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A Systematic Review of Barriers to Vaccination during Pregnancy in the Canadian Context

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ABSTRACT

Objective: While vaccination in pregnancy has the potential to dramatically impact maternal and infant morbidity and mortality, uptake of recommended vaccinations in pregnancy remains low. Our objective was to identify barriers and facilitators of vaccination during pregnancy in Canada.

Methods: The MEDLINE database, as well as the table of contents of four relevant Canadian journals were screened to identify all studies that considered barriers and/or facilitators to vaccination during pregnancy, specifically in Canadian settings. Citations were screened and a narrative synthesis of findings was undertaken given the heterogeneity of study design.

Results: In total, 17 studies met inclusion criteria, most with a focus on the seasonal and pandemic influenza vaccines. Facilitators and barriers were identified at the level of the patient and the provider. At both levels, knowledge was an important facilitator of vaccine acceptance during pregnancy and was notably improved in studies following the 2009 pandemic H1N1 influenza compared to earlier studies. Vaccine endorsement by a prenatal care provider and clear messages of safety for the fetus emerged as key motivators. Few studies addressed system level barriers or interventions for improving vaccine uptake during pregnancy in the Canadian setting.

Conclusions: Common themes have emerged from the Canadian literature addressing barriers and facilitators of vaccination during pregnancy. However, there is a paucity of literature to suggest strategies to improve the uptake of vaccination during pregnancy in Canadian settings. Further research is urgently needed given the expanding role of vaccination during routine prenatal care.

KEY WORDS

Immunization

Vaccination

Vaccine

Pregnancy

Barriers

INTRODUCTION

Vaccination in pregnancy has the potential to dramatically impact maternal and infant morbidity and mortality. A prime example is the widespread introduction of routine tetanus vaccination during pregnancy throughout the developing world, which led to a 93% reduction in maternal and neonatal tetanus over the last quarter century¹. More recently, in developed nations the influenza and acellular pertussis (Tdap) vaccines have become the focus of maternal vaccination initiatives², and new vaccines in development (e.g. for Respiratory Syncytial Virus, Group B Streptococcus) may eventually be recommended in pregnancy. Currently in Canada, the influenza vaccine is recommended for all pregnant individuals. As of March 2018 Tdap is also recommended by the National Advisory Committee on Immunization³ for all pregnant individuals in every pregnancy. However in Canada, for reasons that remain unclear, uptake of these vaccinations has been limited relative to comparator countries,.

Provincial/territorial estimates for influenza vaccine coverage during pregnancy are not calculated for all Canadian jurisdictions, but where available, estimates of the proportion of women vaccinated against the influenza during pregnancy remain well below 50%. In Nova Scotia, only 17.5% of pregnant women received the influenza vaccine in 2016, compared to 64.1% of adults >65 years⁴. Comparable rates of influenza vaccine uptake were seen among pregnant women in Alberta in 2014-2015 with a 14.58% rate of uptake compared to 62.39% uptake among seniors and 34.9% uptake for children aged 6-23 months⁵. In contrast, population-based estimates from other developed countries suggest uptake rates of 26% in England⁶ and as high as 40-50% in Australia,^{7,8} Ireland⁹ and the United States¹⁰.

The contrast between rates of influenza vaccine coverage for pregnant women in Canada compared to those of pregnant women in similarly-resourced countries is striking, leading to questions regarding the barriers and facilitators for vaccination in pregnancy in the Canadian context. MacDougall and Halperin¹¹ conducted a scoping review of barriers and facilitators to uptake of maternal immunization internationally, finding influences at the patient-level (e.g., vaccine knowledge, perceived disease severity, concern over vaccine safety), health care provider-level (e.g., age, specialty, practice type, and vaccine attitudes), and systems-level (e.g., costs, reimbursement methods, and IT infrastructure). The current analysis builds on the work by MacDougall and Halperin to systematically conduct a more comprehensive review of empirical research on vaccination in pregnancy specifically in Canadian settings, with the objective of identifying factors that prevent or facilitate vaccination of pregnant individuals in Canada.

METHODS

This study systematically reviewed empirical research that identified barriers and facilitators to vaccination in pregnancy among Canadian populations.

