Laying the foundation for a community pharmacist intervention to improve pneumococcal vaccine uptake

by

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A thesis submitted in partial fulfillment of the requirements for the degree of

Master of Science
in
Pharmacy Practice

Faculty of Pharmacy and Pharmaceutical Sciences

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ABSTRACT

Background: Pneumonia is an invasive infectious disease of the lower respiratory tract that reduces the lungs' ability to transport oxygen in an individual and can be fatal. Among the various pathogens, *Streptococcus pneumoniae* is a common bacterial cause of community-acquired pneumonia. Effective pneumococcal vaccines are available for use in Canada but their uptake has remained suboptimal due to multiple barriers such as vaccine hesitancy. Community pharmacists are in a unique position to address these barriers due to their accessibility to the public. Pharmacists in Alberta have been able to administer vaccines and medications by injection since 2007 and can provide insight into addressing barriers related to pneumococcal vaccine uptake.

Goal and Objectives: The overall goal of this thesis is to develop foundational knowledge that will help inform a community pharmacy-based intervention aimed at improving pneumococcal vaccine uptake. Within my two thesis projects, I sought to: 1) describe the actions related to administering an injection, including the types of medications commonly administered; and, identify perceived barriers and facilitators pharmacists face when providing injection services and 2) identify and describe community pharmacy-based intervention programs aimed at improving pneumococcal vaccine uptake.

Methods: The first thesis project was a cross-sectional survey of Alberta pharmacists registered with the Alberta College of Pharmacy. We collected information regarding the types of vaccines and medications they administer within their practice. Additionally, pharmacists were asked about their perspectives on various barriers and facilitators they encounter when providing an injection service. The second thesis project was a systematic review of interventions and strategies employed to improve the pneumococcal vaccination rate in community pharmacies.

Results: : In project 1, a total of 397 pharmacists (7.8%) out of 5102 pharmacists willing to be contacted for research purposes responded to the survey. Participants were grouped into "Active", and "Non-Active" Providers based on responses to questions of injection authorization and administration in the first section of the survey. The most common medication injected was influenza vaccine, administered by 98% of Active Providers followed by vitamin B12 (95%), herpes zoster vaccine (88%), hepatitis vaccines (86%), and pneumococcal vaccines (82%). Non-Active Providers were more likely than Active Providers to report that comfort with

administering injections ($p<0.001$) and managing adverse reactions ($p=0.013$) were moderate or major barriers to providing injections. More than 60% of survey respondents indicated that access and automated reporting to the provincial immunization registry would be essential to increasing the frequency of providing injection services.

In project 2, we identified 21 studies (10 experimental, 11 quasi-experimental) that implemented intervention strategies to improve pneumococcal vaccination uptake within community pharmacies. The intervention programs were implemented between 1998 and 2020. Strategies focused on training pharmacy staff on pneumococcal vaccine indications, screening strategies, coordination of vaccine delivery amongst pharmacy staff, utilizing automated systems to proactively identify eligible patients, and utilizing assertive and motivational communication techniques to address vaccine hesitancy. Direct to consumer advertising to raise awareness of vaccine eligibility and practice tools such as decision-making aids were also implemented in several studies. We identified practice tools such as follow-up coaching, software for record documentation, automated patient screening, and decision support tools that were implemented during the intervention. A majority of studies reported improvement in pneumococcal vaccination rates compared to baseline or comparison group, however, only 7 studies reported these differences were statistically significant.

Conclusion: In project 1, we identified that Alberta pharmacists administer a wide variety of vaccines and other medications by injection. By stratifying the participant pool to Active and Non-Active Providers, we identified benefits, organizational factors, education policies and patient-related strategies that pharmacists frequently employ to better help their patients. In project 2, we observed that strategies focused on training pharmacy staff on pneumococcal vaccine indications, screening strategies, and coordination of vaccine delivery amongst pharmacy staff. Although, all interventions helped raise awareness of pneumococcal vaccines, none of the studies included in our review reported reasons for individuals refusing a pneumococcal vaccine. Information gathered in these two studies enables us to develop an intervention program that address barriers and help improve pneumococcal vaccine uptake.

PREFACE

This thesis is an original work by Daniyal Khan. The research project described in Chapter 2, of which this thesis is a part, received research ethics approval from the University of Alberta Research Ethics Board, *A survey of Alberta pharmacists' actions and opinions in regard to administering vaccines and medications by injection*, Pro00103825.

