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RESEARCH PAPER

Vaccination during pregnancy: Canadian maternity care providers' opinions and practices

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ABSTRACT

A number of countries have implemented vaccination in pregnancy as a strategy to reduce the burden of influenza and pertussis. The aim of this study was to assess the involvement of Canadian maternity care providers in administration of vaccines to their pregnant patients. A cross-sectional web-based survey was sent to family physicians, obstetricians-gynecologists, midwives, pharmacists, and nurses. A multivariable logistic regression model was used to determine variables independently associated with offering vaccination services in pregnancy in providers' practice. A total of 1,135 participants participated. Overall, 64% (n = 724) of the participants reported offering vaccines in their practice and 56% (n = 632) reported offering vaccines to pregnant patients. The main reasons reported for not offering vaccination services in pregnancy were the belief that vaccination was outside of the scope of practice; logistical issues around access to vaccines; or lack of staff to administer vaccines. In multivariable analysis, the main factors associated with vaccination of pregnant patients in practices where vaccination services were offered were: providers' confidence in counseling pregnant patients about vaccines, seeing fewer than 11 pregnant patients on average each week, and being a nurse or a family physician. Although the majority of participants expressed strong support for vaccination during pregnancy, half were not offering vaccination services in their practice. Many were not equipped to offer vaccines in their practice or felt that it was not their role to do so. To enhance vaccine acceptance and uptake in pregnancy, it will be important to address the logistical barriers identified in this study.

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Introduction

Pregnant persons[a] are at higher risk of contracting some vaccine-preventable diseases, and from suffering complications once infected.[1-3] Because neonates and infants are also more susceptible to vaccine-preventable diseases such as pertussis, the vaccination schedule in Canada starts when infants are 2 months of age and the first series is completed at 6 months of age. However, infants remain at risk prior to their first vaccination at 2 months of age. To address this "immunity gap"[4] vaccination during pregnancy has been used.[5,6] In Canada, the influenza vaccine has been recommended during pregnancy since 2007.[7] Given the demonstrated safety of pertussis-containing vaccines in pregnancy and their effectiveness for protecting neonates and infants, a number of countries have implemented maternal vaccination programs as a strategy to reduce the burden of the disease.[8] As of February 2018, Canada's National Advisory Committee on Immunization (NACI) recommended that Tetanus Toxoid, Reduced Diphtheria Toxoid, and Reduced Acellular Pertussis (Tdap) be administered in every pregnancy, with the aim of protecting newborn infants from severe outcomes of pertussis infection.[9] In addition, potential new vaccines, such as for group B streptococcus, cytomegalovirus, and respiratory syncytial virus that are presently in clinical trials, are anticipated to be available to pregnant

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persons in the future to prevent diseases in infants and/or fetuses.[4]

Coverage for recommended vaccines in pregnancy remains suboptimal in most high-income countries.[8] Barriers to vaccine uptake in pregnancy are diverse and include a lack of awareness, lack of acceptance, or lack of access to vaccination services.[10-13] A key factor influencing a pregnant person's decision to accept a vaccine is receiving a strong recommendation from a maternity care provider. Many studies have shown that providers' vaccination recommendations, along with access to vaccines in their office, are strongly associated with increased vaccine uptake in this population.[14,15] Unfortunately, studies have also shown that many maternity care providers do not view vaccine administration as a part of their scope of practice.[16-22] Maternity care providers often report that vaccines should be administered by other health-care professionals or that patients prefer to receive vaccination elsewhere.[19,23-25] Insufficient time during the consultation to inform and educate patients about vaccination during pregnancy was identified as an additional challenge.[18]

Logistical issues in providing vaccination services in pregnancy are also a significant barrier to maternity care provider use. For example, the most commonly reported reasons for not administering vaccines in maternity care providers' offices include the costs of providing vaccination services (e.g., logistics to maintain the cold chain; costs related to vaccine supply) and insufficient reimbursement for vaccine administration in routine appointments.[16,17,19-26] Appropriate remuneration for vaccine services may be an incentive to provide vaccinations in maternity care providers' practices.[27,28]The majority of studies related to logistical issues have been conducted in the United States; thus, their conclusions need to be interpreted cautiously given the differences in prenatal health care and vaccination service delivery in Canada.

In Canada, vaccination programming is a shared responsibility between federal, provincial, and territorial governments, with provincial and territorial governments and local public health authorities undertaking the planning and delivery of immunization programming. Physicians and nurses are the most involved in vaccine administration. Administration varies among provinces and territories: for instance, in Alberta, physicians administer adult vaccines, but childhood vaccines are delivered by nurses in public health clinics, whereas in Quebec, around half of childhood vaccines are given by family physicians or pediatricians in private clinics and half by nurses in public health clinics. At the time of this study, only the influenza vaccination was recommended in pregnancy. During influenza season, Canadians can receive the vaccine in public health clinics, in some family physician offices or in pharmacies (in nine Canadian provinces).

The aim of this study was to assess the involvement of Canadian maternity care providers (obstetricians, family physicians, midwives, nurses, and pharmacists) in the administration of vaccines to their pregnant patients. Providers' opinions regarding the pertussis vaccine were also assessed.

