






RESEARCH ARTICLE



Healthcare provider awareness, attitudes, beliefs, and behaviors regarding the role of pharmacists as immunizers

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ABSTRACT

We explored perceptions of healthcare providers in Nova Scotia and New Brunswick about pharmacists as immunizers. Pharmacists' scopes of practice are increasingly broadening to include immunization, and providers and policymakers may find meaning in the lessons we learned. Invitations to participate in our online survey were circulated by professional associations, health authorities, and in social media posts. A total of 204 healthcare providers completed our survey, of whom 59.3% were pharmacists, 17.6% were nurses, and 23.0% were physicians. Nurses (30.6%) and physicians (34.0%) experienced fewer logistical barriers to immunizing compared to pharmacists, 71.1% of whom identified practice logistics as a determinant in offering vaccines to patients ($p < .001$). Pharmacists were most supportive of the expansion of their own scope of practice to include the provision of vaccines to adults (95.9%) and children as young as five years (92.6%) compared to nurses (72.2% and 69.4%) and physicians (61.7% and 40.4%) ($p < .001$). Diversity of opinion was evident even among pharmacists about whether they should be permitted to vaccinate children younger than five years. Nurse and physician respondents had lower odds of thinking pharmacists have enough training to vaccinate ($p < .001$), that vaccines should be given in a pharmacy ($p < .001$), and of supporting the expansion of pharmacists' scope of practice ($p < .001$) than pharmacists did in the multivariable analyses. Pharmacists are well-positioned and willing to vaccinate and generally have support from their nurse and physician peers, but logistical challenges and interprofessional complexities persist as barriers to optimizing immunization by pharmacists.

PLAIN LANGUAGE SUMMARY

In most Canadian provinces and territories, pharmacists are trained and able to give vaccines alongside traditional immunizers like doctors and nurses. In this study, we surveyed the views of immunizing professionals (pharmacists, doctors, and nurses) in Nova Scotia and New Brunswick about pharmacists giving vaccines. Healthcare providers were invited to do our online survey by their professional associations, provincial health authorities, and through posts on social media. Healthcare providers generally supported pharmacists giving vaccines, but not without some conditions from nurses, doctors, and some pharmacists themselves. We found all three professions to be very vaccine positive but learned that pharmacists experience barriers to giving vaccines that their nurse and doctor colleagues do not such as working by themselves, volume of work, time, compensation, and record-keeping. We highlight the importance of collaboration between immunizing professionals, acknowledgment of pharmacists' training as immunizers, a uniform funding model for all immunization providers, and a central and accessible vaccine registry. We also suggest that until power dynamics and complexities between professions are addressed in meaningful and structural ways, we might not enjoy the full benefits of pharmacists as immunizers. We hope these findings are useful in places where pharmacists cannot yet vaccinate and where pharmacists' scopes of practice are in the process of widening to include immunization.

ARTICLE HISTORY

Received 19 August 2022
Revised 1 November 2022
Accepted 10 November 2022



KEYWORDS

Immunization; vaccination; vaccination coverage; pharmacists; health knowledge, attitudes, practice; public health; scope of practice

Introduction

Vaccination has been hugely influential in the prevention and eradication of infectious diseases¹ and has been the topic of renewed attention in the wake of the coronavirus disease of 2019 (COVID-19) pandemic.^{2,3} The National Advisory Committee on Immunization (NACI) in Canada recommends that all healthy adults be vaccinated against influenza annually, diphtheria and tetanus every 10 years, pertussis once in adulthood and during each pregnancy, shingles starting at 50 years

of age, and pneumococcal disease at 65 years or older.⁴ NACI also recommends that healthy adults 24 years of age and younger get a meningococcal vaccine if they did not get one in adolescence. Depending on risk, it is recommended that adolescents and adults with specific conditions get either a multicomponent meningococcal B vaccine, and/or a meningococcal conjugate quadrivalent vaccine (MenC-ACWY).⁴ Despite these recommendations, vaccine uptake, particularly among healthy adults, remains consistently below

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vaccine coverage goals, leaving many adults needlessly susceptible to illness.⁴⁻⁶ In the years since the data in this manuscript were collected, NACI recommended (and continues to recommend) that all adults 18 years of age and older without contraindications receive a complete primary series (two doses) of mRNA COVID-19 vaccine, and that a booster dose be offered at least six months later.⁷ As COVID-19 vaccination targets are constantly changing,⁸⁻¹⁰ we cannot comment conclusively on the adequacy of uptake at this time although it has been described by experts at various points throughout the pandemic as being suboptimal.^{8,9,11}

Several factors have been cited as contributing to vaccination behavior including peoples' beliefs, perceptions, openness to vaccination, extrinsic norms and pressures, and logistical issues such as accessibility, convenience, and cost of the vaccine and associated services.^{12,13} Healthcare provider recommendation, (un)awareness of adult immunization, (missed) opportunities for vaccination at the point of care, funding of vaccines and reimbursement to providers (or lack thereof), and (in)accessibility of current vaccine records can also contribute or detract from immunization in adulthood.⁴⁻¹²⁻¹⁹ Even as frameworks of vaccine acceptance evolve to embrace the increasing complexity evident in the COVID-19 pandemic, healthcare workers remain central figures.²⁰

As among the most accessible and trusted healthcare providers, pharmacists are excellent candidates to address some of the logistical issues associated with vaccination.^{15,21} Out of 99 countries surveyed, the International Pharmaceutical Federation (IPF) found pharmacy-based immunization to be available in 36, marking a 16 country increase between their 2016 and 2020 surveys.^{22,23} Pharmacists in 11 of the 13 provinces and territories in Canada can administer vaccines, including in Nova Scotia and New Brunswick.²⁴⁻²⁷ Pharmacists have also played (and continue to play) a pivotal role in giving COVID-19 vaccines to Canadians. The flexibility with which pharmacists can provide services, their proximity to peoples' homes, and the frequency with which the public visits pharmacies offer a high degree of convenience for people seeking vaccination.¹⁵⁻¹⁸⁻²¹⁻²⁸ While the exact relationship between policy change and immunization uptake is challenging to measure, systematic reviews and meta-analyses have shown improved immunization uptake where pharmacists are involved as vaccine providers,^{18,29,30} especially among patients who did not get the influenza vaccine in the previous year.^{18,30} Researchers using secondary data from several cycles of a nationally representative survey in Canada found a marginal increase in influenza vaccine uptake in jurisdictions where pharmacists are authorized to immunize compared to those where they are not.³¹ While attitudes and beliefs about pharmacists as immunizers among the public and healthcare providers are generally positive, several barriers from the provider perspective were identified prior to the COVID-19 pandemic.¹⁵⁻¹⁹ These include but are not limited to concerns about workload, time, patient safety, record-keeping, cost, reimbursement, and lack of interprofessional collaboration with other immunization providers.¹⁵⁻¹⁹ The data presented in this manuscript were also collected prior to the ongoing pandemic, but remain relevant given the expediency of mass COVID-19 vaccination efforts and the widening of

pharmacists' (and other allied health professionals) scopes of practice to include immunization elsewhere.

We first explored the general public's awareness, attitudes, beliefs, and behaviors about pharmacists as immunizers in two provinces on the east coast of Canada (Nova Scotia and New Brunswick) where pharmacists are authorized to immunize.³² Here we present the perspectives of traditional vaccine providers (nurses and physicians) and pharmacists on this topic.

Methods

We used a cross-sectional, quantitative survey to assess the awareness, attitudes, beliefs, and behaviors of vaccine-providing physicians and nurses, and pharmacists about pharmacists as immunizers. The survey opened to healthcare providers in March 2017 and was completed no later than November 2017, allowing a 33-week window for completion and submission. The survey was left open for this duration to ensure that any healthcare providers interested in taking part had the opportunity to do so.

Setting

Although the survey was available to healthcare providers throughout Nova Scotia and New Brunswick, concerted efforts were made to recruit participants in two primarily rural communities in Nova Scotia and two urban or suburban communities in New Brunswick. The specific sites were selected based on a planned intervention to improve vaccine coverage following this study. This survey and the ensuing results therefore serve as a baseline for the interventional study. The communities of Kentville and New Glasgow (and surrounding areas) in Nova Scotia, and Saint John and Moncton (and surrounding areas) in New Brunswick were geographically separated to minimize cross-contamination of patients receiving healthcare at different regional health centers.

