5.1. Existing barriers to SBIP

Stakeholders identified several barriers to SBIP. Among existing barriers was the perceived low buy-in and the passive role school staff played in SBIP delivery.

“The school is passive in the in the whole thing ... It doesn’t have to be something that, you know, they have no control over. But I think they could be more active partners.” (Decision Maker_NS_01)

Decision maker and healthcare provider participants described the success of SBIP clinics were dependent on individual relationships with school staff. Healthcare providers described some staff were accommodating with SBIP procedures, while others felt school staff could make SBIP unnecessarily challenging. Healthcare provider also discussed it often took years of SBIP planning to foster relationships with a key contact person at each school to facilitate clinics.

“I mean it’s always varied from school to school ... there were people who were rock stars, and there are others that were, you know, if they could find a way to be more uncooperative than they would have been.” (Healthcare Provider_NS_01)

Teacher participants described having a passive role in SBIP and were often reluctant to discuss SBIP or vaccines with students, due to a perceived lack of capacity to accurately answer questions.

“I tried to kind of stay a little bit out of it ... I don’t wanna give too much information where I’m not really qualified.” (Teacher_NB_02)

5.2. Negative impacts of COVID-19 on SBIP

The pandemic created several challenges with SBIP, and exacerbated barriers identified above. This included high staff turnover across public health and education sectors, with many healthcare providers transferring roles to cover health system strain, and teachers retiring during

the pandemic. Decision maker and healthcare provider participants described the challenges of establishing new public health-school staff relationships.

“We had a lot of teachers in this area that recently retired over the pandemic. So we have a lot of new grade seven teachers that maybe don’t quite understand the program or the process of the program, I guess, because really it is a huge partnership ... like building back connections, I guess, is kind of what we’re trying to do now.” (Healthcare Provider_NS_05)

Administering concurrent SBIP and catch-up programs for older grades also meant many clinics required additional staff and resources. In some of these instances, community healthcare providers were brought in to support clinics.

“Because school had been shut down, we had more grade seven and grade eights. So there was a bigger cohort, so the clinics were bigger. Like for a while there, they had not just people from public health, you know, casual LPNs, RNs, different programming, but they also had like pharmacists helping with the vaccines.” (Healthcare Provider_NS_01)

The changes to SBIP delivery and catch-up programming resulted in some adolescents missing their opportunity to get vaccinated through SBIP. Many parent participants did not recall receiving communication about catch-up procedures, and were pro-active in contacting public health to coordinate vaccinations for their children. This was particularly noted among homeschooling participants.

6. Desired changes to SBIP service delivery

There was interest in modifying two elements of SBIP: moving to e-consent forms and expanding vaccinations offered. E-consent forms were a conflicting theme among stakeholders. Teacher, healthcare provider and decision maker participants expressed a strong desire to shift to e-consent forms. Benefits of this mode of delivery included ensuring parents received the form, efficient documentation and charting for healthcare providers, and reducing workload for teachers. Healthcare providers noted the time saved could be used on in-school health promotion activities with students.

“I think that would be a great change. It would take it more out of my hands. Yeah, I think that would be lovely as so much is online. Now when I give out paper, I’m always like they’re gonna lose this.” (Teacher_NB_01)

Table 3
Themes and belief statements mapped to COM-B and relevant TDF domains.

Belief Statements	Relevant COM-B Components &TDF Domains									
	Capability			Opportunity		Motivation				
	Psychological capability			Social	Physical	Reflective				Automatic
	Knowledge	Behavioural Regulation	Memory, Attention, Decision Making	Social Influences	Environmental Context & Resources	Beliefs about Capabilities	Beliefs about Consequences	Social/ Professional Role	Goals	Emotion
Enablers to SBIP										
Equitable vaccine access					X		X			
No need for family doctor appointment					X		X			
Positive parent-teacher relationships				X				X		
Positive peer influences				X						X
SBIP space requirements to comply with PHM improved efficiency					X					
Barriers to SBIP										
Low school staff buy-in to SBIP								X		
Healthcare provider-school staff relationships (barrier/enabler)				X						
Teachers' capability to answer SBIP questions	X						X		X	
Staff shortages since COVID-19						X				
Missed students in vulnerable groups					X		X	X		
Desired Changes to SBIP Delivery										
E-consent form						X				X
Adding Men-B vaccines						X				X
Student Anxiety										
Lack of youth involvement in vaccine decision making			X				X			
"Fear of the unknown"										X
Student Peer Pressure				X						X
Regulating students' emotions		X								
Vaccination Views & Changes during the COVID-19 Pandemic										
Risk perception of routine vaccines	X		X					X		
Minimal changes to routine vaccine views since COVID-19			X							

Although some parent participants recognized the many benefits described above, they also recognized that emails could get filtered to a junk folder. Some parent participants described the paper-based forms ensured they read and understood the information when providing consent for their child's vaccinations.