Materials and methods

Recruitment

In Canada, prenatal care is provided by different health-care professionals and no official list of maternity care providers is available. The data collection process was led by the Society of Obstetricians and Gynecologists of Canada (SOGC) in partnership with other professional organizations that represent maternity care providers: the College of Family Physicians of Canada (CFPC), the Canadian Pharmacists Association, the Canadian Association of Midwives (CAM), the Canadian Association of Perinatal and Women's Health Nurses (CAPWHN), and *l'Association des obstétriciens et gynécologues du Québec* (AOGQ). The invitation and link to complete an online survey were sent by e-mail to relevant members of each partner organization via organizational listservs and membership lists. To be eligible, participants needed to care for pregnant patients.

Data collection

The development of the survey was informed by a literature review and semi-structured interviews with 22 Canadian maternity care providers.[29] The survey was pilot-tested with five providers (family physicians, obstetricians-gynecologists and nurses) and adjustments were made to ensure clarity. In addition to eight demographic questions (e.g., professional specialty, place of practice, mean number of pregnant patients seen each week, etc.), the survey included 48 items designed to collect information across five themes:[2] vaccine availability and vaccine administration in providers' practice; (2) providers' attitudes and beliefs regarding the benefits and risks of vaccinating pregnant patients against pertussis; (3) providers' self-estimated level of knowledge regarding vaccination in general and regarding vaccination during pregnancy and confidence in discussing vaccination with pregnant patients; (4) providers' sources of information on vaccination in general and level of confidence in these different sources; and (5) providers' vaccination behaviors. Most of the items were closed-ended and could be answered on 7-point Likert scales (ranging from "strongly agree" to "strongly disagree" with the option to answer "I don't know" or ranging from "know nothing" to "expert").

It took approximately 10 min to complete all items and the survey was available in both official languages in Canada: English and French. All responses were anonymous. This study received approval from the CHU de Quebec-Université Laval Research Ethics Board (2016–2741).

Data analysis

Descriptive statistics were generated for all variables (frequencies, percentages, means) using SAS version 9.4 (SAS Institute Inc., Cary, North Carolina). Responses to open-ended questions were analyzed following standard protocols in content analysis to create categories in Excel and then imported into SAS 9.4. We compared responses against different maternity care providers' characteristics (e.g., number of years of practice, primary specialization, etc.) using Chi-square or Fisher's exact tests. A multivariable logistic regression model was used to determine variables independently

Table 1. Study participants' characteristics (n = 1,135).

	Providers who don't vaccinate pregnant women in their practice (n = 503)[a]		Providers who vaccinate pregnant women in their practice (n = 632)[a]		Total (n = 1135)		
Characteristics	N	%	N	%	N	%	P value
Profession							
Family Physician/General practitioner	66	13.1	236	37.3	302	26.6	<.0001
Obstetrician-gynecologist	200	39.8	73	11.6	273	24.1	
Midwife	190	37.8	28	4.4	218	19.2	
Nurse	26	5.2	194	30.7	220	19.4	
Pharmacist	18	3.6	95	15.0	113	10.0	
Other	3	0.6	6	0.9	9	0.8	
Gender							
Male	57	11.3	54	8.6	111	9.8	.016
Female	433	86.1	568	90.6	1001	88.6	
Other	13	2.6	5	0.8	18	1.6	
Number of years of practice							
Less than a year	50	10.0	35	5.6	85	7.5	<.0001
1–9 y	192	38.3	211	33.5	403	35.6	
10–19 y	141	28.1	155	24.6	296	26.2	
20–29 y	68	13.6	125	19.8	193	17.1	
≥30 y	50	10.0	104	16.5	154	13.6	
Professional training							
Mostly received in Canada	447	89.4	592	94.6	1039	92.3	.0016
Mostly received outside Canada	53	10.6	34	5.4	87	7.7	
N of pregnant patients seen each week							
21 or more	291	58.4	171	27.5	462	41.3	<.0001
From 11 to 20	107	21.5	96	15.4	203	18.1	
From 6 to 10	54	10.8	130	20.9	184	16.4	
5 or less	46	9.2	225	36.2	271	24.2	
Missing	5	-	10	-	15	-	
Have received the flu vaccine during the 2016/17 season							
Yes	373	74.2	578	91.5	951	83.8	<.0001
No	130	25.8	54	8.5	184	16.2	
Have recommended the flu vaccine during the 2016/17 season							
To all of my pregnant patients	264	52.5	495	78.7	759	67.0	<.0001
To some of my pregnant patients	158	31.4	97	15.4	255	22.5	
To none of my pregnant patients	39	7.8	8	1.3	47	4.2	
Don't know/Prefer not to answer	42	8.3	29	4.6	71	6.3	

[a]Missing answers are excluded in the calculations of percentages.

associated with the administration of different vaccines to pregnant patients in providers' practices where vaccines were already offered. Variables associated in the univariate analysis at $p \leq 0.20$ were entered into the multivariable regression model using stepwise selection (forward and backward). Each rejected variable was reevaluated in the final model to assess model fit. A probability level of $p < .05$ based on two-sided tests was considered statistically significant. Collinearity was checked, and model fit was assessed using the Akaike Information Criterion (AIC) and the Hosmer and Lemeshow test.

Results

Participants' characteristics

A total of 1,542 participants completed the survey, of whom 129 (8%) were excluded because they did not care for pregnant patients. Another 278 surveys were excluded from analysis because participants did not answer the sociodemographic section (n = 271) or submitted a blank survey (n = 7). The final analysis includes 1,135 participants. Overall, 64% (n = 724) of the participants reported offering vaccines in their practice and 56% (n = 632) reported offering vaccines to pregnant patients. No participants reported vaccinating only pregnant patients (i.e., those who vaccinate pregnant patients in their practice were also vaccinating other patients). The majority of participants (84%, n = 951) had been vaccinated themselves against influenza during the last vaccination campaign. Table 1 shows the participants' characteristics.