Population and sample

All vaccine-providing physicians and nurses, and pharmacists in Nova Scotia and New Brunswick were eligible to participate in our survey. Pharmacists, nurses, and physicians were invited to participate in the online survey through publications distributed by professional associations, e-mails sent through provincial health authorities, and social media messages on Facebook and Twitter. Healthcare providers in the aforementioned communities were also recruited by way of posters and flyers in pharmacies, regional hospitals, physician offices and clinics. Participants were required to provide informed consent to access the survey instrument. At the end of the survey, they were invited to enter a draw to win a \$100 gift card to a restaurant of their choice in acknowledgment of their time and effort spent participating in the study.

Survey instrument

There is considerable overlap between the constructs that make up the Theory of Planned Behavior (perceived susceptibility and severity, perceived benefits and barriers, cues-to-action,

and self-efficacy) and the Health Belief Model (attitude toward behavior, subjective norm, perceived control, and intention to perform the behavior). We developed our questionnaire using a formative process informed by the Theory of Planned Behavior with target constructs from the Health Belief Model.^{33–36} Questions from questionnaires previously developed by coauthors on this study were employed whenever possible and adapted as necessary.^{37,38} The survey instrument was constructed following the principles of survey design of Dillman, Smyth and Christian.³⁹ The questionnaire contained 67 questions that included categorical, yes or no, multi-selection, and strength of agreement questions using a Likert scale. Questions measured provider awareness of vaccine recommendations and funding, attitudes toward and beliefs about vaccines, perceived pressures to give vaccines, sources of vaccine-related information, personal vaccination behavior, and practice logistics.

Reliability and validity

Prior to distributing the survey, the validity of individual questions and the questionnaire were evaluated by a panel of six experts comprised of nurses, pharmacists, and infectious diseases physicians. Each item was rated using a standard content validity index with a 4-point ordinal rating scale, where 1 indicated irrelevance and 4 high relevance. Items that received a score of 3 or 4 were judged to have content validity. Items that did not achieve the required minimum score were reworded if and when appropriate. Some items were neither changed nor eliminated because they were identified as being predictors of vaccine awareness, attitudes, beliefs, and/or behaviors in the literature and/or theories underpinning this work.

Test-retest reliability was assessed by having six vaccine-providing healthcare providers complete the questionnaire at two different points in time (an average of 19 days apart). A correlation co-efficient was calculated to compare the two sets of responses; questionnaire responses with a coefficient $>.70$ were interpreted as consistent.

Statistical analysis

The first level of analysis comprised a review of the descriptive statistics for trends in the data. The second level involved tests of association between attitudinal, intentional, social, behavioral, and belief-based outcomes and predictors. Differences in nominal survey responses were assessed using Fisher's exact tests. Associations between attitudinal, behavioral, and demographic characteristics were either estimated using ordinal logistic regression or Fisher's exact tests depending on whether the order of categories was of importance. Analysis was undertaken using Statistical Analysis Software (version 9.4, Carey, NC);⁴⁰ p-values of $< .05$ were considered statistically significant.

Predictive models were built based on behavior change theories and existing literature and used demographic and population characteristic variables. Multiple logistic regression was used to predict binary awareness responses, and ordinal logistic regression to predict ordered attitudinal responses. For each outcome variable, whether binary or ordered,

demographic and population characteristic variables were used in a backwards elimination stepwise procedure to develop a multiple regression model. Predictor variables remaining at the end of the stepwise procedure were summarized and p-values were calculated. P-values of $< .05$ were considered statistically significant.

A sample size of 327 individuals was targeted to provide a 95% confidence interval of a maximum of approximately $\pm 5\%$ around the point estimate for any survey question.

Results

Demographics

A total of 204 healthcare providers completed the survey, of whom 121 (59.3%) were pharmacists, 36 (17.6%) were nurses who provide vaccines, and 47 (23.0%) were physicians who provide vaccines (Table 1). The majority of pharmacists surveyed (67.8%) practiced in community pharmacies, a few practiced in a community clinic (3.3%), and the remainder (28.9%) practiced in a hospital. The most common practice settings identified by nurses were private practice (30.6%), community clinics (22.2%), and hospitals (16.7%). The remaining nurse respondents practiced in Public Health units (5.6%) and at schools (2.8%). Almost all the physicians surveyed reported practicing in either private practice (76.6%) or a community clinic (19.2%). The level of professional experience amongst pharmacist and physician respondents was relatively evenly distributed, but the nurses who responded to our survey tended to be more experienced (47.2% having 20 years of experience or more).

More nurses (80.6%) and physicians (95.7%) reportedly provided vaccines to children, adolescents, and youth in their practice than pharmacists (11.6%) ($p < .001$), and 67.8% of pharmacists provided vaccines to those aged 5 and older (Table 1). Protecting patients from infectious diseases was cited by pharmacists (76.0%), nurses (91.7%), and physicians (93.6%) as the primary reason for providing vaccines to patients. Nurses (91.7%) and physicians (93.6%) also identified that it was part of their routine practice. Convenience was the second most commonly identified reason for providing vaccines among pharmacists (70.2%), followed by immunization being part of their routine practice (67.8%), and the standard of care in the province (60.3%). The least commonly identified reason for giving vaccines by pharmacists (31.4%), nurses (22.2%), and physicians (46.8%), was that they were funded to do so.

Attitudes and beliefs about vaccination

More nurses (97.2%) than pharmacists (73.6%) and physicians (85.1%) surveyed thought themselves to be up to date on all their adult vaccines ($p = .003$) (Figure 1). Self-reported vaccination was highest for the seasonal influenza vaccine (89.3%), with pertussis uptake as a close second (70.2%) among pharmacists. Nurses reported identical uptake for the influenza and pertussis vaccines (88.9%). While 95.7% of physicians self-reported receipt of the seasonal influenza vaccine, 100% of the physicians surveyed reported receiving the pertussis vaccine.

Table 1. Demographic characteristics.