"... it being a hard copy actually made me look at it. I think if it was an e-mail, I just, I don't know if I would have read it completely. I feel like with an e-mail you can just like click, click, click delete." (Parent_NB_04)

There was minimal interest across stakeholders to offer COVID-19 or influenza vaccines in school settings. However, there was a strong desire

Table 4
Themes and belief statement agreement across stakeholder groups.

Theme	Belief Statement	Stakeholder Group				
		Healthcare Provider	Government Decision Maker	Teacher	Parent	Adolescent
Enablers to SBIP	Equitable vaccine access	X	X	X	X	
	No need for family doctor appointment	X	X	X	X	
	Positive parent-teacher relationship	X	X	X		
	Positive peer influences	X			X	X
	SBIP space requirements to comply with PHM improved efficiency	X	X	X	X	X
Barriers to SBIP	Taking smaller cohorts of students to clinics	X		X		
	Low school buy-in to SBIP	X	X			
	Healthcare provider- school staff relationships (barrier/enabler)	X	X	X		
	Teachers' capability to answer SBIP questions			X		X
	Staff shortages since COVID-19	X	X			
Desired Changes to SBIP delivery	Missed adolescents in vulnerable groups		X		X	X
	e-consent form	X	X	X	X	
Student Anxiety	Adding Men-B vaccines	X	X	X	X	X
	Lack of adolescent involvement in vaccine decision making				X	X
Vaccine Views and Changes to Views since COVID-19	"Fear of the unknown"	X		X	X	
	Student Peer Pressure	X	X	X	X	X
	Regulating students' emotions	X	X	X	X	X
	Risk perception of routine vaccines				X	X
	Minimal changes to routine vaccine views since COVID-19				X	X

to offer a men-B vaccine in high schools through SBIP. Decision makers, healthcare providers, teachers and parent participants noted the recent outbreak of men-B as a contributing factor to this goal. Young adults being a higher risk group for men-B, severity of disease, and vaccine costs were additional reasons to include the vaccine in SBIP.

"I would like to see in the very near future meningococcal B become part of this whole vaccine as well, just with the recent, like you know, deaths and everything around that." (Healthcare Provider_PEI_03)

7. Student anxiety

When asked about SBIP vaccine decision making, parent participants were the primary decision maker, and often made the decision without their child's or partner's involvement.

"I never really gave her the option. No, there was just 'you're getting needles,' you know? It wasn't really an ask." (Parent_PEI_02)

Adolescent participants were content with deferring to their parent for vaccine decision making, and often assumed their parents' vaccination views. Older adolescents explained that if they disagreed with their parent's decision they would not feel pressured to get vaccinated and could discuss their concerns.

"I just leave it up to my mom." (Adolescent_NS_02)

"If I felt uncomfortable, she wouldn't pressure me or anything. But I am, I was always open to it, so." (Adolescent_NB_01)

While adolescent participants felt positively about vaccines, they still experienced anxiety around SBIP. Parent, healthcare provider, decision maker, and teacher participants described some of the anxiety stemming from a fear of needles and perceived judgement from students; however, a "fear of the unknown" was more often cited, as adolescents had no experience with SBIP and had little knowledge of what clinics involved. Teachers explained students were already anxious about SBIP on the first day of class in the grades where SBIP were offered.

"It's definitely an anxiety-inducing day for them. Like, I will get questions on ... my first day with the kids." (Teacher_NS_01)

Boys' anxiety also stemmed from potentially being punched in the

arm by older students after receiving their vaccinations. While male adolescent participants usually described this as a joke, it was reported across stakeholder groups and provinces.

"... he had a lot of anxiety around it because he had been told that the kids in the older grades were gonna punch him in the arm." (Parent_NS_06)

"I don't know. It doesn't really happen that much, but it's like kind of just a joke." (Adolescent_NS_06)

Participants identified various coping skills used to help manage adolescents' anxiety. Adolescents used breathing exercises, parents and teachers offered pep talks and emotional support, healthcare providers explained the procedures to the students, and decision makers suggested various distractions tactics.

"... like if I know they're very nervous, I'll tell them like I'm proud of you. And it wasn't as bad as you thought When you explain things to kids and give them some coping strategies, it goes a long way." (Healthcare Provider_PEI_02)

8. Vaccination views and changes since the COVID-19 pandemic

Vaccinating parents felt there were few risks when compared to the benefits of vaccinating, and felt it was their responsibility to protect their child's health through vaccination. Perceived risks (e.g., sore arm) were minimal compared to benefits.