Administration of vaccines in participants' practice

Figure 1 presents the practices of providers who reported that they did not (44%, n = 503) and that they did (56%, n = 632), provide vaccines to pregnant patients in their practice. Of the 632 participants who were vaccinating pregnant patients in their practice, 577 (91%) reported that vaccines were administered within the same scheduled prenatal visit.

Among the 632 providers who were offering vaccination services in pregnancy, the most commonly administered vaccines in pregnancy were the influenza vaccine (94%, n = 593) and the pertussis vaccine (64%, n = 405). Some participants (19%, n = 121) reported giving other vaccines, mainly the hepatitis A and hepatitis B vaccines.

The majority of the participants who were not offering vaccination services in pregnancy did not intend (86%, n = 350) or were unsure (12%, n = 50) about doing so in their practice in the following year. The main reasons were the belief that vaccination was outside of their scope of practice; they had logistical issues regarding access to vaccines; or they lacked staff to administer the vaccines. The majority of participants not vaccinating pregnant patients in their practice reported referring patients elsewhere for vaccination (93%, n = 421).

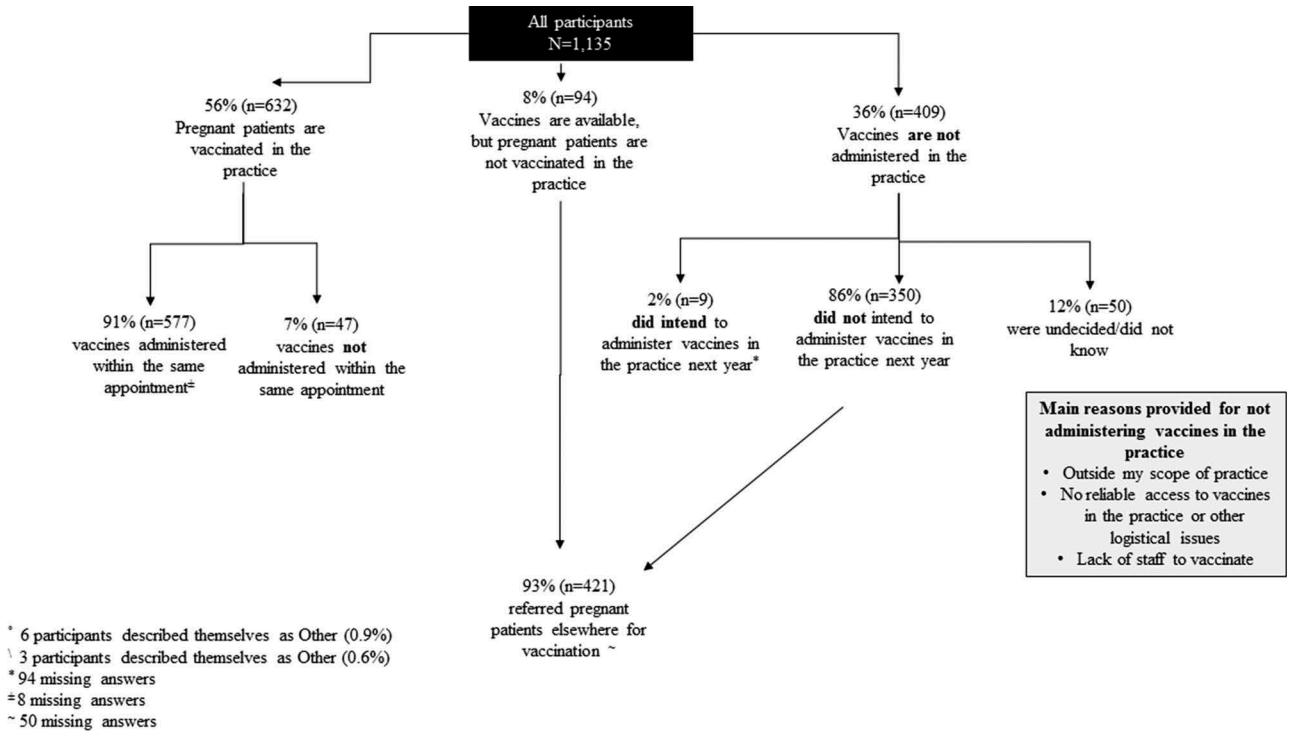

Figure 1. Participants' practices regarding vaccination.

In an open-ended question, providers who were not offering vaccines to pregnant patients were asked about what they would need to feel more equipped to administer vaccines in their practice. Support with logistical issues (n = 100); more education and training for providers (n = 84); more patients to vaccinate (n = 64) and the inclusion of vaccination in providers' scope of practice (n = 51) were the most frequently reported needs.

Participants' vaccination counseling

Table 2 and Figure 2 show participants' confidence in their ability to discuss vaccines with their pregnant patients. Seventy (70%, n = 795) and 69% (n = 768) of providers felt confident in their abilities to provide vaccination counseling to pregnant patients and to administer vaccines, respectively. Statistically significant differences in level of confidence were found between providers who were offering vaccination services to pregnant patients and those who were not and across the type of profession (Figure 2).