A version of Chapter 2 has been accepted in the Journal of the American Pharmacists Association: "Khan D, Hughes CA, Schindel TJ, Simpson SH, A survey of Alberta pharmacists' actions and opinions in regard to administering vaccines and medications by injection, Journal of the American Pharmacists Association (2023), doi: *https://doi.org/10.1016/j.japh.2022.12.002*."

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1.1. Background

1.1.1. Overview of pneumonia

Pneumonia is an infection in the lungs that creates inflammation and fluid buildup in the alveolar sacs. Individuals with pneumonia usually present with sudden onset of fever, chills, difficulty breathing, productive cough, rapid heart rate, and rapid respiratory rate.(1) Severity of the infection can range from mild to potentially fatal. People who are most at risk of severe forms of pneumonia are very young children, people aged 65 and older, and immunocompromised individuals. There are two categories of pneumonia that are based on where a person contracts the infection. Pneumonia can either be contracted within a hospital (nosocomial pneumonia), or through community spread (community-acquired pneumonia).(2) This thesis will focus on community-acquired pneumonia.

1.1.2. Epidemiology of community-acquired pneumonia

Community acquired pneumonia is a major public health concern because it is quite common, with an annual incidence rate between 1,600 and 2,000 cases per 100,000 individuals.(3) In Alberta, pneumonia was the most responsible diagnosis for 151 emergency room visits and 95 hospitalizations per 100,000 people in 2021.(4) Pneumonia is the eighth leading cause of death in Canada,(5) and listed as the cause of death in 13 per 100,000 Albertans in 2021.(4)

1.1.3. Healthcare cost of pneumonia

The Conference Board of Canada forecasted that the cost of treating pneumonia is expected to rise from $216 million in 2010 to $532 million in 2025.(6) In Alberta, pneumonia related healthcare costs were $126 million in 2014-2015, with costs expected to rise due to an aging population at risk.(6) Individuals over the age of 18 comprised 85% of direct healthcare costs for pneumonia treatment whilst individuals over 65, comprised 60% of direct healthcare costs in adults.(6) In 2019, it was estimated that a single case of bacterial pneumonia infection in adults cost $11,634 in Alberta.(7)

1.1.4. Streptococcus pneumoniae

There are various pathogens that may result in community-acquired pneumonia including fungi (e.g., *Histoplasma capsulatum),* respiratory viruses (e.g., SARS-CoV-2), and bacteria (e.g., *Chlamydia pneumonia* and *Streptococcus pneumoniae).* While there are multiple

pathogens that may cause community-acquired pneumonia, *Streptococcus pneumoniae* is the most commonly identified bacterial cause.(8, 9, 10) *Streptococcus pneumoniae* is a gram-positive, non-motile, diplococci bacteria and is hemolytic under both aerobic and anaerobic conditions.(11) It comprises anywhere between 12% - 75% of all cases of community-acquired pneumonia in the world.(2, 10, 11) Transmission of *S. pneumoniae* occurs via respiratory droplet transmission from person-to-person and is most common during winter months, especially in highly crowded areas.(2)

There are multiple variations, or serotypes, of *S. pneumoniae* that are indicated as causes of community-acquired pneumonia in Canada (Figure1-1).(11) Serotypes 19A, 3, 7F and 22F have been identified as the most common pathogens causing community-acquired pneumonia.(11)