Characteristic	Pharmacists		Nurses		Physicians		Inter-Profession Measure of Significance <i>p</i> -value	Total		
	n = 121 (59.3%)		n = 36 (17.6%)		n = 47 (23.0%)			n = 204 (100%)		
	n	%	n	%	n	%		n	%	95% CI
How long have you been in clinical practice?										
<5 years	29	24	2	5.6	12	25.5	.067	43	21.1	(14.9, 29.0)
5-<10 years	26	21.5	7	19.4	12	25.5		45	22.1	(15.7, 30.1)
10-<20 years	30	24.8	10	27.8	6	12.8		46	22.5	(16.1, 30.6)
20+ years	36	29.8	17	47.2	17	36.2		70	34.3	(26.6, 43.0)
Please indicate the primary setting in which you practice.										
Hospital	35	28.9	6	16.7	1	2.1	< .001 ^a	42	20.6	(14.0, 29.1)
Private practice	0	0	11	30.6	36	76.6		47	23.0	(16.1, 31.8)
School	0	0	1	2.8	0	0		1	0.5	(0.1, 4.3)
Public health unit	0	0	2	5.6	0	0		2	1.0	(0.2, 5.1)
Community clinic	4	3.3	8	22.2	9	19.1		21	10.3	(5.9, 17.4)
Pharmacy	82	67.8	0	0	0	0		82	40.2	(31.5, 49.6)
Are vaccines provided/administered to children, adolescents, and youth in your practice?										
Yes	14	11.6	29	80.6	45	95.7	< .001	88	43.1	(35.1, 51.5)
Yes, only to those 5 and older	82	67.8	1	2.8	1	2.1		84	41.2	(33.3, 49.6)
No	25	20.7	6	16.7	1	2.1		32	15.7	(10.5, 22.7)
If yes, for what indications?										
Routine	71	74	30	100	46	100	< .001	147	85.5	(79.3, 90.4)
High-risk	41	42.7	30	100	34	73.9	< .001	105	61	(53.3, 68.4)
Travel	74	77.1	25	83.3	37	80.4	0.816	136	79.1	(72.2, 84.9)
Research	3	3.1	0	0	2	4.3	0.704	5	2.9	(1, 6.7)
Approximately how many vaccinations on average do you prescribe/administer per month for children, adolescents and youth?										
<1 vaccine	48	50	1	3.3	4	8.7	< .001	53	30.8	(22.4, 40.7)
1-5 vaccines	37	38.5	6	20	6	13		49	28.5	(20.4, 38.3)
6-10 vaccines	7	7.3	8	26.7	14	30.4		29	16.9	(10.7, 25.6)
11-20 vaccines	3	3.1	5	16.7	15	32.6		23	13.4	(7.9, 21.7)
21-50 vaccines	1	1	7	23.3	4	8.7		12	7.0	(3.4, 13.9)
51+ vaccines	0	0	3	10	3	6.5		6	3.5	(1.3, 9.3)
Do you administer vaccines to adults?										
Yes	90	74.4	35	97.2	46	97.9	< .001	171	83.8	(77.2, 88.8)
No	31	25.6	1	2.8	1	2.1		33	16.2	(11.2, 22.8)
If yes, for what indications?										
Routine	77	85.6	33	94.3	45	97.8	0.051	155	90.6	(85.3, 94.6)
High-risk	41	45.6	30	85.7	41	89.1	< .001	112	65.5	(57.9, 72.6)
Travel	79	87.8	24	68.6	39	84.8	0.039	142	83	(76.6, 88.3)
Research	2	2.2	0	0	2	4.3	0.655	4	2.3	(0.6, 5.9)
Approximately how many vaccinations on average do you prescribe/administer per month to adults?										
<1 vaccine	5	5.6	4	11.4	3	6.5	0.412	12	7.0	(3.4, 14.0)
1-5 vaccines	42	46.7	9	25.7	19	41.3		70	40.9	(31.6, 51.0)
6-10 vaccines	23	25.6	9	25.7	8	17.4		40	23.4	(16.0, 32.9)
11-20 vaccines	16	17.8	8	22.9	11	23.9		35	20.5	(13.6, 29.7)
21-50 vaccines	2	2.2	4	11.4	3	6.5		9	5.3	(2.3, 11.8)
51+ vaccines	2	2.2	1	2.9	2	4.3		5	2.9	(1.0, 8.6)
Why do you provide vaccines? Select all that apply.										
Part of my routine practice	82	67.8	33	91.7	44	93.6	< .001	159	77.9	(71.6, 83.4)
Because I am funded to do so	38	31.4	8	22.2	22	46.8	0.052	68	33.3	(26.9, 40.3)
Convenience for patients	85	70.2	23	63.9	41	87.2	0.027	149	73.0	(66.4, 79.0)
To protect patients from infectious diseases	92	76	33	91.7	44	93.6	.007	169	82.8	(77.0, 87.7)
It is the standard of care in this province	73	60.3	27	75	42	89.4	< .001	142	69.6	(62.8, 75.8)

^aThis *p*-value is artificially small and ought to be interpreted with caution because only pharmacists would identify pharmacy as their primary practice setting.

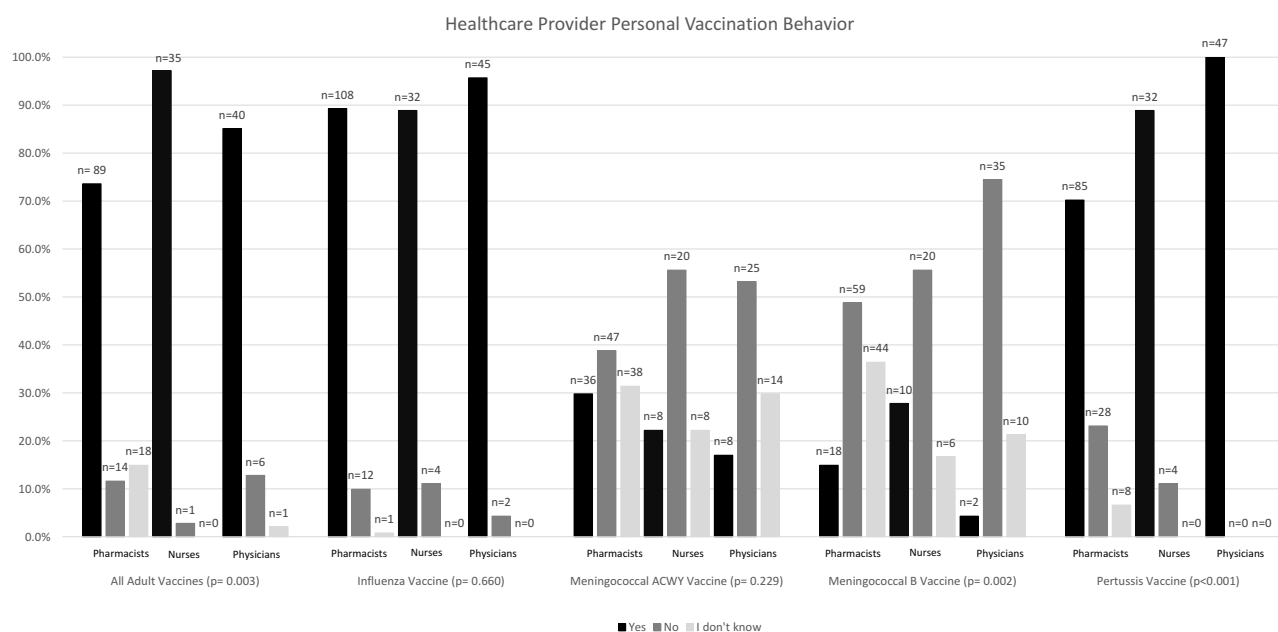


Figure 1. Healthcare providers' personal vaccination behavior. Bars indicate the number and proportion of pharmacists, nurses, and physicians who self-reported receiving all adult vaccines, the influenza vaccine, the meningococcal ACWY vaccine, the meningococcal B vaccine, and the pertussis vaccine.

Receipt of meningococcal vaccines was variable with a moderate degree of uncertainty reported across all three professions (Figure 1). Self-reported receipt of the meningococcal ACWY and B vaccines among pharmacists was 29.8% and 14.9% respectively; however, 31.4% and 36.4% did not know whether they had received these vaccines. Similarly, 22.2% and 27.8% of nurses surveyed reported receipt of the meningococcal ACWY and B vaccines, with 22.2% and 16.7% uncertain about whether or not they had been vaccinated with these antigens. Of the three professions represented, physicians had the lowest self-reported receipt of the meningococcal ACWY (17.0%, $p = 0.229$) and B (4.30%, $p = 0.002$) vaccines. Physicians also reported a high degree of uncertainty about whether or not they had received the meningococcal ACWY (29.8%) and B (21.3%) vaccines. The sample of healthcare providers in this study were generally experienced (with more than one-third having had 20+ years of experience) and thus would not have been given these vaccines in adolescence.

There was nearly unanimous agreement among healthcare providers surveyed, that vaccines are safe and effective in preventing infectious diseases, and trust in the present scientific knowledge about vaccines (Table 2). Most pharmacists (90.1%), nurses (83.3%), and physicians (97.9%) believed that influenza poses a serious threat to the health of adults, and that the adult population is at significant risk of getting it (87.6%, 83.3%, and 93.6% respectively). Compared to the influenza virus, fewer pharmacists (85.5%) and physicians (76.6%) and the same number of nurses (83.3%) believed that meningitis poses a serious threat to people aged 18 to 24 years old. Approximately one-half of the pharmacists (52.9%), nurses (50.0%), and physicians (53.2%) surveyed believed pertussis to pose a serious threat to the health of adults, and that adults are at significant risk of getting it (48.8%, 55.6%, and 55.3% respectively).

Awareness of, and agreement with recommendations

Pharmacists (98.3%), nurses (100%), and physicians (97.9%) were highly aware of and in agreement with (95.8%, 100%, and 93.5%, respectively) the NACI recommendation that adults receive the influenza vaccine annually (Table 3). Comparatively fewer pharmacists (76.9%), nurses (72.2%), and physicians (63.8%) were aware of the NACI recommendation that older adults receive a high-dose influenza vaccine; however, the majority (90.3%, 88.5%, and 83.3%) still agreed with this recommendation.