Search Strategy

We sought peer-reviewed studies in French or English that used any empirical research method to identify barriers and/or facilitators to vaccination in pregnancy in Canadian settings. Prior to 2001 publically funded provincial programs for influenza vaccine were rare, and Canadian recommendations to include pregnant individuals in influenza vaccination programs have been issued in subsequent years; therefore we sought studies published 2001-2017. Studies were identified through a combination of electronic database searching, searches of key Canadian journals of interest, by hand-searching reference lists of included articles for additional citations, and by consulting Canadian immunization experts for assistance identifying any studies the previous methods failed to find.

We searched the MEDLINE database using the Ovid interface on July 11, 2017, by combining MeSH terms for vaccines, vaccination, and immunization with pregnancy and with Canada (all exploded to include all relevant subheadings; see Appendix for search detail).¹ Searches were conducted by author VP in consultation with author DG, an MLIS-qualified information scientist with expertise in health services and policy reviews. Results were limited to articles focusing on humans that were written in English or French and published in 2001 or after. We electronically searched the contents of the four Canadian journals most likely to publish peer reviewed studies

¹ An additional pilot search of the CINAHL nursing database did not result in unique relevant citations; therefore we did not export and assess these results with the others.

of vaccination in pregnancy (Journal of Obstetrics & Gynaecology Canada, Canadian Medical Association Journal, Canadian Family Physician, and Canadian Journal of Public Health). We then identified additional citations by asking experts on the topic for any missing Canadian literature, and through hand-searching the reference lists of identified articles on the topic.