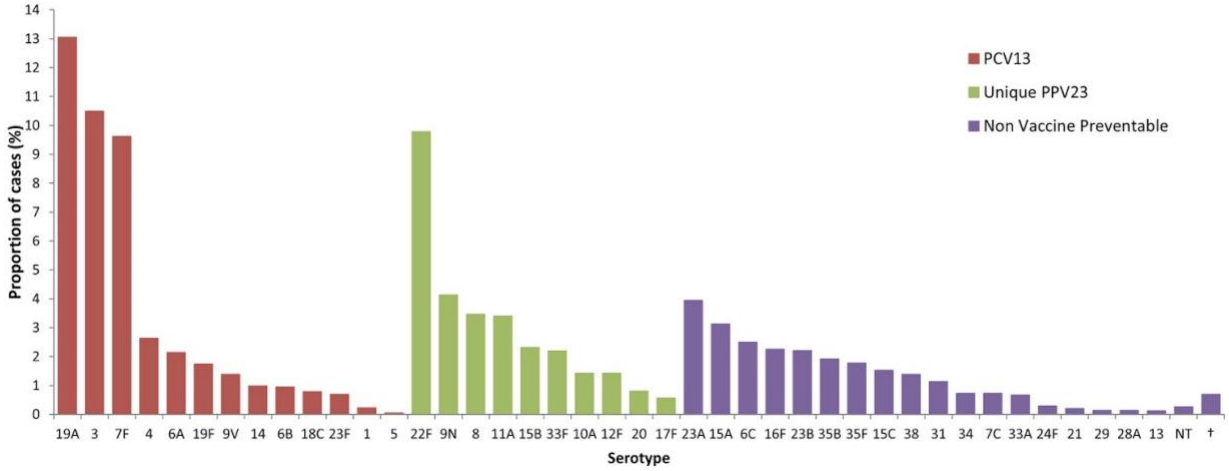

Figure 1-1: Proportion of Streptococcus pneumoniae serotypes in Canada.(11)

*Serotype 2 is unique to PPSV23 vaccine, but no isolates were observed in the study (11)

Pneumococcal pneumonia can progress to a more severe form of disease, invasive pneumococcal disease (IPD) that can increase the risk of hospitalization and mortality.(12) In Alberta, the incidence rate of IPD was observed to be 7.3 per 100,000 individuals in 2021.(4) As *S. pneumoniae* is a common cause of community acquired pneumonia, which may progress to a more severe and potentially fatal disease, vaccines have been developed to reduce the risk of this infection.(13, 14)

1.1.5. Pneumococcal vaccines

The first pneumococcal vaccine in Canada was developed by Merck® and approved for market in 1978.(15) This pneumococcal polysaccharide vaccine, known under the brand name of

Pneumovax 23® (also referred to as PPSV23 and Pneu-P-23), covers 23 serotypes (variants) of *S. pneumoniae* that are most associated with invasive pneumococcal disease and pneumonia (Figure 1-1). *Pneumovax 23*® was added to the Alberta immunization program in April 1997 and is covered under provincial funding for people at high risk of severe pneumococcal infection (see Section 1.1.8).(16) Wyeth, now Pfizer®, created a pneumococcal conjugate vaccine with 7 serotypes in the 1990s, which was approved for market in Canada in 2001 under the brand name *Prevnar*® (also referred to as PCV-7 and Pneu-C-7).(17) The 7 serotypes covered in this vaccine were directly related to most common cases of invasive pneumococcal disease, acute otitis media, and pneumonia in children under the age of 5.(17) *Prevnar*® has since been updated with additional serotypes to *Prevnar 13*® (Figure 1-1),(14) and more recently *Prevnar 20*® (PCV-20).(18). Additionally, Merck announced a conjugate vaccine, *Vaxneuvance™,* which covers 15 pneumococcal serotypes, that has been approved for use in Canada.(19)

1.1.6. Efficacy of pneumococcal vaccines

Both vaccines aim to illicit an immunogenic response in patients by introducing inactive serotypes of *S. pneumoniae*. PPSV23 is a polysaccharide vaccine (i.e., serotypes bound to a sugar molecule),(20) whereas PCV-13, PCV-15, and PCV-20 are conjugate vaccines (i.e., serotypes bound to diphtheria toxoid). In general, conjugate vaccines are able to illicit a better immune response compared to polysaccharide vaccines but are more expensive to produce.(21, 22) PPSV23 has a been demonstrated to reduce the risk of invasive pneumococcal disease by 50-54% in adults over the age of 50.(21, 23, 24) A randomized controlled trial was conducted to evaluate the 13-valent conjugate vaccine (PCV-13) and reported a risk reduction of 24.7% against developing invasive pneumococcal disease in the general population and a risk reduction of 89.5% in high-risk individuals.(25) Whilst the number of non-vaccine-serotypes is on the rise, the burden of disease in the population continues to be caused by serotypes that are covered in the available vaccines (Figure 1-1).