Awareness of the NACI recommendation that adults receive a pertussis vaccine was higher among physicians and nurses (93.6% and 88.9%) than among pharmacists (71.9%) ($p = .002$), who are not funded to give them (Table 3). Agreement with this recommendation was high among physicians (97.7%), nurses (100%), and pharmacists (98.9%) alike.

Pharmacists (74.4%), nurses (80.6%), and physicians (70.2%) were generally aware of the NACI recommendation that healthy adolescents and young adults receive the meningococcal ACWY vaccine and were unanimously in agreement (100%) with this recommendation (Table 3). There was comparatively less awareness among pharmacists (62.5%), nurses (70.0%), and physicians (67.4%) about the NACI recommendation that healthy adolescents and young adults may receive the meningococcal B vaccine. Less than one-half of the pharmacists (45.8%), nurses (40.0%), and physicians (41.3%) surveyed agreed with the statement that it *can* be given, rather than it *should*. The overall proportion of respondents who neither agreed nor disagreed with this statement (35.5%) leads us to believe that this may have been an unclear question to ask and therefore ought to be interpreted cautiously.

Table 2. Attitudes and beliefs about vaccination.

Characteristic	Pharmacists		Nurses		Physicians		Inter-Profession Measure of Significance <i>p</i> -value	Total		
	n = 121 (59.3%)		n = 36 (17.6%)		n = 47 (23.0%)			n = 204 (100%)		95% CI
	n	%	n	%	n	%		n	%	95% CI
Vaccines are effective in preventing disease										
Disagree	2	1.7	2	5.6	0	0	.183	4	2.0	(0.6, 5.9)
Neither agree nor disagree	0	0	0	0	0	0		0	0	(0.0, 2.7)
Agree	119	98.3	34	94.4	47	100		200	98.0	(94.1, 99.4)
In general, vaccines are safe										
Disagree	2	1.7	2	5.6	0	0	.124	4	2.0	(0.6, 5.9)
Neither agree nor disagree	0	0	0	0	1	2.1		1	0.5	(0.1, 3.6)
Agree	119	98.3	34	94.4	46	97.9		199	97.5	(93.4, 99.1)
Influenza poses a serious threat to the health of adults										
Disagree	6	5	3	8.3	1	2.1	.189	10	4.9	(2.4, 9.9)
Neither agree nor disagree	6	5	3	8.3	0	0		9	4.4	(2.0, 9.3)
Agree	109	90.1	30	83.3	46	97.9		185	90.7	(84.6, 94.5)
The adult population is at a significant risk of getting influenza										
Disagree	3	2.5	2	5.6	0	0	.495	5	2.5	(0.9, 6.6)
Neither agree nor disagree	12	9.9	4	11.1	3	6.4		19	9.3	(5.5, 15.4)
Agree	106	87.6	30	83.3	44	93.6		180	88.2	(81.8, 92.6)
Influenza is rare enough that the adult population no longer needs to be vaccinated against it										
Disagree	117	96.7	36	100	45	95.7	.813	198	97.1	(92.7, 98.8)
Neither agree nor disagree	3	2.5	0	0	2	4.3		5	2.5	(0.9, 6.6)
Agree	1	0.8	0	0	0	0		1	0.5	(0.1, 3.6)
Meningitis poses a serious threat to individuals aged 18–24 years old										
Disagree	1	0.8	1	2.8	2	4.3	.404	4	2.0	(0.6, 5.9)
Neither agree nor disagree	17	14	5	13.9	9	19.1		31	15.2	(10.1, 22.2)
Agree	103	85.1	30	83.3	36	76.6		169	82.8	(75.6, 88.2)
Individuals aged 18–24 are at risk of developing meningitis										
Disagree	2	1.7	2	5.6	1	2.1	.360	5	2.5	(0.9, 6.6)
Neither agree nor disagree	18	14.9	2	5.6	7	14.9		27	13.2	(8.5, 19.9)
Agree	101	83.5	32	88.9	39	83		172	84.3	(77.3, 89.5)
Meningitis is rare enough that individuals aged 18–24 no longer need to be vaccinated against it										
Disagree	101	83.5	32	88.9	36	76.6	.131	169	82.8	(75.6, 88.2)
Neither agree nor disagree	14	11.6	4	11.1	11	23.4		29	14.2	(9.3, 21.0)
Agree	6	5	0	0	0	0		6	2.9	(1.2, 7.3)
Pertussis poses a serious threat to the health of adults										
Disagree	27	22.3	6	16.7	13	27.7	.608	46	22.5	(16.4, 30.2)
Neither agree nor disagree	30	24.8	12	33.3	9	19.1		51	25.0	(18.5, 32.9)
Agree	64	52.9	18	50	25	53.2		107	52.5	(44.1, 60.6)
The adult population is at a significant risk of developing pertussis										
Disagree	31	25.6	5	13.9	8	17	.571	44	21.6	(15.5, 29.2)
Neither agree nor disagree	31	25.6	11	30.6	13	27.7		55	27.0	(20.2, 35.0)
Agree	59	48.8	20	55.6	26	55.3		105	51.5	(43.2, 59.7)
Pertussis is rare enough that the adult population no longer needs to be vaccinated against it										
Disagree	99	81.8	30	83.3	39	83	.622	168	82.4	(75.1, 87.8)
Neither agree nor disagree	13	10.7	3	8.3	7	14.9		23	11.3	(7.0, 17.7)
Agree	9	7.4	3	8.3	1	2.1		13	6.4	(3.4, 11.8)
I trust the present scientific knowledge on vaccines										
Disagree	3	2.5	0	0	0	0	.536	3	1.5	(0.4, 5.2)
Neither agree nor disagree	2	1.7	0	0	2	4.3		4	2.0	(0.6, 5.9)
Agree	116	95.9	36	100	45	95.7		197	96.6	(92.0, 98.6)

Table 3. Awareness of, and agreement with recommendations.

Characteristic	Pharmacists		Nurses		Physicians		Inter-Profession Measure of Significance <i>p</i> -value	Total		
	n = 121 (59.3%)		n = 36 (17.6%)		n = 47 (23.0%)			n = 204 (100%)		
	n	%	n	%	n	%		n	%	95% CI
Are you aware that the NACI recommends that adults receive a vaccine for protection against influenza?										
Yes	119	98.3	36	100	46	97.9	1.000	201	98.5	(95.2, 99.6)
Do you agree with this recommendation?										
Agree	114	95.8	36	100	43	93.5	.646	193	96.0	(91.2, 98.2)
Neither agree nor disagree	2	1.7	0	0	2	4.3		4	2.0	(0.6, 6.0)
Disagree	3	2.5	0	0	1	2.2		4	2.0	(0.6, 6.0)
Are you aware that the NACI recommends that older adults (65 years of age or older) receive a high-dose vaccine for protection against influenza?										
Yes	93	76.9	26	72.2	30	63.8	.236	149	73.0	(65.6, 79.4)
Do you agree with this recommendation?										
Agree	84	90.3	23	88.5	25	83.3	.213	132	88.6	(80.9, 93.4)
Neither agree nor disagree	5	5.4	3	11.5	5	16.7		13	8.7	(4.6, 15.9)
Disagree	4	4.3	0	0	0	0		4	2.7	(0.9, 8.0)
Are you aware that the NACI recommends that healthy adolescents and young adults (12 to 24 years) receive vaccine for protection against meningitis groups ACWY?										
Yes	90	74.4	29	80.6	33	70.2	.562	152	74.5	(67.1, 80.7)
Do you agree with this recommendation?										
Agree	90	100	29	100	33	100		152	100	(96.4, 100)
Neither agree nor disagree	0	0	0	0	0	0		0	0	(0, 0)
Disagree	0	0	0	0	0	0		0	0	(0, 0)
Are you aware that the NACI recommends that adults receive vaccination for protection against pertussis?										
Yes	87	71.9	32	88.9	44	93.6	.002	163	79.9	(72.9, 85.4)
Do you agree with this recommendation?										
Agree	86	98.9	32	100	43	97.7	.717	161	98.8	(94.5, 99.7)
Neither agree nor disagree	0	0	0	0	1	2.3		1	0.6	(0.1, 4.5)
Disagree	1	1.1	0	0	0	0		1	0.6	(0.1, 4.5)
Are you aware that the NACI indicates that healthy adolescents and young adults (12–24 years) may receive vaccination for protection against meningitis group B?										
Yes	60	62.5	21	70	31	67.4	.742	112	65.1	(56.6, 72.7)
Do you agree with the recommendation that this vaccine <i>can</i> be given rather than it <i>should</i> be given?										
Agree	44	45.8	12	40	19	41.3	.436	75	43.6	(34.9, 52.7)
Neither agree nor disagree	34	35.4	8	26.7	19	41.3		61	35.5	(27.3, 44.5)
Disagree	18	18.8	10	33.3	8	17.4		36	20.9	(14.5, 29.2)