Participants' knowledge and trust in sources of information about vaccination

The majority of the 1,135 participants reported having a high level of knowledge about vaccination in general (58%, n = 654) and about vaccination during pregnancy (57%, n = 651). A greater proportion reported having a high level of knowledge specifically about influenza vaccination (78%, n = 885) compared to pertussis vaccination during pregnancy (52%, n = 585). Providers who were offering vaccination services in their practice generally reported higher levels of knowledge (Table 3).

Table 2. Participants' perceptions of vaccination counseling.

	Providers who vaccinate pregnant patients in their practice[d] n = 632		Providers who don't vaccinate pregnant patients in their practice[d] n = 503		Total[d] n = 1,135		
	n	% (Row)	n	% (Row)	n	% (Col)	P value
I am confident offering advice about vaccines to pregnant patients[a]	496	78.5	299	59.4	795	70.2	<.0001
I am confident in vaccinating pregnant patients (myself or nurse/assistant working with me) as a part of my practice[b]	557	88.1	211	41.9	768	69.2	<.0001
Delivering advice about vaccination to pregnant patients is easy for me[a]	456	72.2	261	51.9	717	63.3	<.0001
I think other maternity care providers discuss vaccination with their pregnant patients[c]	253	40.0	167	33.2	420	41.7	.06

[d]Only include "Strongly agree" and "Agree" responses.
[a]2 missing responses; [b]–25 missing responses; [c]128 missing responses.

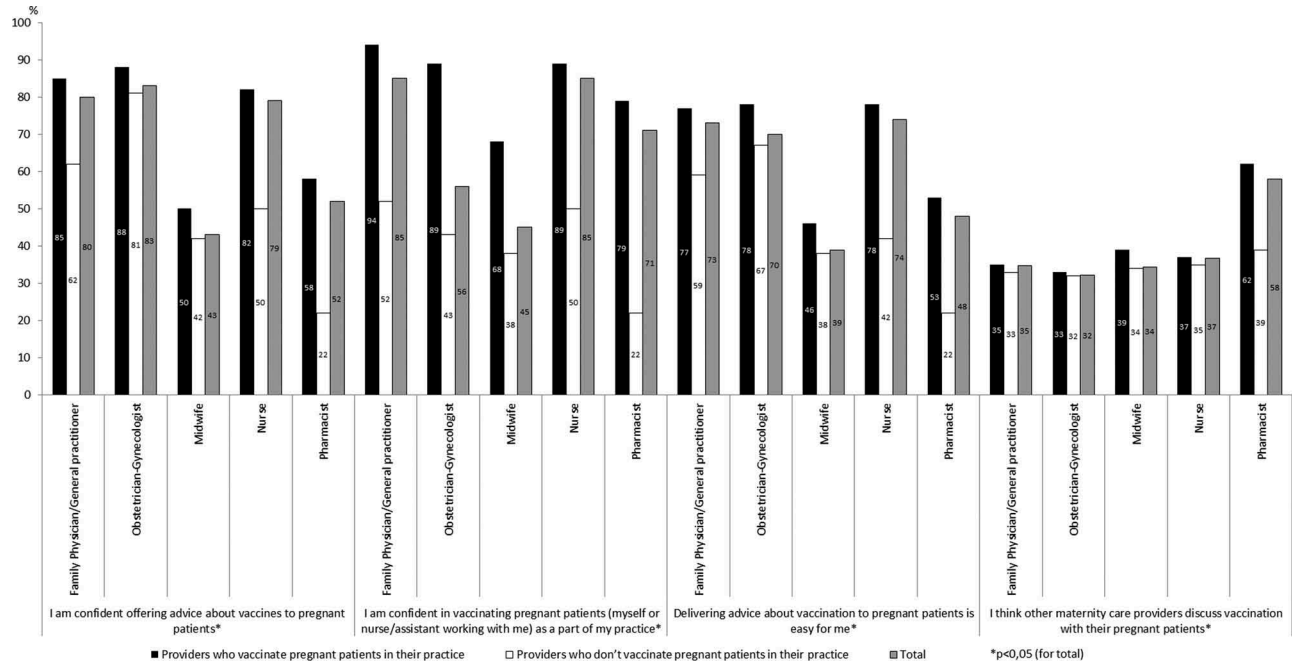

Figure 2. Participants' perceptions of vaccination counseling by type of profession (% "Strongly agree" and "Agree responses").

Table 3. Participants' reported level of knowledge.

	Providers who vaccinate pregnant patients in their practice[a] n = 632		Providers who don't vaccinate pregnant patients in their practice[a] n = 503		Total[a] n = 1,135		
Reported level of knowledge on:	n	% (Row)	n	% (Row)	n	% (Col)	P value
Vaccination in general							
None/Low	190	39.7	289	60.3	479	42.3	<.0001
High[a]	441	67.4	213	32.6	654	57.7	
Vaccination in pregnancy							
None/Low[b]	245	50.8	237	49.2	482	42.5	.005
High[a]	386	59.3	265	40.7	651	57.5	
Vaccination against influenza in pregnancy							
None/Low[b]	117	47.4	130	52.6	247	21.8	.004
High[a]	513	58.0	372	42.0	885	78.2	
Vaccination against pertussis in pregnancy							
None/Low[b]	256	47.0	289	53.0	545	48.2	<.0001
High[a]	372	63.6	213	36.4	585	51.8	

[b]Includes items 1 to 5 on an 8-point Likert scale ranging from Know nothing to Expert.
[a]Includes items 6 to 8 on an 8-point Likert scale ranging from Know nothing to Expert.