1.1.7. Pneumococcal vaccine indications

The Canadian Immunization Guide is a national resource for immunization recommendations that are based on advice from the National Advisory Council on Immunizations (NACI) and other organizations.(26) Immunization schedules are centred on prevention of common childhood diseases such as measles, mumps, diphtheria or pertussis (Whooping cough), as well as seasonally affective illnesses such as influenza.(27) Vaccination

recommendations for *S. pneumoniae* are based on clinical trial evidence that it significantly reduces the risk of community acquired pneumonia and hospitalization for IPD.(21, 22, 26, 27) These recommendations are aimed at protecting individuals at high risk of adverse outcomes from pneumonia and IPD.(28)

1.1.8. National Advisory Council on Immunization recommendations

There are two groups of adults that are identified as having high risk of adverse outcomes related to pneumonia and IPD. First, individuals over the age of 65 are considered at an elevated risk of serious outcomes due to their weakened immune system.(31, 32) Second, adults aged 18 to 64 years are considered at high risk of IPD if they have chronic heart disease, chronic kidney disease, diabetes mellitus, chronic liver disease, chronic obstructive pulmonary disorder, asthma, cochlear implants, chronic cerebrospinal fluid leak, a chronic neurologic condition that impairs clearance of oral secretions, or immunocompromising conditions, like sickle cell disease, asplenia, cancer, or immunocompromising therapy.(32) Anyone aged 65 years and older and adults aged 18 to 64 years with a medical condition placing them at high risk for IPD can receive the polysaccharide pneumococcal vaccine for free in Alberta under a provincially funded program.(Table 1-1)(16) Adults 18 years of age or older with a medical condition placing them at high risk for IPD can receive the conjugate pneumococcal vaccine for free in Alberta under a provincially funded program.(32)

Table 1-1: Alberta Health Indications for Provincially Funded pneumococcal vaccines.(16, 32)