Provider logistics

The majority of nurses (65.7%) and physicians (78.3%) surveyed in this study reported having a method for identifying unvaccinated adults (Table 4). Conversely, most pharmacists (86.7%) had no such method ($p < .001$). Providers across all three professions generally felt that their colleagues think it is important for them to provide vaccines. More than one-quarter of nurses (27.8%) and pharmacists (34.7%) and slightly fewer physicians (21.3%) felt under professional pressure to administer vaccines ($p = 0.011$). Most pharmacists (81.0%) and physicians (85.1%) and nearly all nurses (97.2%) felt they had enough information to recommend vaccines to patients, and to answer patients' questions about vaccines (82.6%, 85.1%, and 97.2% respectively) with little inter-profession variability.

Nearly one-quarter (24.0%) of pharmacists reported vaccines to be too time consuming to give compared to their physician (14.9%) and nurse (2.8%) colleagues ($p = 0.001$) (Table 4). Almost one-half of pharmacists (44.6%) found obstacles regarding record-keeping to be a significant barrier, whereas only 11.1% of nurses and 12.8% of physicians reported feeling this way ($p < .001$). A minority of nurses (13.9%), nearly one-third (29.8%) of physicians, and more than one-half of pharmacists (54.5%) thought that compensation for providing vaccines is insufficient ($p < .001$). Almost three-quarters of pharmacists (71.1%) identified practice logistics as a factor in deciding whether to give vaccines compared to roughly one-third of nurses and physicians (30.6%, 34.0%, $p < .001$). Working in a solo setting also reportedly makes it challenging for the majority of pharmacists surveyed (71.9%) to provide vaccines compared to their nurse (25.0%) and physician (12.8%) colleagues ($p < .001$).

Table 4. Provider logistics.

Characteristic	Pharmacists		Nurses		Physicians		Inter-Profession Measure of Significance <i>p</i> -value	Total		
	n = 121 (59.3%)		n = 36 (17.6%)		n = 47 (23.0%)			n = 204 (100%)		
	n	%	n	%	n	%		n	%	95% CI
Do you have a method for identifying unvaccinated adult patients?										
Yes	12	13.3	23	65.7	36	78.3	< .001	71	41.5	(33.4, 50.1)
No	78	86.7	12	34.3	10	21.7		100	58.5	(49.9, 66.6)
My colleagues think it is important for me to provide vaccines										
Disagree	6	5.0	0	0.0	0	0.0	.093	6	2.9	(1.2, 7.3)
Neither agree nor disagree	23	19.0	2	5.6	8	17.0		33	16.2	(10.9, 23.3)
Agree	92	76.0	34	94.4	39	83.0		165	80.9	(73.5, 86.6)
I feel under professional pressure to administer vaccines										
Disagree	49	40.5	24	66.7	23	48.9	.011	96	47.1	(38.9, 55.4)
Neither agree nor disagree	30	24.8	2	5.6	14	29.8		46	22.5	(16.4, 30.2)
Agree	42	34.7	10	27.8	10	21.3		62	30.4	(23.3, 38.6)
I have enough information to recommend vaccines to patients										
Disagree	15	12.4	1	2.8	4	8.5	.214	20	9.8	(5.9, 15.9)
Neither agree nor disagree	8	6.6	0	0	3	6.4		11	5.4	(2.7, 10.5)
Agree	98	81.0	35	97.2	40	85.1		173	84.8	(77.8, 89.9)
I have enough information to answer patients' questions about vaccines										
Disagree	14	11.6	1	2.8	6	12.8	.235	21	10.3	(6.2, 16.5)
Neither agree nor disagree	7	5.8	0	0	1	2.1		8	3.9	(1.7, 8.6)
Agree	100	82.6	35	97.2	40	85.1		175	85.8	(79.0, 90.7)
I understand how to report an adverse event following immunization										
Disagree	10	8.3	1	2.8	8	17.0	.066	19	9.3	(5.5, 15.4)
Neither agree nor disagree	10	8.3	0	0	2	4.3		12	5.9	(3.0, 11.2)
Agree	101	83.5	35	97.2	37	78.7		173	84.8	(77.8, 89.9)
The increasing number of vaccines makes it too complicated to provide them										
Disagree	82	67.8	33	91.7	29	61.7	.009	144	70.6	(62.5, 77.6)
Neither agree nor disagree	23	19.0	3	8.3	8	17.0		34	16.7	(11.3, 23.8)
Agree	16	13.2	0	0	10	21.3		26	12.7	(8.2, 19.4)
Vaccines are too time consuming to give										
Disagree	74	61.2	34	94.4	31	66.0	.001	139	68.1	(59.9, 75.4)
Neither agree nor disagree	18	14.9	1	2.8	9	19.1		28	13.7	(8.9, 20.5)
Agree	29	24.0	1	2.8	7	14.9		37	18.1	(12.6, 25.4)
Obstacles related to vaccine record-keeping are a significant barrier to vaccination										
Disagree	50	41.3	31	86.1	31	66.0	< .001	112	54.9	(46.5, 63.0)
Neither agree nor disagree	17	14.0	1	2.8	10	21.3		28	13.7	(8.9, 20.5)
Agree	54	44.6	4	11.1	6	12.8		64	31.4	(24.2, 39.6)
Compensation for provision of vaccination is sufficient										
Disagree	66	54.5	5	13.9	14	29.8	< .001	85	41.7	(33.7, 50.0)
Neither agree nor disagree	36	29.8	23	63.9	15	31.9		74	36.3	(28.7, 44.6)
Agree	19	15.7	8	22.2	18	38.3		45	22.1	(15.9, 29.7)
Practice logistics are a factor in deciding whether or not to give vaccines										
Disagree	12	9.9	20	55.6	22	46.8	< .001	54	26.5	(19.8, 34.4)
Neither agree nor disagree	23	19.0	5	13.9	9	19.1		37	18.1	(12.6, 25.4)
Agree	86	71.1	11	30.6	16	34.0		113	55.4	(47.0, 63.5)
Working in a solo practice setting makes it very difficult to provide vaccines										
Disagree	10	8.3	12	33.3	12	48.9	< .001	45	22.1	(15.9, 29.7)
Neither agree nor disagree	24	19.8	15	41.7	18	38.3		57	27.9	(21.1, 36.0)
Agree	87	71.9	9	25.0	6	12.8		102	50.0	(41.7, 58.3)