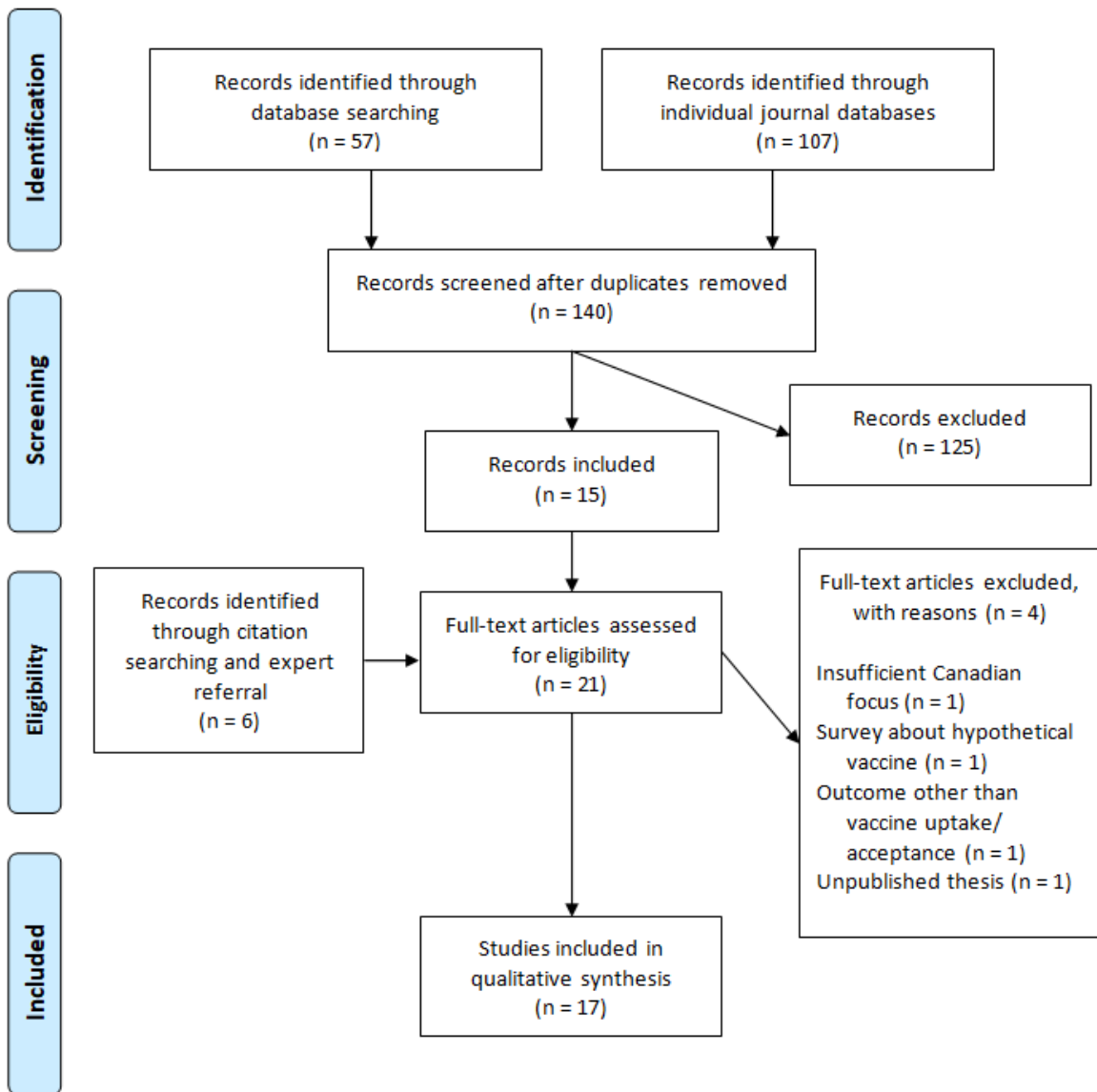
Inclusion and Exclusion Criteria

Studies eligible for inclusion focused wholly or in part on a Canadian population and on vaccination in pregnancy, were peer-reviewed, published in 2001 or later in English or French, and identified, attempted to address, or otherwise studied barriers to or facilitators of vaccination in pregnancy, using any empirical research method. Studies that did not identify or address patient, provider, or system barriers and/or facilitators to vaccination of pregnant individuals in Canada were excluded from the study, as were commentaries, review articles without meta-analysis, clinical guidelines, cost-effectiveness analyses and studies that focused on outcomes of vaccination in pregnancy.

Citation Screening

Citations identified through our searches were exported to an EndNote database. After de-duplication, titles and abstracts were screened and articles that did not meet inclusion criteria were excluded. All potentially-includable articles were obtained in full text and read to ensure that they met inclusion criteria, and any that did not were discarded prior to data extraction and analysis. Two authors assessed all studies for inclusion (VP and DG) and any disagreements about eligibility were decided by the third author (EC). See Figure 1 for PRISMA Flow Diagram of the search and screening process.

Figure 1. Prisma Diagram of Search and Screening Process



Data Analysis

Data was abstracted from included studies using Microsoft Excel, within which studies were characterized according to their year of publication, population attributes, research method(s), vaccine(s) under study, and whether the study addressed barriers and/or facilitators at the patient, population or system level. Given the heterogeneity of study design among the studies,

statistical meta-analysis was not possible; therefore we conducted a narrative synthesis of factors at each level.

RESULTS

A total of 57 studies were identified through the MEDLINE search and 107 were identified by searching journal contents. After de-duplication, this totaled 140 unique citations, which were winnowed to 15 by screening title and abstract. An additional 6 studies were identified through hand-searching the reference lists of published articles and by asking experts on the topic for any missing Canadian literature. Figure 1 depicts the flow of citations through the different stages of this review, including reasons for excluding 4 of these 21 full text documents. In total, 17 studies met inclusion criteria. These included studies are summarized in Table 1.

Author, Date	Data Year	Vaccine	Study Methods	Setting	Population	Barriers / Facilitators	Limitations
Bettinger, 2016	2010-2011	Seasonal influenza immunization	Pre/post survey; focus groups	Greater Vancouver, British Columbia	34 pregnant and postpartum women recruited from obstetric waiting rooms	Patient level: + perception of disease severity + perception of disease susceptibility for self and infant + perceived benefit of vaccination - omission bias - 'natural' ideology + decisiveness about vaccination + health care provider recommendation	Possible selection bias (rate of refusal 58%); large proportion of patients were of high socioeconomic means and highly educated compared to the general Canadian population.
Brien 2012	2009	Pandemic influenza immunization	Cross-sectional study using population data	Montreal, Quebec	Denominator of 19,490 pregnant women	Patient level: - social deprivation	Limited information specific to coverage among pregnant women
Desjardins 2017	2015	Seasonal influenza immunization	Survey of prenatal care providers	Quebec	344 prenatal care providers	Provider level: + provider age >40 years	Possible selection bias (37% response rate). Possible information