Pneumovax 23	**Prevnar 13**	
Anyone 65 years and older	All healthy children 2 months to 59 months	
Persons 24 months to 64 years with any of the following:	Children 2 months up to 17 years who are considered high risk with any of the following:	Adults 18 years and older with any of the following:
Alcoholism.		
Asplenia/hypersplenism (functional or anatomic).	Asplenia/hypersplenism (functional or anatomic)	Asplenia/hyposplenism (functional or anatomic)
Chronic cardiac disease.	Chronic cardiac disease.	
Chronic cerebral spinal fluid (CSF) leak.	Chronic cerebral spinal fluid (CSF) leak.	Chronic cerebral spinal fluid (CSF) leak.
Chronic liver disease, including hepatic cirrhosis due to any cause, hepatitis B carriers and hepatitis C infection.	Chronic liver disease (including hepatitis B and C and hepatic cirrhosis due to any cause).	
Chronic neurologic conditions that may impair clearance of oral secretions.	Chronic neurologic condition that may impair clearance of oral secretions.	
Chronic pulmonary disease (including asthma requiring medical treatment within the last 12 months regardless of whether they are on high dose steroids).	Chronic pulmonary disease (excluding asthma unless treated with High-dose oral corticosteroid therapy).	
Chronic renal disease, including nephrotic syndrome.	Chronic renal disease, including nephrotic syndrome.	Nephrotic syndrome
Cochlear implants (candidates and recipients).	Cochlear implants (candidates and recipients).	Cochlear implants (candidates and recipients).
Congenital immune deficiencies involving any part of the immune system, including B-lymphocyte (humoral) immunity; T-lymphocyte (cell) mediated immunity; complement system (properdin or factor D deficiencies); or phagocytic functions.	Congenital immunodeficiencies involving any part of the immune system, including B-lymphocyte (humoral) immunity, T-lymphocyte (cell) mediated immunity, complement system (properdin or factor D deficiencies) or phagocytic functions.	Congenital immunodeficiencies involving any part of the immune system, including B-lymphocyte (humoral) immunity, T-lymphocyte (cell) mediated immunity, complement system (properdin or factor D deficiencies) or phagocytic functions.
Diabetes mellitus.	Diabetes mellitus.	
Hematopoietic stem cell transplant (HSCT) recipients.	Hematopoietic stem cell transplant (HSCT) recipients	Hematopoietic stem cell transplant (HSCT) recipients
HIV infection.	HIV infection.	HIV infection.
Undergoing or anticipating immunosuppressive therapy including: ▪ use of long-term corticosteroids, ▪ chemotherapy, ▪ radiation therapy, ▪ post-organ transplant therapy	Undergoing or anticipating immunosuppressive therapy including: ▪ use of long-term corticosteroids, ▪ chemotherapy, ▪ radiation therapy, ▪ post-organ transplant therapy	Undergoing or anticipating immunosuppressive therapy including: ▪ use of long-term corticosteroids, ▪ chemotherapy, ▪ radiation therapy, ▪ post-organ transplant therapy
Biologic and non-biologic immunosuppressive therapies for: ▪ inflammatory arthropathies, e.g. systemic lupus erythematosus (SLE), rheumatoid or juvenile arthritis, ▪ inflammatory dermatological conditions, e.g. psoriasis, severe atopic dermatitis and eczema, and ▪ inflammatory bowel disease, e.g. Crohn's disease, ulcerative colitis. Note: Individuals prescribed eculizumab (Soliris®) are at increased risk of serious infections, especially with encapsulated bacteria, such as Streptococcus pneumoniae	Biologic and non-biologic immunosuppressive therapies for: ▪ inflammatory arthropathies, e.g. systemic lupus erythematosus (SLE), rheumatoid or juvenile arthritis, ▪ inflammatory dermatological conditions, e.g. psoriasis, severe atopic dermatitis and eczema, and ▪ inflammatory bowel disease, e.g. Crohn's disease, ulcerative colitis. Note: Individuals prescribed eculizumab (Soliris®) are at increased risk of serious infections, especially with encapsulated bacteria, such as Streptococcus pneumoniae	Biologic and non-biologic immunosuppressive therapies for: ▪ rheumatologic and other inflammatory diseases Note: Individuals prescribed eculizumab (Soliris®) are at increased risk of serious infections, especially with encapsulated bacteria, such as Streptococcus pneumoniae
Malignant solid organ tumors either currently or within past 5 years.	Malignant solid organ tumors undergoing or anticipating immunosuppressive therapy (chemotherapy or radiation).	Malignant solid organ tumors undergoing or anticipating immunosuppressive therapy (chemotherapy or radiation).
Living in homeless/chronically disadvantaged situations: Definition: At the time of diagnosis, the individual did not have an address or home (apartment, townhouse, etc.). This would include people staying in shelter, cars, etc. Document "No Fixed Address" under home address. If the individual is using a friend/relative's mailing address, it can be included in brackets.		
Sickle cell disease and other hemoglobinopathies.	Sickle-cell disease and other hemoglobinopathies.	Sickle-cell disease and other hemoglobinopathies.
Solid organ or islet transplant (SOT) candidates and recipients	Solid organ or islet transplant (SOT) candidates and recipients	Solid organ or islet transplant (SOT) candidates and recipients

Structures to monitor population level immunizations are also important in understanding the extent of current vaccination coverage. Alberta's healthcare electronic records systems, *Netcare* and more recently, *Connect Care* have a comprehensive list of all immunizations provided to Albertans within the last 20 years.(34, 35) The *Connect Care* database is accessible to all physicians, pharmacists, and public health officials working within Alberta Health Services (e.g., hospitals, long-term care) to monitor and administer vaccines. Healthcare professionals working outside Alberta Health Services (e.g., community pharmacies) are able to access the provincial immunization database using the older *Netcare* system.(35)

1.1.9. Epidemiology of pneumococcal vaccine uptake

In the latest survey of vaccine uptake performed by the Public Health Agency of Canada, 58.1% of individuals over the age of 65 had received a pneumococcal vaccine.(37) In contrast, 25.4% of individuals with chronic health conditions between the ages of 18 and 64 years were vaccinated.(34) In a study performed in Alberta in 2011, 53% of individuals with diabetes self-reported receiving a pneumococcal vaccine.(37) These rates all fall well below the recommended coverage target of 80% set by Health Canada and NACI, and 95% set internally by Alberta Health.(38) There are many barriers to pneumococcal vaccine uptake in Canadians, especially those at high risk, that should be addressed.