Figures 3 and 4 present the participants' trust in different sources of information on vaccination. Providers who were offering vaccines to pregnant patients compared to those who were not had statistically significant differences in trust in the information provided by public health organizations, continuing medical education and conferences, and pharmaceutical companies. Statistically significant differences were also found across the type of profession for all items. Twenty percent (n = 226) of participants strongly agreed or agreed that they were feeling overwhelmed by the increasing number of professional guidelines (data not shown in the figures).

Maternity providers' attitudes and practices regarding pertussis vaccination during pregnancy

Participants' attitudes regarding pertussis vaccination during pregnancy are presented in Figure 5 (n = 964). The majority of all participants reported that the pertussis vaccine was safe and beneficial for pregnant patients. Of note, 10% (n = 105) and 21% (n = 200) of participants answered "I don't know" to the statements regarding the Pertussis vaccine safety for pregnant patients and for the fetus, respectively. As well, 14% (n = 133) of participants did not know if the Pertussis vaccine was effective at reducing the risk of pertussis infection for newborn babies (data not shown in Figure).

Statistically significant differences were found between professions. Midwives generally reported less favorable attitudes toward safety of the pertussis vaccine during pregnancy (22% strongly agreed compared to 62% for all other providers, when excluding "I don't know" answer, $p < .0001$) and effectiveness (22% strongly agreed compared to 48% for all other providers, $p < .0001$). Half of the family physicians reported believing that the pertussis vaccine is safe for the fetus in all trimesters compared to only one-third of obstetrician-gynecologists, nurses and pharmacists and to one out of ten of the midwives. A higher proportion of family physicians, obstetrician-gynecologists and nurses considered vaccination during pregnancy as an effective means to

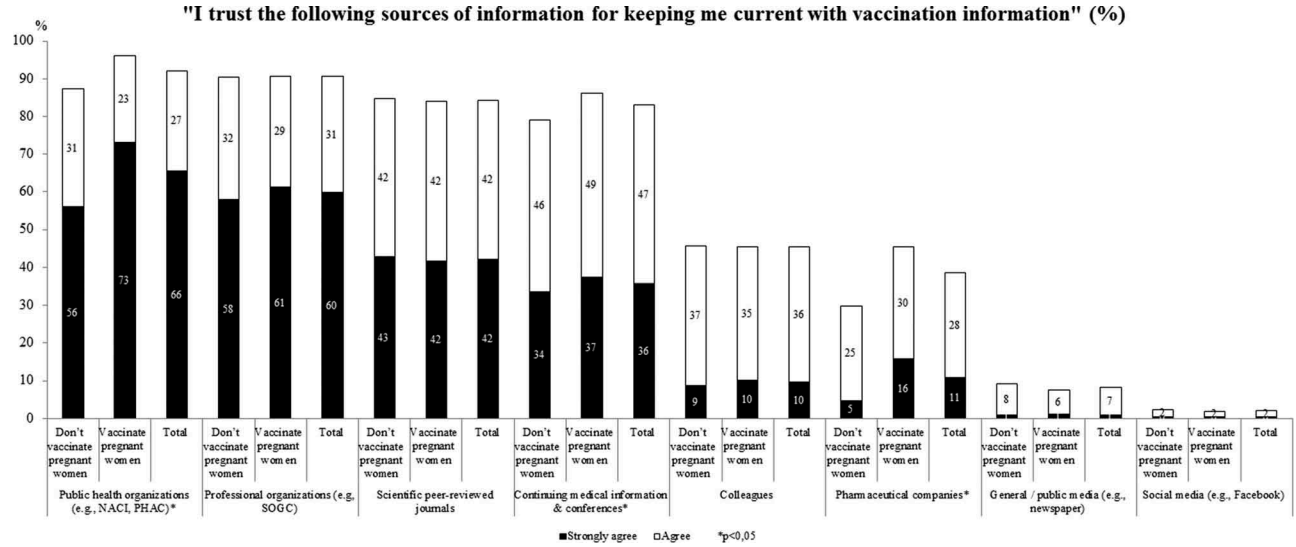

Figure 3. Participants' trust in different sources of information about vaccination.