						+ higher prenatal clinical volume + academic practice +/- differences between professions	bias (self-reported data).
Fabry 2011	2010	Pandemic influenza immunization	Cross-sectional survey	Sherbrooke, Quebec	250 pregnant or postpartum women	Patient level: +/- trimester of pregnancy + education through government websites + belief in the efficiency of vaccine + recommendation from health professional	Risk of selection bias is low (refusal rate 5.2%). Possible information bias secondary to self-reported vaccination status.
Gracie 2011	2011	Pandemic influenza immunization	Cross-sectional survey	Calgary, Alberta	509 pregnant women	Patient level: + higher household income + higher education + planned pregnancy	Risk of selection bias (response rate of 79%); large proportion of patients were of high socioeconomic means and highly educated compared to the general Canadian population. Possible information bias secondary to self-reported vaccination status.
Halperin 2014	2005-2006 and 2011	Seasonal influenza immunization	Cross-sectional survey at time points pre- and post-H1N1	Halifax, Nova Scotia	821 pregnant women	Patient level: + enhanced knowledge about influenza and vaccinations post-pandemic + higher education + higher socioeconomic status + recommendation from a physician	Possible selection bias: large proportion of patients was of high socioeconomic means and highly educated compared to the general Canadian population. Self-reported vaccination status.

Hilderman 2011	2000-2008	Seasonal influenza immunization	Cross-sectional study using population data	Manitoba	All deliveries in the province between 2000-2008 (denominator not provided)	Patient level: + family physician as prenatal care provider + comorbid conditions + higher income + older maternal age + child at home <24 months + more frequent prenatal visits	Data available from population databases provided limited individual level explanations for the identified trends
Kowal 2015	n/a	Immunizations during pregnancy in general	In-person interviews	Edmonton, Alberta	23 immigrant women from South Asia and China	Patient level: - language barrier for verbal and written information about vaccination + provider recommendation + family and social networks	Possible selection bias in terms of recruitment strategy. Self-reported vaccination behavior not corroborated with rates of uptake.
Lee 2004	2002	Seasonal influenza immunization	Mailed out survey	Ontario	113 midwives and midwifery students	Provider level: +/- year of graduation + knowledge of impact of influenza in pregnancy +/- beliefs about immunization in general	Possible selection bias (36-42% response rate). Self-reported behavior may present possible information bias.
Legge 2014	2010-2012	Seasonal influenza immunization	Cross-sectional study using population data	Nova Scotia	12,223 pregnant women	Patient level: + higher income +/- marital status + higher risk pregnancy - rural residence	Data available from population databases provided limited individual level explanations for the identified trends
Liu 2012	2009-2010	Pandemic influenza immunization	Cross-sectional study using population data	Ontario	64,293 pregnant women	Patient level: + family physician as prenatal care provider + higher socioeconomic status + older maternal age + medical comorbidities + earlier prenatal care	Data available from population databases provided limited individual level explanations for the identified trends
MacDougall 2016	2008-2014	Tdap	Surveys distributed in	Multiple urban	346 pregnant women	Patient level:	Possible selection bias

			conjunction with recruitment into a clinical trial	centers in Canada (Edmonton, AB; Montreal QC; Vancouver, BC; Ottawa, ON; Halifax, NS)		+ physician recommendation - low knowledge about pertussis and the pertussis vaccine + generally favourable attitude toward vaccination in pregnancy	(response rate not listed). Large proportion of patients were of high socioeconomic means and highly educated compared to the general Canadian population..
Sakaguchi 2011	2009	Pandemic influenza immunization	Telephone survey	Centre in Toronto, ON with participants from all of Canada	130 pregnant women accessing MotherRisk services	Patient level: - media provided confusing information + accessing MotherRisk - concern of safety to the fetus	Selection limited to women accessing the MotherRisk services may limit generalizability of conclusions
Tong 2008	2003-2004	Seasonal influenza immunization	Cross-sectional survey of prenatal care providers and postpartum women	Toronto, Ontario	227 prenatal care providers and 185 post-partum women	Provider level: - knowledge gaps +/- Provider type (FP vs. OB) + attitudes toward vaccination Patient level: - knowledge gaps - concern safety to the fetus + recommendation by a physician	Possible selection bias (response rate 34-55%). Self-reported vaccination behavior.
Yudin 2009a <i>Pregnant Women's Knowledge of Influenza and the Use and Safety of the Influenza Vaccine During Pregnancy</i>	2006	Seasonal influenza immunization	Cross sectional survey of post-partum women	Toronto, Ontario	100 postpartum women	Patient level: - knowledge gaps - vaccine offered infrequently - concern for safety to the fetus	Possible selection bias (convenience sample).
Yudin 2009b <i>Impact of Patient Education on Knowledge of Influenza and Vaccine Recommendations Among Pregnant Women</i>	2006-2007	Seasonal influenza immunization	Cross sectional survey of post-partum women pre- and post-implementation of educational brochure	Toronto, Ontario	Total of 400 post-partum women (100 from 2006 and 300 from 2007)	Patient level: + direct patient education	Possible selection bias (convenience sample). Possible information bias secondary to self-report of vaccination behavior