1.1.10. Barriers to vaccination

There are patient-level, provider-level and organizational barriers to immunization. Patient-level barriers vaccination may be explained using the Health-Belief model.(39) The Health-Belief model was developed in 1950s to understand why some individuals may not adopt recommended health prevention strategies.(39) This model states that there are individual level factors regarding a disease or illness which impacts their willingness to participate in healthy behaviours. The major components of the Health-Belief model (Figure 1-2) include: 1) perceived susceptibility of acquiring the disease, 2) perceived severity of the disease, 3) perceived benefits of engaging in a preventative or healthy behaviour, 4) perceived barriers to performing the healthy action, such as lack of time, 5) cues to action or triggers to engage in the behaviour, such as chest pain, and 6) self-efficacy regarding successfully engaging in the healthy behaviour.(39)

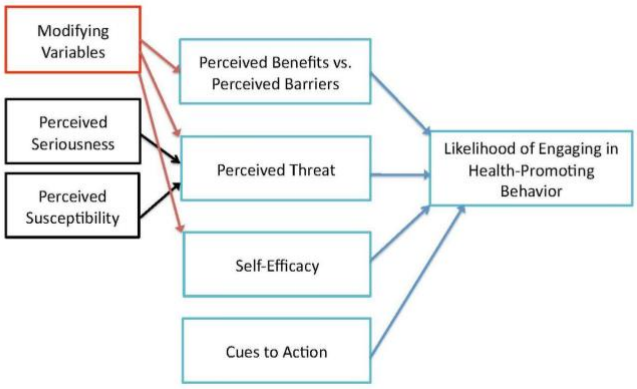

Figure 1-2: Health-Belief Model.(39)

Using the framework of the Health-Belief model, we can identify that an individual's perceived seriousness regarding the disease and perceived susceptibility of contracting the disease create a perceived threat, which can influence their decision to engage in a disease prevention strategy, like vaccination.(39) The Health-Belief model also helps us identify that the individual's understanding of the benefits of a disease prevention strategy will also influence their decision to accept it. Modifying factors can affect an individual's perceptions. For example, advice from a healthcare professional regarding disease susceptibility and the effectiveness of vaccines may help address an individual's hesitancy based on lack of perceived threat or doubts about vaccine benefits as they are modifiable factors.(39)

Provider-level barriers to the provision of vaccines are two-fold. First, cross-sectional surveys have identified vaccine availability and storage requirements as key barriers to providing vaccinations.(38, 39, 40) Second, providers are often strained for time and resources, such as screening tools or a private space to administer injections, to adequately assess patients for vaccine eligibility and administer the vaccine.(42, 43)

Additionally, there are organizational barriers to providing immunizations, such as health information, and vaccine availability and delivery.(44) Previous surveys have indicated that organizational barriers related to vaccinations are government and health authority policy restrictions.(45) Additionally, organizational barriers may also consist of vaccine availability and guidelines related to vaccine storage and administration.(42) Results of a 2014 cross-sectional survey indicated that 56% of patients did not receive a pneumococcal vaccine.(44) The authors identified informational barriers are key to low immunization delivery. These barriers were

missed opportunities to educate patients by staff, knowledge gaps regarding vaccine indications, insufficient time addressing patient concerns, and limited patient screening to identify patient eligibility.(44) Vaccine provider (e.g., physicians, nurses, pharmacists) beliefs and attitudes regarding immunizations play an important role in the uptake of vaccines. Healthcare providers that identify immunization gaps in patient history, educate patients and address their concerns may help increase vaccine uptake.

1.1.11. Summary of pneumococcal pneumonia and the importance of closing the care gap in pneumococcal vaccine uptake

Infectious diseases have plagued communities and societies for centuries. Attempts to instill immunity against these diseases started with methods such as inoculation, and later variolation.(46) These techniques were utilized to curtail the spread of small pox with limited success as they required exposing a healthy individual to an infected one.(47) Vaccination, as identified currently, was successfully demonstrated in the 17th century by Edward Jenner using dead smallpox virus to trigger an immune response rather than a deadly live virus.(47) This laid the foundation for modern vaccines with the advent of hypodermic needles and utilization of cell cultures to develop and produce safe and economical vaccines.(44)

Vaccination has been heralded as one of the key public health victories of the 20th century and considered the most important public health measure in the United States.(48) The development of vaccines for smallpox and polio have resulted in an almost complete eradication of their respective disease throughout the world.(46) Mass vaccination programs have since been promoted by the World Health Organization (WHO) to target common childhood illnesses, such as pertussis (whooping cough) and measles, to reduce the burden of illness from communicable diseases globally.(49) The Canadian history of successful mass vaccination campaigns highlights the elimination of measles in 1998, and reduction of incidence of Rubella from 5300 cases per year in 1971 to less than 30 in 1994.(50, 51)