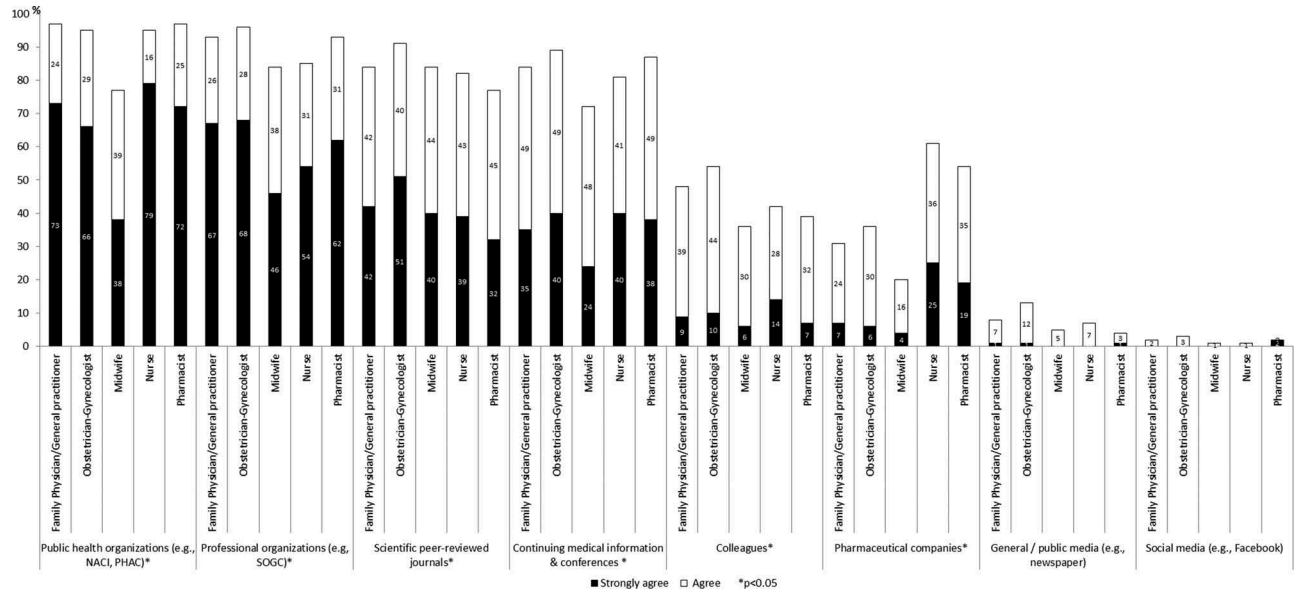

Figure 4. Participants' trust in different sources of information about vaccination by type of profession (%).

protect infants, compared to pharmacists and midwives (71% vs. 44%).

Thirty-five percent (35%, n = 340/964) of all participants endorsed recommending the pertussis vaccine to all pregnant patients. Among the participants that did not routinely recommend the pertussis vaccine to their pregnant patients (n = 624), the most common reasons stated were insufficient education/training (69%, n = 181); concerns about vaccine safety in pregnancy for fetus (19%, n = 50); concerns about vaccine safety in pregnancy for patients (16%, n = 43); concerns about vaccine safety with respect to long-term pediatric outcomes (13%, n = 34); and because the pertussis vaccine was not at that time recommended in Canada for all pregnant patients unless there is an outbreak (18%, n = 48).

Multivariate analysis

A multivariate analysis was conducted to identify the determinants of offering vaccination services in general – not specific to pertussis – to pregnant patients in maternity care providers' practices where vaccination services were already offered (n = 724). The main factors associated with offering vaccination services to pregnant patients were participants' confidence in counseling pregnant patients about vaccines, seeing fewer than 11 pregnant patients on average each week, and being a nurse (Table 4).

Discussion

Vaccination during pregnancy is a single intervention that has the potential to protect pregnant persons themselves through

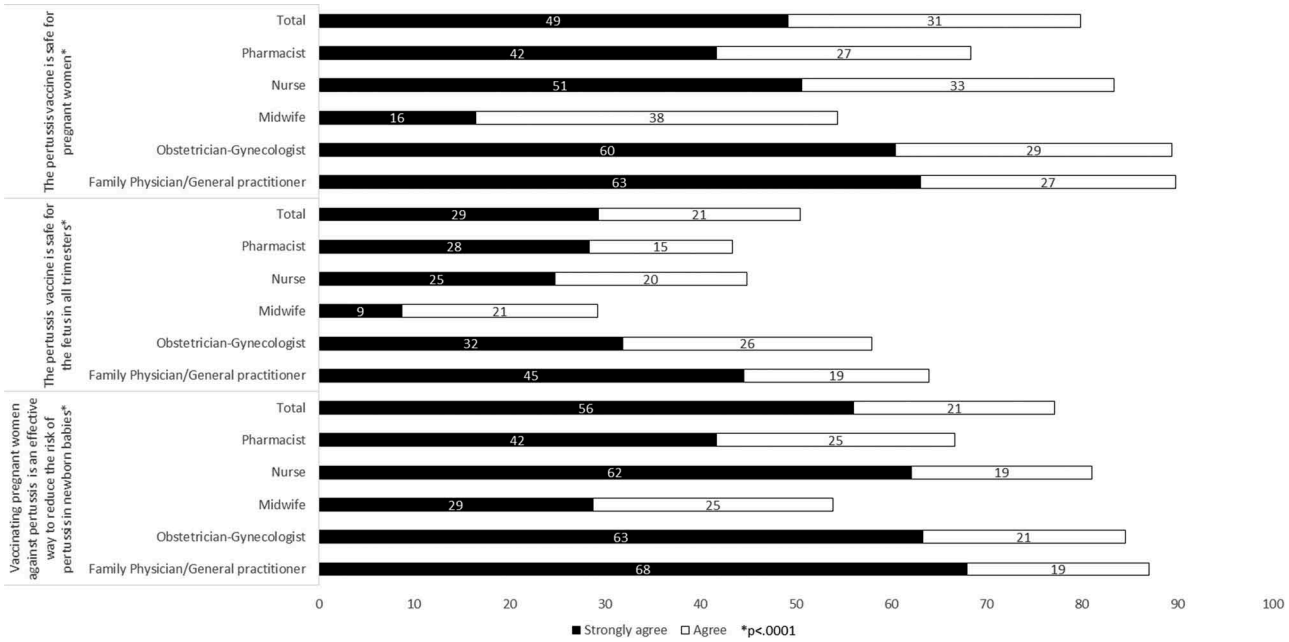

Figure 5. Participants' opinions regarding pertussis vaccination in pregnancy (%).

Table 4. Factors associated with offering vaccination services to pregnant patients in practices offering vaccination services to other clientele (n = 724)[a].