Yudin 2010	2007	Seasonal influenza immunization	Calculation of vaccination rate after implementation of clinical nurse champion for immunization in prenatal clinic	Toronto, Ontario	n/a	Patient level: + dedicated staffing to offer prenatal vaccination	Aggregate level data with limited data points available to control for confounding when comparing to previous vaccination rates
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Overview of available literature

Two of the 17 included studies had national or multicenter Canadian representation among participants while the others had single-province participation from Nova Scotia (2), Quebec (3), Ontario (6), Manitoba (1), Alberta (2) and British Columbia (1). Most of the available literatures focused on the seasonal influenza vaccine (10) and the pandemic influenza H1N1 vaccine (6) during pregnancy, with one study looking at tetanus-diphtheria-pertussis vaccination during pregnancy. Diverse study methodologies have been employed, including cross-sectional observational studies of population-level data (4), survey-based studies of prenatal care providers (3), survey-based studies of pregnant or post-partum women (9), interview and focus group methods with pregnant and post-partum women (2), and investigations of interventions designed to increase vaccine uptake (1).

Patient-level barriers and facilitators

Six studies¹²⁻¹⁷ reported on characteristics of patients associated with receipt or non-receipt of vaccinations during pregnancy. Seven additional studies evaluated knowledge, attitudes, beliefs and intended behavior of pregnant women toward immunization in pregnancy¹⁸⁻²⁴. Given the potential effect that H1N1 media coverage and response campaigns targeting pregnant women

may have had on uptake, we have presented studies on patient-level barriers and facilitators separately for cohorts prior to 2009-2010 H1N1 pandemic influenza (7) and those during the 2009-2010 H1N1 pandemic or thereafter (8).

Patient-level barriers and facilitators prior to 2009-2010

Prior to the H1N1 pandemic outbreak, the literature considering patient factors, knowledge and attitudes about the influenza vaccine during pregnancy identified knowledge gaps, especially about vaccine safety and disease severity, as a substantial barrier to vaccination. Important facilitators of vaccination in this period were the desire of pregnant women to protect their infants and the recommendation of a health care provider.

Prior to the 2009-2010 pandemic influenza, the available literature indicates low uptake of the influenza vaccine during pregnancy. A population-based cohort study from Manitoba reported a 6% rate of uptake for the influenza vaccine during pregnancy by 2008¹⁵ and found low-income, young age, fewer prenatal care visits prior to 32 weeks of gestational age to be associated with low uptake of the influenza vaccine during pregnancy¹⁵. A Toronto-based survey of post-partum women by Tong found in 2003-04 that 14% self-reported having received the influenza vaccine during pregnancy²². Findings from both the population-based cohort study and the survey-based study suggested that maternal intention to protect the infant was an important predictor for receipt of the influenza vaccination. Tong *et al* found that women who knew that maternal influenza vaccination was beneficial for their babies were more likely to have received the influenza vaccine during pregnancy (OR 3.5, 95% CI 1.4-9)²²; and Hilderman *et al* demonstrated that women were more likely to have received the influenza vaccine during pregnancy if they had had comorbidities or if they had a child at home under 24 months of age¹⁵. Similarly, the

Manitoba Immunization Study found that recently pregnant women were twice as likely than pregnant women to receive the influenza vaccine¹⁵.