"It's not just about protecting you, it's about protecting the other people that are around you and in your classroom." (Parent_PEI_01)

Vaccine hesitant parents felt it was their role as a parent to protect their child from the risks of vaccination. Perceived risks included feeling the HPV vaccine was too new for boys to receive, insufficient research into the safety of vaccines and low confidence in the provincial government. These parents also described feeling rushed to provide consent for school vaccine services.

"HPV, for me, has been a little bit of a roller coaster. Just where it's offered through the school system, I had reservations because I'm not

exactly sure what's going on there ... And I didn't want it to be one of those things where my kids would be over-vaccinated." (Parent_NB_04)

Most parents' and adolescents' views towards routine vaccinations were largely unaffected by the COVID-19 pandemic. Three parent participants described more positive views since the pandemic, and none identified more negative views. The pandemic did not change vaccine hesitant parents' views towards routine vaccines.

"Not really like if you mean like with the school ones. The pandemic doesn't really change my thoughts on those ... We would have done it in 2019-2020." (Parent_NS_01)

"I used to kind of see the flu vaccine as like, oh, it's just the flu. And now I think that my view on that has changed ... before I may have skipped a year or two and now I'm like, no, we're not skipping any." (Parent_NS_03)

9. Discussion

We sought to explore stakeholders' experiences with SBIP and how services and vaccine decision making were affected by the COVID-19 pandemic. Applying the COM-B and TDF frameworks, we identified several individual, social and environmental factors affecting stakeholders' capabilities, opportunities, and motivations to engage in SBIP delivery and routine vaccination decisions.

The benefits of equitable vaccine access for students described in this study are established in the literature [6,39–41]. In this study, the COVID-19 pandemic and shift to hybrid learning resulted in some adolescents, especially those being homeschooled, failing to get vaccinated in a timely manner through SBIP or catch-up programming. Though many parents were pro-active and reached out to public health to coordinate vaccinations for their children, putting the onus on motivated parents to organize care diminishes the equity and convenient aspects of SBIP. With multiple cohorts of students experiencing hybrid learning between the 2019/2020, 2020/2021 and 2021/2022 school years, alongside the growing absenteeism in schools following the return to in-person learning [42,43], this represents a large number of adolescents who may remain unvaccinated against vaccine-preventable diseases. This is supported by recent NS data which indicated SBIP vaccination rates dropped 4.73 % (hepatitis B) to 11.80 % (HPV) between the 2018/19 and 2020/21 school years [44]. Public health organizations should consider leveraging the physical opportunity of SBIP and parents' motivation to offer catch-up programming in high schools in upcoming years to reach remaining unvaccinated adolescents prior to graduation. Offering school-based clinics may help to catch-up adolescent students, while public health clinics may be beneficial for adolescents with more complex needs.

Healthcare providers in our study described spending years building individual relationships with school staff to support SBIP clinics, which deteriorated during the pandemic with high turnover rates in both sectors. Healthcare provider and decision makers may benefit from cross-sectoral collaborations to enhance SBIP delivery [8]. Engaging with school staff during professional development days may capitalize on social opportunities to build relationships, and offering SBIP education modules during these events may support teachers' capacities to address vaccine questions. A NS study found engaging school staff in education was positively associated with improved SBIP vaccine uptake [45]. Engaging school nurses may also provide a connection between public health and education stakeholders, as school nurses could mediate between school staff and healthcare provider interests, while being a credible source of information for SBIP questions [45,46]. Future research is needed to understand and address the barriers to successful collaborations between public health and education sectors to offer SBIP.

One of the main findings from this study is the lack of adolescent engagement in vaccine decision making. Adolescents' low motivation,