	Adjusted OR	95% CI		P value
Feeling confident in offering advice about vaccines to pregnant patients	6.2	3.4	11.4	<.0001
Seeing fewer than 11 pregnant patients on average each week (vs. seeing 11 or more pregnant patients each week)	2.8	1.5	5.1	.001
Being a nurse or a family physician (vs. being a midwife, an ob/gyn or a pharmacist)	2.2	1.2	4.0	.011
Having recommended influenza vaccine to all pregnant patients during last season	2.1	1.1	3.9	.021
Having received information on influenza vaccination for pregnant patients during last season	1.9	1.0	3.4	.041
Having a high reported level of knowledge on vaccination in general	1.8	1.0	3.4	.05

[a]The odds ratios were adjusted for all other variables shown in the model, as well as for province.

direct immunity as well as their infants through maternally derived antibodies. As indicated in the literature, key determinants of high vaccine uptake in pregnancy are strong recommendations by health-care providers and ease of access to vaccination services.[6,30-32]

In this study, more than half of the maternity care providers offered vaccines to pregnant patients. These providers were generally family physicians and nurses who saw fewer pregnant patients each week. Maternity care providers who saw the highest number of pregnant patients (i.e., obstetricians-gynecologists and midwives) each week were working in practices where no vaccination services were provided. Providers offering vaccination services for pregnant patients may thus be more likely to be caring for different types of patients and to be offering vaccination services as part of their routine care (e.g., childhood vaccines for pediatric patients, influenza vaccines for elderly patients, etc.). They are likely to encounter fewer logistical barriers compared with providers who are specialized in prenatal care, who work in practices where no vaccination services are provided. In another Canadian study, obstetricians-gynecologists were more likely to support vaccination in pregnancy compared to family physicians, but less likely to offer it because they believed it was the responsibility of family physicians or local public health units to provide vaccination.[33] The lack of access to vaccination services represents an important barrier to the implementation of the new NACI recommendation to vaccinate against pertussis in every pregnancy. Provinces/Territories may face important challenges when integrating universal maternal pertussis immunization into the existing model of prenatal care, as many practices delivering prenatal care do not stock vaccines and are not the usual immunization providers.[34]

In our study, the main reasons mentioned by participants who were not offering vaccination services to pregnant patients were that vaccination was outside of their scope of practice, that they were having logistical issues regarding access to vaccines or that they were lacking staff to administer the vaccines. This is similar to findings from studies conducted in other countries.[21,25,35,36] Additional efforts and incentives are needed to encourage prenatal providers to include vaccination services (e.g., easier vaccine distribution channels, access to training, infrastructure for vaccine storage and handling), particularly as guidelines change and more vaccines are recommended during pregnancy. A 2018 review of the literature on strategies for increasing uptake of vaccination in pregnancy in high-income

countries demonstrated that education and information for health-care providers and patients, reminder alerts on medical records, and allowing midwives to administer vaccinations were the most effective strategies to increase vaccine uptake.[37] As shown previously in Canada with pharmacists, expanding the scope of practice of some health-care providers to include vaccination may be an effective method of improving vaccine coverage amongst hard-to-reach populations, including adults.[38]

Multivariable analyses identified that the main determinant of offering vaccination services for pregnant patients in practices already providing vaccines was a high level of confidence in counseling pregnant patients about vaccination. This might reflect the fact that providers working in practices offering vaccines more commonly counsel pregnant patients, have developed specific communication approaches, and feel more equipped to manage these conversations with pregnant patients.[39] A recent qualitative study in an obstetrics-gynecology clinical setting in the United States (US) showed that provider-patient communication approaches, and their influence on maternal vaccine uptake, was an important factor to consider for optimal maternal vaccination services.[40]

To ensure high acceptance and uptake of vaccination in pregnancy, all maternity care providers should strongly recommend vaccination and pregnant patients should be able to receive vaccination on-site, without the need to make an extra appointment. However, the reality is far more complex. Many pregnant patients are cared for in clinics that are not equipped to administer vaccines. The discrepancy between support of vaccination by a majority of maternity care providers and the actual delivery of vaccines in a minority of their practices identified in this study raises some issues regarding access to vaccination. Given the different approaches to prenatal care in Canada, there will not be one unique clinical encounter to integrate the delivery of vaccination for pregnant persons. However, incentives or regulations may be needed to ensure equal access to vaccines for all pregnant persons and make sure that the support of maternity care providers translates into practice. Vaccination is already under the scope of practice of nurses in Canada and pharmacists are allowed to administer the influenza vaccines in many Canadian jurisdictions. The involvement of these professionals may facilitate the implementation of a universal program against pertussis during pregnancy in Canada.

Findings from our survey also indicate that the majority of Canadian maternity care providers are supportive of pertussis vaccination during pregnancy. Only a minority of providers disagreed with statements regarding the safety and effectiveness of pertussis vaccination during pregnancy. However, the fact that between 16% and 26% answered "I don't know" to these questions is noteworthy. Similarly, 40% of providers self-reported their level of knowledge on maternal vaccination against pertussis as moderate to low. Lack of knowledge about the benefits of vaccines during pregnancy is an important barrier to maternity care providers' vaccination recommendations to pregnant patients. Studies have consistently shown that maternity care providers with a higher level of knowledge and more positive attitudes toward vaccination are more likely to discuss and recommend vaccines to their pregnant patients.[19,27,33,41-44] In our study, providers with more years of practice as well as family physicians and nurses, who are the usual immunization providers, were more comfortable in counseling pregnant patients about vaccination. With the new NACI recommendations, efforts are currently undertaken in Canada to address these knowledge gaps among maternity care providers. For example, the Society of Obstetricians and Gynecologists of Canada hosted a live webinar on pertussis with accompanying FAQ and infographic resources (available on www.pregnancyinfo.ca). The SOGC will also launch in June 2019 a comprehensive, accredited e-course. The e-course will be hosted on their online portal and will consist of eight modules that are complemented by over 25 tools and resources for health-care providers (in both French and English).