Knowledge gaps among pregnant individuals prior to 2009-2010 pandemic influenza were clearly illustrated through two Toronto-based surveys^{22,23}. Overall, knowledge was imperfect, with respondents answering only 62% of knowledge questions correctly²³. Misperception about the safety of the influenza vaccine during pregnancy was common, with 54% of women believing that the influenza vaccine should be avoided during pregnancy²² and over 20% believing it was associated with birth defects²³. The potential severity of influenza infection during pregnancy was underestimated with the majority of women believing that influenza infection for a pregnant woman carried the same risk as influenza infection for a non-pregnant woman²³. Tong *et al* demonstrated a positive correlation between knowledge and receipt for the influenza vaccine²². Relevant to misconceptions of vaccine safety, survey by Yudin *et al* found that 80% of women survey preferred to be vaccinated against influenza in the post-partum period²³.

The role of the health-care provider was also important in the pre-H1N1 studies. Women receiving prenatal care from an obstetrician exclusively were less likely to be vaccinated in the Manitoba cohort compared to women receiving care from a primary care physician. Tong *et al* found that women who received a recommendation from their physician were significantly more likely to have received the influenza vaccine during pregnancy (OR 34.5, 95%CI 10.5-119)²².

Patient-level barriers and facilitators subsequent to 2009-2010

Subsequent to the H1N1 pandemic outbreak, uptake of influenza vaccination in pregnancy increased somewhat, and the literature considering patient factors, knowledge and attitudes about

the influenza vaccine during pregnancy identified that knowledge about disease severity and vaccine safety appeared to have improved compared to prior to studies conducted H1N1.

Physician recommendation and clarity of information became increasingly cited as facilitators to vaccination for pregnancy women.

The Canadian literature reporting on cohorts during or following the 2009-2010 H1N1 pandemic influenza report higher rates of uptake of the influenza vaccine among pregnant women compared to the period prior to 2009-2010. This is particularly striking for the H1N1 pandemic influenza vaccine with self-reported rates of uptake of up 67-76%^{13,14,24} in Quebec, Alberta and Nova Scotia and population-based estimates of 38% in Ontario¹⁷. Estimates of influenza vaccine uptake during pregnancy based on self-report differ from those based on population-level data. Post-H1N1, older maternal age, higher income, increased education and presence of medical comorbidities continued to be associated with higher uptake of the influenza vaccine during pregnancy^{14,16,17}.

Type of provider continued to be associated with uptake of the influenza vaccine during pregnancy with women in Ontario being more likely to receive the pandemic H1N1 influenza vaccine if their prenatal care was provided by a family physician¹⁷. Survey-based studies from the post-H1N1 time period continue to underscore the importance of physician recommendation as a key motivator for receipt of the influenza vaccine during pregnancy^{13,20,24} and one survey-based study comparing cohorts pre- and post-H1N1 suggests that this was becoming an increasingly important motivator²⁴.

Patient concerns about safety remained the most commonly cited barrier to influenza vaccination during pregnancy among these studies^{13,20}, though Halperin *et al* found the proportion of women

reporting that it was best to avoid all vaccinations during pregnancy declined in the period following H1N1²⁴. Notably, appreciation for disease severity appeared increased in this time period, with 73.1% of women in one survey-based study citing “concern about the risk of H1N1 infection in the fetus and/or themselves” to be the primary motivator for receiving the H1N1 pandemic influenza vaccine during pregnancy²⁰.

Bettinger *et al* conducted focus groups and pre/post flu season surveys involving 22 women sampled from British Columbia to understand their rationale for receipt or non-receipt of both the seasonal influenza and the H1N1 pandemic vaccination during pregnancy¹⁸. While most of the sample of women self-identified as being pro-vaccine and agreed that vaccines are effective and safe for pregnant women, just half the sample agreed that they had enough information to make a decision about being vaccinated during pregnancy. Only a minority of women reported having had a health care provider discuss vaccination with them during pregnancy and ambiguous information combined with aversion to ambiguity were cited as important barriers to receipt of a vaccination during pregnancy¹⁸.