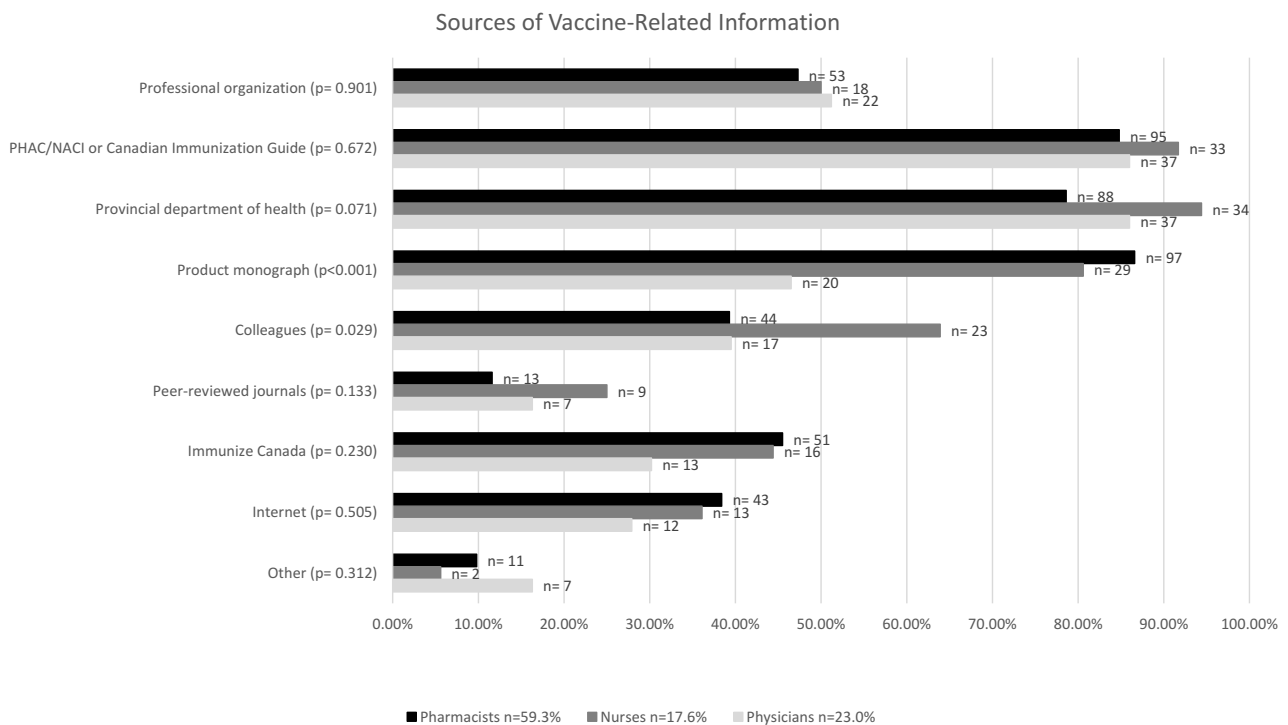


Figure 2. Sources of vaccine-related information. Bars indicate the number and proportion of pharmacists, nurses, and physicians who identified each source of vaccine-related information in a select-all-that-apply question.

The two most commonly identified sources of vaccine-related information among pharmacists were the product monograph (86.6%) and the Public Health Agency of Canada (PHAC), NACI or Canadian Immunization Guide (all three of which were categorized together) (84.8%) (Figure 2). Nurses most commonly identified the provincial department of health (94.4%) and the PHAC, NACI or Canadian Immunization Guide (91.7%) as sources of vaccine-related information, as did their physician counterparts except in no particular order (PHAC, NACI or Canadian Immunization Guide (86.0%) and the provincial department of health (86.0%)). More pharmacists (86.6%) and nurses (80.6%) than their physician counterparts (46.5%) identified product monographs as sources of vaccine-related information ($p < .001$). Nurses tended to rely on their colleagues as sources of vaccine-related information (63.9%) more than physicians (39.5%) or pharmacists (39.3%) ($p = 0.029$). The least commonly identified source of vaccine-related information across pharmacists (11.6%), nurses (25.0%), and physicians (16.3%) was peer-reviewed journals.

Attitudes and beliefs about pharmacists as immunizers

Most pharmacists supported the expansion of their practice to include the provision of vaccines to adults (95.9%) and to children and adolescents aged 5 to 18 years old (92.6%) (Table 5). Fewer nurses (72.2% and 69.4%, respectively) and even fewer physicians (61.7% and 40.4% respectively) were supportive of these expansions ($p < .001$). There was considerable ambivalence among physicians about the expanded scope of pharmacists' practice (with 17.0% and 12.8% of them neither agreeing nor disagreeing with the statements, respectively) compared to their nurse and pharmacist colleagues.

Diversity of opinion was evident among pharmacists about whether they should be allowed to vaccinate children younger than five (Table 5). Slightly more than one-third (33.1%) believed that they should, 27.3% were uncertain, and 39.7% thought that they should not. More nurses and physicians were against pharmacists vaccinating children younger than five in comparison (52.8% and 66.0%, respectively, $p = 0.002$). However, 41.7% of nurses favored pharmacists vaccinating children under the age of five.

While most pharmacists surveyed (86.0%) believed they have enough training to give vaccines, far fewer of their nurse (47.2%) and physician (31.9%) peers held this belief ($p < .001$) and only 66.7% of nurses and 55.3% of physicians would refer a patient to a pharmacist for a vaccine. Most healthcare providers across all three professions surveyed believed that vaccines should be administered in public health clinics and family physician's offices. Nearly all pharmacists surveyed (95.9%) thought that vaccines should also be administered in pharmacies, but again their nurse (69.4%) and physician (61.7%) colleagues were less supportive ($p < .001$).

Factors associated with perceptions of pharmacists as immunizers

Being a pharmacist, working in the hospital, administering less than six vaccines per month, finding record-keeping to be an obstacle, believing compensation for vaccination to be insufficient, and identifying logistics as a factor in deciding whether or not to be vaccinated were associated with positive beliefs about pharmacists as immunizers in the univariable analyses (Table 6). For the direction and magnitude of effect, please refer to Table S1.

Table 5. Perceptions of pharmacists as immunizers.

Characteristic	Pharmacists		Nurses		Physicians		Inter-Profession Measure of Significance <i>p</i> -value	Total		
	n	%	n	%	n	%		n	%	95% CI
I support the expansion of pharmacists' scope of practice to include provision of vaccines to adults										
Disagree	3	2.5	8	22.2	10	21.3	< .001	21	10.3	(6.2, 16.5)
Neither agree nor disagree	2	1.7	2	5.6	8	17		12	5.9	(3.0, 11.2)
Agree	116	95.9	26	72.2	29	61.7		171	83.8	(76.7, 89.1)
I support the expansion of pharmacists' scope of practice to include provision of vaccines to children and adolescents (aged 5 to 18 years old)										
Disagree	4	3.3	9	25	22	46.8	<.01	35	17.2	(11.8, 24.4)
Neither agree nor disagree	5	4.1	2	5.6	6	12.8		13	6.4	(3.4, 11.8)
Agree	112	92.6	25	69.4	19	40.4		156	76.5	(68.7, 82.8)
Pharmacists should be allowed to vaccinate children under the age of 5 years old										
Disagree	48	39.7	19	52.8	31	66	.002	98	48.0	(39.8, 56.4)
Neither agree nor disagree	33	27.3	2	5.6	5	10.6		40	19.6	(13.8, 27.1)
Agree	40	33.1	15	41.7	11	23.4		66	32.4	(25.1, 40.6)
Pharmacists have enough training to administer vaccines										
Disagree	4	3.3	10	27.8	14	29.8	<.001	28	13.7	(8.9, 20.5)
Neither agree nor disagree	13	10.7	9	25	18	38.3		40	19.6	(13.8, 27.1)
Agree	104	86	17	47.2	15	31.9		136	66.7	(58.4, 74.0)
I would refer a patient to receive a vaccine from a pharmacist at a pharmacy										
Disagree	N.A.	N.A.	9	25	11	23.4	.282 ^b	20	24.1	(14.8, 36.8)
Neither agree nor disagree	N.A.	N.A.	3	8.3	10	21.3		13	15.7	(8.4, 27.4)
Agree	N.A.	N.A.	24	66.7	26	55.3		50	60.2	(47.1, 72.0)
Where do you think vaccines should be administered? (Select all that apply)										
Family doctor's office	113	93.4	31	86.1	44	93.6	.332	188	92.2	(87.6, 95.5)
Public health clinic	119	98.3	34	94.4	44	93.6	.172	197	96.6	(93.1, 98.6)
Pharmacy	116	95.9	25	69.4	29	61.7	<.001	170	83.3	(77.5, 88.2)

^bThe *p*-value presented here is a two-way measure of the (dis)similarity of nurses and doctor responses to this question, as pharmacists were ineligible to answer.