In our study, we identified statistically significant differences in level of knowledge about vaccination during pregnancy and confidence in discussing vaccination with pregnant patients. Family physicians and nurses were the most well informed and were having the most favorable view of vaccination during pregnancy, while midwives displayed more doubts and reservations. These differences in attitudes toward vaccinations across profession are aligned with findings of previous studies on childhood vaccination.[45,46] A review by Attwell and al. on midwives' attitudes and beliefs about childhood vaccination also concluded that while the majority of midwives supported vaccination, a "spectrum of beliefs and concerns" about vaccinations also emerged.[47]

Given their critical role in influencing vaccine acceptance, it is critically important to support health-care providers' role in vaccination discussion with pregnant patients. It is well known that health-care providers' knowledge and attitudes about vaccines are an important determinant of their own vaccine uptake, their intention to recommend the vaccine to their patients and the vaccine uptake of their patients.[48-50] Health-care providers are assumed to be knowledgeable about the risks and benefits of vaccination, the risks of vaccine-preventable diseases and to be able to communicate this information well to their patients. However, previous studies have indicated that a significant proportion of health-care providers are vaccine hesitant in their personal and professional lives.[46,51] A recent literature review showed that while most health-care providers are favorable to vaccinations, many also have concerns and doubts regarding the safety and usefulness of vaccines.[45] Addressing vaccine hesitancy among health-care providers is of critical importance to enhance vaccine acceptance and uptake in pregnancy.[45]

Only 35% of the maternity care providers surveyed in this study reported routinely recommending the pertussis vaccine to pregnant patients. This was expected given that the survey was conducted prior to the official NACI statement recommending pertussis immunization in every pregnancy.[9] In fact, at the time of the survey, NACI was recommending to offer pertussis vaccine only to those who had not been previously vaccinated in adulthood. Only in special circumstances, such as regional outbreaks, was immunization with pertussis recommended, regardless of the immunization history.[52] Importantly, providers who said they were routinely recommending pertussis vaccine to all their pregnant patients were deviating from the official guidelines and recommendations. Providers who do so may have adopted this practice based on

well-publicized recommendations for universal pertussis immunization in pregnancy that have been in place in the United Kingdom (UK) and the US since 2012.

There are some limitations to this study worth noting. Given our recruitment approach, we were unable to determine the number and characteristics of providers who received the invitation to participate but declined. As the invitation to participate was sent to different professional association membership lists and that a single provider could have received more than one invitation, it is impossible to calculate a response rate, and this is a significant limitation of this study. Thus, the participants may represent a biased sample whose responses differ from the general population of maternity care providers.[53] We cannot exclude either the possibility that responses from multiple participants in the same practice were included in the analysis. Selection bias is possible, as providers interested in maternal immunization (either positively or negatively) might have been more prone to participate. The results are also based on providers' self-report and they might have overestimated some of their practice (e.g., frequency of recommendations to pregnant patients, level of knowledge, etc.). Finally, doubts and concerns regarding vaccination, or vaccine hesitancy, is an important barrier to vaccine acceptance in pregnancy. However, the issue of vaccine hesitancy by pregnant patients was not assessed directly in our survey questionnaire.[39]

In conclusion, although the majority of participants expressed strong support for vaccination during pregnancy, half were not offering vaccination services in their practice. Many were not equipped to offer vaccines in their practice or felt that it was not their role to do so. In countries such as the UK,[54] where family physicians are the primary prenatal care provider, pregnant women are commonly vaccinated in their physician's office. The UK and the US have successfully implemented universal vaccination programs against pertussis during pregnancy, obtaining vaccine coverage of over 70%, at least in the UK.[55,56] In contrast, the diverse prenatal care delivery model in Canada results in significant practice implementation challenges along with difficulties to collect data on coverage in pregnancy. To ensure the success of the implementation of the new recommendation, it will be important to address the logistical barriers identified in this study and to provide incentives to prenatal providers to implement vaccination services in their practice, including appropriate funding. As shown by the inclusion of pharmacists as immunizers, these changes are possible. Given the lack of knowledge of some maternity care providers around pertussis vaccination during pregnancy and the confusion over role and responsibilities around vaccination in pregnancy, it will be important that professional associations in Canada develop continuous education tools and guidelines for providers on this issue. Finally, now that pertussis vaccination is recommended in every pregnancy in Canada, it would be interesting to repeat this survey to assess the evolution of maternity care providers' knowledge, attitudes, beliefs, and behaviors on this issue.

Notes

a We recognize that some pregnant persons may not identify themselves as women or mothers. This is why we used the terms "pregnant persons" to be inclusive to those individuals who do not specifically identify as female gender but are pregnant. We also acknowledge the current debate regarding the terminology patients vs. clients. As no consensual gender-neutral word to refer to pregnant persons seeking prenatal care exists, we have used "pregnant patients" when referring to providers' practices around vaccination in pregnancy.

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