A qualitative study by Kowel *et al* conducted semi-structured interviews with 23 women in Edmonton, Alberta, who had recently immigrated to Canada from South or East Asia¹⁹. Important themes that emerged from this study were that the sample of women demonstrated significant trust in the recommendations of health-care providers and in Canadian recommendations about vaccination during pregnant. The majority of women did not seek information beyond the health care provider; however, few recalled having had vaccinations discussed by a health care provider during their pregnancy. A particularly poignant quote was even used as the title for the study, “If they tell me to get it. I’ll get it. If they don’t...”

Participants in this study identified language of spoken and written information to be an important barrier to accessing vaccine information in Canada¹⁹.

Chronologic assessment of Canadian information related to barriers to vaccination during pregnancy at the level of the patient revealed that while knowledge about safety and disease severity has evolved following 2009-2010 H1N1 pandemic influenza, several important barriers persist: the need for clear and unambiguous information about safety and the necessity of a recommendation from a prenatal care provider.

Care Provider-level barriers and facilitators

Prenatal care provider characteristics and practices that have consistently been identified as potential barriers or facilitators to vaccination in pregnancy include provider specialty (with patients of family doctors more likely to be vaccinated against influenza than those who received prenatal care from an obstetrician only), provider vaccine knowledge (with higher knowledge associated with higher likelihood of offering vaccination), and practice setting (with physicians working in academic centres or family practices that offered other vaccinations more likely to recommend or offer vaccination in pregnancy).

Five studies^{15,22,25,26} reported on characteristics of prenatal care providers (e.g. specialty, vaccine knowledge, practices etc.). Three of these^{22,25,26} used survey-based designs with response rates of 32-43%, and inquired about prenatal care provider self-reported knowledge, beliefs and practice patterns in Ontario^{22,25} and Quebec²⁶. Provider self-reports of recommendation to be vaccinated against influenza are stable between two surveys of prenatal care providers, one prior and the other subsequent to 2009-2010 pandemic H1N1, with 63.4%²² and 60%²⁶ of providers

reporting recommending the influenza vaccine for pregnant women, respectively. However, the most recent survey of providers in Quebec²⁶ reports higher self-reported rates of recommending the influenza vaccine to pregnant women for obstetricians (80% vs. 65%) and midwives (12% vs. 8.5%) compared to previous reports^{22,25}.

Vaccine knowledge by care providers was consistently associated with higher likelihood of recommending the influenza vaccine during pregnancy^{22,25,26}. An important knowledge gap identified by two pre-H1N1 studies relates to failure to recognize that influenza could have severe consequences for pregnant women, with 40% of obstetricians and family practitioners²² and 63% of midwives²⁵ having answered questions on this topic incorrectly. Knowledge about safety and efficacy were high among obstetricians and family practitioners, but low among midwives prior to pandemic H1N1^{22,25}. Other facilitating factors associated with higher likelihood of offering the influenza vaccine during pregnancy were a positive attitude toward the influenza vaccine^{22,25} and having personally received the influenza vaccine^{22,25}.

Two studies reported provider characteristics associated with uptake of the influenza vaccine during pregnancy using population-based data^{15,17}. Here, information about provider characteristics gleaned from population-based data is limited to the association between specialty of primary prenatal care provider and uptake rate of the influenza vaccine during pregnancy. Both of these studies demonstrate that women who have a family physician as a prenatal care provider are significantly more likely to receive an influenza vaccine compared to who are followed by an obstetrician alone or by a midwife during pregnancy^{15,17}.

In summary, more recent publications suggest that at the level of the Canadian health-care provider, there is improved knowledge about vaccinations during pregnancy as well as increased

adherence to guidelines for all types of prenatal care providers. However, the self-reported rates of guideline adherence do not align with the population based estimates of actual vaccine delivery. As such, further research is needed to identify the structural barriers that limit a provider's ability to recommend *and* deliver vaccines to pregnant women despite knowledge and desire to do so.

System-level Barriers and Facilitators

Very few available studies reported specifically on structural barriers that affect the provider's ability to administer vaccines to pregnant women. However, Desjardins did identify a higher rate of adherence to guidelines about vaccination in pregnancy for physicians working in an academic centre (66% vs. 53%, $p=0.03$). Additionally, Tong *et al*, who found that family physicians were more likely to recommend the influenza vaccine during pregnancy, identified that all family physicians surveyed worked in practices that offered at least one type of vaccine, compared to only 26% of obstetricians included in their sample.