Nurse and physician respondents had statistically significantly lower odds of believing pharmacists have enough training to vaccinate ($p < .001$), of thinking that vaccines should be given in a pharmacy ($p < .001$), and of supporting the expansion of pharmacists' scope of practice ($p < .001$) than pharmacists did in the multivariable analyses (Table 6). Beliefs about sufficiency of compensation for the provision of vaccination were statistically significantly associated with whether a nurse or physician would refer their patient to receive a vaccine in a pharmacy in the multivariable analysis. Practitioners who agreed that compensation was sufficient had lower odds of referring their patients to get vaccinated elsewhere.

Discussion

In theory, pharmacists are well positioned to provide immunizations to the public given their accessibility, trustworthiness, flexibility, and convenience,^{15–18–21–28} but what about in practice? Our objective in doing this study was to determine the perceptions of immunization providers (pharmacists, nurses, and physicians) about pharmacists as immunizers. While physicians and nurses reported minimal logistical challenges associated with providing immunizations, significant challenges persisted for pharmacists as immunizers (i.e. solo practice setting requiring them to leave a pharmacy unattended to provide immunizations, time required to give vaccines,

inadequate compensation, and record-keeping). We also found that healthcare providers were supportive of pharmacists' role as immunizers, but not without provisos and conditions from nurses, physicians, and sometimes even pharmacists themselves.

Logistical challenges

Despite being authorized to provide vaccines for seven years in New Brunswick and four in Nova Scotia when we collected these data, pharmacists continued to experience unique logistical workload and time barriers to immunizing. This finding contrasts a pattern noted elsewhere, of pharmacists in provinces where they can immunize being less concerned about time required to vaccinate, compared to those where they cannot.¹⁷ Pharmacists in our study are not alone in their struggles to navigate the increased workload of immunizing. Elsewhere in Canada, pharmacists are reportedly concerned about the added workload of immunizing, feel pressured to be certified to give vaccines and reach vaccine quotas, and lack the human resources necessary to adapt to their widening scope of practice.¹⁶ Researchers in a study across Canadian provinces found that physicians and pharmacists have insufficient time to give adult immunizations. The latter identifying time constraints as the primary reason why they opt not to give vaccines.¹⁴ Time and the inability to vaccinate on top of other

Table 6. Factors associated with awareness, attitudes, behaviors, and beliefs about pharmacists as immunizers.

Synopsis of Statements	Support Expansion of Pharmacists' Scope of Practice to Include Immunization of Adults	Pharmacists Have Enough Training to Vaccinate	Would Refer a Patient to a Pharmacist for a Vaccine	Vaccines Should be Administered in a Pharmacy
	Univariable/Multivariable <i>p</i> -value	Univariable/Multivariable <i>p</i> -value	Univariable/Multivariable <i>p</i> -value	Univariable/Multivariable <i>p</i> -value
What is your occupation?	< .001/<0.001	< .001/< .001		< .001/< .001
Please indicate the primary setting in which you practice	< .001	< .001		< .001
Are vaccinations provided/administered to children, adolescents and youth in your practice?	< .001	< .001		< .001
Approximately how many vaccines on average do you prescribe/administer per month to children, adolescents, and youth?	< .001	< .001		< .001
Approximately how many vaccines on average do you prescribe/administer per month to adults (18+ years old)?	.006	.016	.041	
Pertussis poses a serious threat to the health of adults			.008	.037
The increasing number of vaccines makes it too complicated to provide them				.015
Obstacles related to vaccine record-keeping are a significant barrier to vaccination	.015	.005		.011
Compensation for provision of vaccination is sufficient	.002	< .001	.072/.029	.010
Practice logistics are a factor in deciding whether or not to give vaccines	.023	< .001		.015
Working in a solo practice setting makes it very difficult to provide vaccines	< .001	< .001		.016
Have you ever received a Tdap vaccine as an adult?		.014		

responsibilities are also barriers experienced by pharmacists across the neighboring United States.¹⁸

The widespread engagement of pharmacists in the delivery of COVID-19 vaccines may have resolved or mitigated some of those logistical barriers. Pharmacy technicians and students are identified in the literature as having untapped potential for mitigating some of the logistical challenges associated with the broadening scope of pharmacists' practice.^{15,18,19,41} In the wake of the COVID-19 pandemic, Nova Scotia became the first province in Canada to authorize regulated pharmacy practitioners with immunization training to administer vaccines, including pharmacy technicians.⁴² Future work should explore whether the inclusion of these providers has had the intended effect of reducing the workload of pharmacists and what further logistical challenges and interprofessional complexities may ensue with this change in practice.

In keeping with the findings of our study, Canadian pharmacists have been identified as having compensation concerns associated with broadening their scope of practice to include immunization.^{14,15,17,41} In fact, almost the exact same proportion of pharmacists in our study believed themselves to be insufficiently compensated for immunizing as in a study across Canadian provinces for which the data were collected several years prior to ours.^{14,17} This suggests that there have been few (if any) changes made to the compensation mechanism of pharmacists over time, despite Canadian pharmacists' widening scope of practice and increased workload. Compensation concerns are not unique to Canadian pharmacists,¹⁸ nor are they restricted to North America alone. Reimbursement was identified as important by most respondents in a global survey and linked by the International Pharmaceutical Federation (IPF) to vaccine equity, accessibility, and sustainability.²² Until such a time when there

are no extra costs for the pharmacist and/or recipient of a vaccine in a pharmacy (i.e., inclusion of pharmacists as administrators of publicly funded vaccines), the inclusion of pharmacists as immunizers may not attain its full potential.

Record-keeping has been identified nationally and internationally as a challenge to the provision of vaccines by pharmacists.^{17,22} Almost half of the countries where pharmacists can immunize in a global survey could not record vaccine administration in a shared vaccine record.²² The inability to access a shared record is reflected in the data from our study too with a majority of pharmacists having no method of identifying unvaccinated adult patients.

As of June 30, 2016, records of all vaccines given by community pharmacists in Nova Scotia are linked to a province-wide Drug Information System (DIS) that all healthcare providers *should* be able to access.⁴³ Physicians, nurses, and pharmacists can see which vaccines have been given by pharmacists in the DIS, but the opposite is not true. Pharmacists are *only* able to see vaccine records in the DIS if an individual was vaccinated by a pharmacist not by Public Health or by their physician. In some cases, pharmacists must also complete additional records and send them to their patients' primary care provider. Pharmacists in New Brunswick experience similar barriers where they cannot upload or access vaccination data in the Public Health Information Solution (PHIS), although they can use the DIS to log vaccinations and that information gets uploaded to the PHIS.

During the COVID-19 pandemic, partnerships between health authorities, provincial departments of health and wellness in Nova Scotia and New Brunswick, and technological bodies have formed to ensure access to COVID-19 vaccine records.^{44–46} Future research should explore whether the

challenges to record-keeping and identification of un- or under-immunized adults highlighted by pharmacists in our study have improved since the introduction of the DIS in Nova Scotia. Researchers should also explore the partnerships and technological innovations borne of the need for accessible COVID-19 vaccine records during the pandemic, and how these might be extended to include other vaccines outside of a COVID context.

Interprofessional complexities

Most healthcare providers (especially pharmacists) surveyed in our study supported pharmacists as immunizers, although some hesitancy to embrace this widening scope of practice was evident among nurses and especially among physicians. This pattern of pharmacists being most supportive of pharmacists as immunizers, followed by nurses, and least of all by physicians has been noted elsewhere,¹⁷ but it conflicts with other literature which suggests that pharmacists feel supported by their physician peers,⁴¹ and that fears of weakened relationships with colleagues are unsubstantiated.¹⁶ Results from a global study of the impact of pharmacists as immunizers reveals limited acceptance by healthcare provider peers and governments to be the two most commonly identified barriers to pharmacists' role in vaccination.²² We agree with the IPF that concerted efforts ought to be made to inform stakeholders (especially other immunization providers and the public) of the benefits of pharmacists as immunizers, and urge the prioritization of interprofessional collaboration.²²

Pharmacists in Canada must complete an immunization and injection course recognized by a national Council on Continuing Education and/or their provincial regulatory authority. The program must address the same immunization competencies (including but not limited to the anticipation, identification, and management of adverse events following immunizations) required of *all* immunizing healthcare professionals in Canada.^{47,48} Concerns about the adequacy of pharmacists' immunization training raised by physicians and nurses in our study have been identified elsewhere in the Canadian literature,¹⁷ despite the rigorous training required of them. We found pharmacists to be aware of the vaccines recommended by the National Advisory Committee on Immunization, with a few notable exceptions which were not unique to pharmacists (the pertussis and meningococcal vaccines). Contrary to their peers' beliefs, more than 80% of pharmacists in our study reported having enough information to recommend vaccines and answer patients' questions about them. This finding corroborates immunization experiences, beliefs, and attitudes expressed by pharmacists in New Brunswick.⁴¹ It would appear that the issue is not so much the adequacy of pharmacists' training as it may be awareness among other healthcare providers of the extent to which pharmacists are trained and qualified to immunize. If this is indeed the case, physicians and nurses ought to be made aware of the training that their pharmacist colleagues receive to immunize and all three professions should be held accountable for knowing the vaccine recommendations for the demographic(s) to whom they provide care. It may also be the case that beliefs held by physicians and nurses in our study are evidence of

enduring healthcare system hierarchies and power dynamics, which likely require more complex, cultural, and system-level changes to the way healthcare is delivered. It will be interesting to see whether and how interprofessional dynamics have changed as the healthcare system and providers within it have been under extraordinary COVID-19-related pressure.