coupled with parents dismissing adolescents' involvement and teachers' perceived lack of confidence to answer vaccine questions, leaves adolescents with few sources of information and support leading up to SBIP, and may be contributing to their anxiety. Low vaccine knowledge has been associated with higher SBIP anxiety [47]. As SBIP are offered in early adolescence, building on burgeoning autonomy through shared decision making with parents could enhance their motivation and capability to make health decisions [48]. To date, few SBIP studies have focused on adolescents' involvement in vaccine decision making. The Comfort-Ask-Relax-Distract (CARD) system, a comprehensive Canadian SBIP intervention, actively engaged stakeholders throughout intervention design to provide vaccination education and support students' emotion and behaviour regulation [49,50]. Ongoing research has shown the CARD intervention improves a range of adolescents' knowledge and stress responses during SBIP [51,52], but has yet to have a significant effect of vaccine uptake [49,51]. A complex SBIP Australian intervention aimed to improve SBIP HPV vaccination through adolescent decision aids, educational content and improved service delivery [53]. Adolescents and parents were involved in decision aid development, which was associated with improvements in adolescent involvement in vaccination decision making [54]; however, the overall intervention did not improve vaccine uptake [55]. Building on elements of these SBIP interventions by actively engaging adolescents and parents in vaccine decision making, including in the co-design of decision aids and interventions, may help engage adolescents, address anxiety, and ultimately improve vaccine uptake. Future research is warranted to understand the underlying mechanisms behind adolescents' passive role in decision making and ways to improve their capabilities, opportunities, and motivations to engage in vaccine decisions as they transition into young adults.

We identified the COVID-19 pandemic did not shift parents and adolescents perceptions of routine vaccinations. This aligns with other Canadian studies exploring changes in routine vaccination views during the pandemic [56]. Humble, Scott et al. (2023) identified 78.1 % of parents of children aged 7–17 years experienced no changes in routine vaccine views during the pandemic, and over 20 % identified more positive views. These findings are encouraging and suggest decreases in vaccine uptake may be driven by school closures rather than increases in vaccine hesitancy.

Risk perception among parents in this study varied between the perceived risks of vaccination and perceived risk of disease. Hesitant parents in our study perceived the HPV vaccine as 'new' and were uncertain about its safety for boys, which aligns with common parental HPV concerns in the literature [5,6]. There is a well-established body of literature demonstrating the safety of HPV vaccines and its effectiveness at reducing cancers [57–59], however there remains a clear gap in how this information continues to be communicated to, and understood by, the public. Tailored education resources for parents and adolescents concerning HPV vaccine safety, and highlighting the reduced risks for cancers in men and women, may increase the perceived risks of contracting HPV to outweigh perceived risks of vaccination.

Study findings should be interpreted with several limitations in mind. First, we were unable to capture the perspectives of NB government decision makers in this study. We also had limited participation from government decision maker stakeholders in NS and PEI, and only half of parents interviewed consented to having their adolescent interviewed. As participants were interviewed about their SBIP experiences between 2018/2019 and 2022/2023, this may have resulted in recall bias in our findings [60]. Interviewing adolescents with their parents present was helpful in this study as parents were able to prompt their child about their vaccination experiences, however having parents present may have introduced social desirability bias with adolescents' responses [60]. While we recruited 39 participants across a range of stakeholders and Maritimes provinces, participants were predominantly educated white women across stakeholder groups. This may be in part due to our recruitment strategies, as social media has been associated

with recruitment of younger, white and female participants in health research [61,62]. This approach may have also introduced selection bias into our study, as participants may have viewed SBIP and vaccinations more positively than non-respondents or stakeholders who do not support SBIP [60,63]. More expansive recruitment methods are needed to capture historically underserved communities' experiences with SBIP. As the participant sample was comprised of predominantly white participants across PEI, NS and NB, this limits the generalizability of the findings to other ethnic groups and regions in Canada. The low caseloads and high PHM compliance across the Maritimes during the pandemic may also limit the generalizability of findings to regions with different COVID-19 rates or PHM measures.

10. Conclusions

Applying the COM-B and TDF, we identified a range of existing barriers and enablers to SBIP and vaccine decision making, many of which were exacerbated during the COVID-19 pandemic. Continued efforts are needed to ensure SBIP and catch-up programming is accessible so all adolescents have the opportunity to catch-up on missed vaccines prior to graduation. No negative shifts in vaccination views among parents and adolescents suggest changes in vaccine coverage since the pandemic may be due to school closures and accessibility of services rather than increased hesitancy. Future research is required to understand the lack of adolescent involvement in their vaccine decision making.

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Ethics committee approval

This study received ethics approval from Dalhousie University's Health Sciences Research Ethics Board (reference number: 2022-6395).

Declaration of competing interest

The authors have no competing interests (e.g., personal or financial) to declare.

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NA.

Abbreviations

BCW	Behaviour change wheel
COM-B	capability, opportunity, motivation-behaviour model
LPN	licensed practical nurse
m	mean
Men-B	meningococcal B
NB	New Brunswick
NS	Nova Scotia
PEI	Prince Edward Island
PHM	public health measure
RN	registered nurse
SBIP	school-based immunization programs
SD	standard deviation
TDF	theoretical domains framework

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.puhip.2024.100505>.

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