We identified two Canadian studies that focused on interventions aiming to increase knowledge and uptake of influenza vaccination during pregnancy^{27,28}. In the first, distribution of an information pamphlet about the influenza vaccine during the prenatal period resulted in increased knowledge scores and improved vaccination rates from 19% to 56% for a cohort of post-partum women in Toronto, ON²⁸. The second study, also from Toronto, describes the implementation of a "nurse champion" in the prenatal clinic setting. This intervention is characterized both by capacity for point-of-care vaccination and by enhanced clinical staffing (the "nurse champion") to deliver this service. This nurse was employed for a brief two-week period and had no other responsibilities other than to approach patients, educate, offer and administer the influenza

vaccine. This study reported an uptake of 42% for the influenza vaccine among the pregnant women in this sample (n=266) compared to a 16-21% uptake rate reported for this clinic in prior seasons. Neither study had a robust control group to quantify the magnitude of effect of the interventions. Limitations notwithstanding, both studies from Toronto, ON were conducted prior to 2009-2010 pandemic H1N1 influenza and the reported rates of influenza vaccine uptake among these pregnant cohorts were considerably higher than contemporary rates of uptake discussed above. These findings suggest that small changes in care delivery structure that aim to inform and personally invite pregnant individuals to be vaccinated may be effective strategies.

DISCUSSION

Although influenza vaccination is recommended for all pregnant individuals in Canada, rates of seasonal influenza vaccine in pregnancy remain very low, especially when considered in comparison to other similarly resourced countries. Vaccination during pregnancy is becoming a mainstay for improving rates of maternal and neonatal morbidity and the number of vaccinations that are indicated for use in pregnancy is likely to increase in the future.

Our review of the Canadian literature has identified barriers and facilitators to vaccination in pregnant individuals at the level of the patient and the provider. These barriers and facilitators are summarized in the Table 2. We also found indications that targeted outreach to pregnant individuals may be effective in increasing vaccine knowledge and uptake. Among patients and providers alike, improved knowledge and positive beliefs about immunization were found to be important facilitators for immunization in pregnancy. Pregnant patients appear to be especially motivated to be vaccinated when a recommendation is made by a prenatal care provider.

Women receiving prenatal care from family physicians were more likely to be immunized compared to women receiving prenatal care exclusively through an obstetrician. It is likely that system barriers (e.g. logistical ease of managing vaccine stock) influence the ability of a prenatal care provider to deliver vaccines to prenatal patients, but to date, there are virtually no published studies to elucidate the system barriers relevant to practitioners in Canada.

The Canadian health care system is dramatically different from that of our neighbours to the south; therefore, when considering health services issues we cannot rely solely on evidence from a largely privatized and highly fragmented system of delivering health care. However, the bulk of the existing research on the question of barriers and facilitators to vaccination in pregnancy

has been conducted in US settings. To address this knowledge gap, further research is required to better understand patient, provider and system level barriers to maternal vaccination in Canada. In particular, in-depth, context-sensitive methods such as ethnography, which can delve into cultural and structural factors affecting vaccine uptake in Canadian settings, would be of great value. Moreover, efforts to understand barriers and improve the uptake of vaccination during pregnancy would benefit from strengthening of immunization registries in a variety of jurisdictions around the country to provide comprehensive and objective estimates of vaccine coverage.

CONCLUSION

Even the safest and most effective vaccine is of limited use if it is not accepted by patients, recommended by care providers and effectively delivered within the health care system.

Indications for vaccination in pregnancy are likely to expand in the coming decades; therefore, there is an urgent need to identify determinants of vaccine acceptance and strategies to improve the uptake of vaccinations during pregnancy that will perform well in Canadian contexts.

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Appendix A: MEDLINE search strategy

Database: Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R) 1946 to Present

Date: 11 July, 2017

Search:

- | | | |
|---|--------|----|
| 1. Exp Vaccines/ | 209070 | |
| 2. Exp Vaccination/ | 75265 | |
| 3. Exp Immunization/ | 160635 | |
| 4. Exp Pregnancy/ | 839743 | |
| 5. Exp Canada/ | 144442 | |
| 6. 1 or 2 or 3 | 295774 | |
| 7. 3 and 4 and 5 | 112 | |
| 8. Limit 6 to (humans and yr="2001 -Current" and (english or french)) | | 57 |