Compared to perceptions in other Canadian literature on this topic,¹⁷ healthcare providers in our study were *more* supportive of expanding the role of pharmacists to include children aged five and over. Still, more than one-third of pharmacists and one-half of physicians and nurses disagreed that pharmacists should be allowed to vaccinate children under the age of five. We did not ask participants in our study *why* they were uncomfortable with pharmacists immunizing children younger than five. However, professional bodies have raised concerns about what will happen from a health monitoring and education perspective if young patients get vaccinated by a pharmacist and not their primary care provider.¹⁵ Pharmacists have also shared a discomfort with the time, stress and effort required to give vaccines to children and to manage their fear of needles.¹⁶

As of 2020, several countries (Argentina, Brazil, Chad, Costa Rica, Denmark, Hong Kong, Kenya, Lebanon, Nepal, South Africa, and the United States) allow pharmacists to vaccinate babies, children, and adolescents.²² Nova Scotia has followed suit, with the College of Pharmacists now allowing pharmacists to vaccinate children as young as two years of age, and between six months and two years for influenza and COVID-19 vaccines specifically.⁴⁹ While challenging to measure the direct impact of immunization policies, researchers should continue trying to do so, especially as pharmacists are authorized to immunize children and infants. Simultaneous qualitative measures of provider, parent, and guardian awareness and perceptions of this changing scope of practice will also be important to contextualize measures of policy impact and for cues about how best to mitigate barriers and concerns as they are identified.

Our finding that nearly one-quarter of the nurses and physicians we surveyed would not refer a patient to get a vaccine from a pharmacist, contradicts a previous study of New Brunswick pharmacists who reported seeing a substantial number of patients referred to them by traditional immunization administrators (i.e., physicians and nurses).⁴¹ It is, however, in keeping with a study of Canadian healthcare providers around half of whom would not refer their patients to a pharmacist for vaccination.¹⁷ In our recently published study, a substantial minority of the public in New Brunswick and Nova Scotia felt more comfortable being vaccinated by a pharmacist if their physician or nurse recommended it.³² Healthcare provider recommendation has also been identified as an influential determinant of immunization uptake among the general public elsewhere in the literature.¹⁴ In sum, people are open to being vaccinated by pharmacists but want traditional healthcare providers (physicians and nurses) to recommend it to them; although not all healthcare providers feel comfortable making that referral.

Much like the beliefs identified by traditional providers about the inadequacy of pharmacists' training to immunize,

addressing their reticence to refer patients to pharmacists for immunization *may* simply be a matter of raising awareness about pharmacist training and competencies. It could also be further evidence to suggest that there are greater and more complex interprofessional factors at play. The pattern that we noted wherein traditional providers satisfied with compensation for vaccinating had lower odds of referring their patients to get vaccinated in a pharmacy has not, to our knowledge, been reported elsewhere and serves as an example of one of the ways that interprofessional complexity and tension is fundamental to the very structure of the healthcare system. In future quantitative research, we recommend that researchers provide the opportunity for physicians and nurses to elaborate on what contributes to their discomfort referring patients to be immunized by pharmacists. We also encourage qualitative work to explore the nuances of this topic.

Limitations

As the sample size of this study was small, some associations may not have been found to be statistically significant, when in fact they may be. Similarly, we may have found statistically significant associations that are not present in the population. We are especially wary of the underrepresentation of physicians and nurses in this study and caution readers that the results may not be generalizable. We acknowledge that the survey was very lengthy (67 questions), which may have deterred prospective participants. Owing to the small sample size, we were unable to complete stratified multivariable analyses to explore (dis)similarities between health professions. Along with our small sample size, the unique population and setting (healthcare providers in two of the smallest provinces in Canada) may pose a threat to external validity.

As with all surveys, ours was susceptible to a social desirability bias despite assurances that the responses would remain anonymous. Other response biases could have also occurred as we asked participants to self-report receipt of vaccines.

Constructs from the Theory of Planned Behaviour and Health Belief Model were the basis of our survey, however we recommend that subsequent surveys use the Royal Society of Canada Vaccine Acceptance Framework as a guide instead.²⁰ The latter has constructs that we feel would have strengthened this work including: the healthcare system, people in place, and an overarching sensitivity to complexity.²⁰

Due to the COVID-19 pandemic, these results are several years old now and may not reflect the current perceptions surrounding pharmacists as immunizers (especially given the large role that they took on in providing COVID-19 vaccines). Instead, they offer a snapshot of perspectives in 2017 when these data were originally collected.

Conclusions

This study demonstrates that healthcare providers are unified in their beliefs about the safety, effectiveness,

recommendations for, and science behind vaccines. Pharmacists are well-positioned and eager to vaccinate, but logistical challenges and interprofessional complexities continue to act as barriers to Nova Scotians and New Brunswickers reaping the full benefit of pharmacists as immunizers. In addition to increasing interprofessional collaboration and awareness of pharmacist training and competence as immunizers, a critical examination of nurses and physicians' discomfort endorsing pharmacists as immunizers is required. As the pharmacy-based immunization workforce continues to diversify, there needs to be a commensurate shift in financing so that pharmacists (and other non-traditional immunizers) can offer vaccines under the same funding model as other healthcare providers. There also continues to be a need for a centralized, accessible digital vaccine registry to help all immunization providers, especially pharmacists, assess patient immunization needs and provide immunization at the point-of-care.

There have been several changes in health policy related to pharmacists as immunizers since the data for this study were collected. Researchers should incorporate parents of children now eligible to be vaccinated by pharmacists and pharmacy technicians currently eligible to give vaccines (in Nova Scotia, at least) into their studies. Researchers working in this area should also collect data on socioeconomic conditions, housing instability, gender, language, race, culture, physical location, and specific immunization providers to get a more holistic picture of exactly *who* is served by pharmacists as immunizers. Finally, researchers might consider exploring whether and how the logistical challenges and interprofessional complexities described in this article have evolved since the onset of the COVID-19 pandemic.

Acknowledgements

The authors would like to acknowledge the Canadian Institutes of Health Research (CIHR), the Canadian Immunization Research Network (CIRN), GlaxoSmithKline Biologicals SA, and Sanofi Pasteur Limited for funding this research. The authors would also like to thank the other members of the Improve ACCESS Team for their contributions to the overall study, and the panel of experts who reviewed our survey instrument for content validity.

Disclosure statement

The authors declare that there are no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper other than those indicated in the Funding details.

Funding

This work was supported by the Canadian Institutes of Health Research (CIHR) through the Canadian Immunization Research Network (CIRN), and through Collaborative Research Agreements with GlaxoSmithKline Biologicals SA, and Sanofi Pasteur Limited. All supporters were provided the opportunity to review this manuscript for factual accuracy, but the authors are solely responsible for final content and interpretation. The authors received no financial support or other form of compensation related to the development of the manuscript

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Ethical approval statement

The research protocol was approved by Research Ethics Boards at the Nova Scotia Health Authority (#1021559), Horizon Health (RS 2016-2351), and St. Francis Xavier University (#22895).

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