The uptake of pneumococcal vaccines in Canada has plateaued.(34) Yearly surveys regarding vaccination uptake conducted by Health Canada and Government of Alberta have indicated a leveling off of vaccination uptake within the population.(36, 52) For example, pneumococcal vaccines are a safe, cheap and effective public health tool; introduction of the polysaccharide vaccine, and later the conjugate vaccine have allowed incident cases of adult pneumococcal pneumonia in Alberta to decline from 600 cases per year in 1998, to less than 300 in 2020.(4)

The stagnant uptake of pneumococcal vaccines in Canada has resulted in a vaccination gap that is well below the 80% coverage target recommended by Health Canada.(27) Addressing this coverage gap in pneumococcal vaccines will help reduce the burden of illness from pneumonia. Additionally, it also reduces the use of antibiotics and subsequent resistance. It requires participation from healthcare providers beyond physicians, such as public health nurses and pharmacists, especially those that interact with patients frequently.

1.2. Pharmacists and vaccinations

To enhance uptake of pneumococcal vaccines, mobilization of established community healthcare providers, such as pharmacists, is required.

1.2.1. Brief historical overview of authorizations

The pharmacist's role in vaccinations has evolved from being primarily caretakers of vaccines to actively administering immunizations within their practice sites under regulatory measures designed to increase their scope of practice.(53) Pharmacists in Alberta may seek authorization to prescribe medications, as well as administer drugs by injection under the *Health Professions Act* of 2007.(54) Pharmacists with first aid and cardiopulmonary resuscitation training (CPR) training are able to acquire the authorization to administer drugs by injection after completing an injection training course.(55) Authorized pharmacists are able to provide a wide variety of medications (vaccines and non-vaccine drugs) via subcutaneous or intramuscular injection to anyone over the age of 5.(55, 56)

Since the introduction of the authorization to administer drugs by injection via the *Health Professions Act* in 2007, over 80% of Alberta pharmacists have gained the authorization.(57) Alberta pharmacists became the primary provider of seasonal influenza vaccines in 2015, having overtaken public health officials, nurses and physicians.(52) Additionally, Alberta pharmacists have been the largest providers of COVID-19 vaccines.(58)

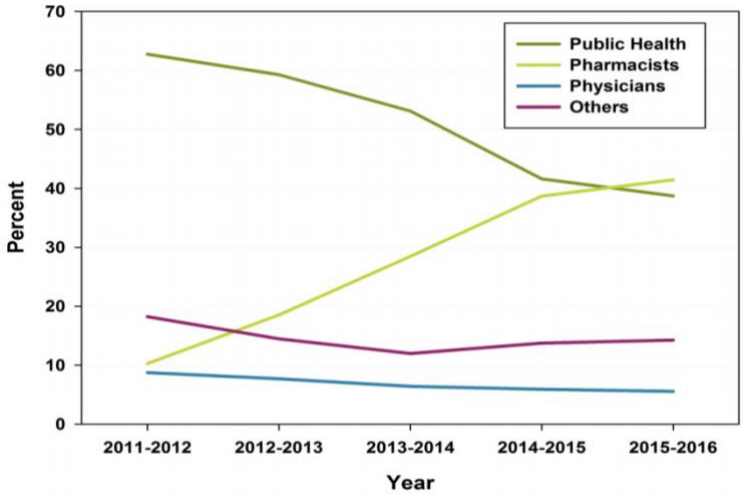

Figure 1-3: Provision of influenza vaccines in Alberta (57)

Legislative changes in Alberta healthcare have allowed for pharmacists within the province to administer injections and other blood products.(60) In contrast, pharmacists in other health jurisdictions in Canada have recently gained the regulatory ability to administer non-vaccine injectable drugs.(61) Previously, Canadian pharmacists practising in other healthcare jurisdictions were only authorised to administer publicly funded vaccines such as influenza.(61) Although pharmacists in Alberta have increasingly provided injections within their community, the details of what pharmacists are injecting is relatively unknown. Additionally, barriers and facilitators regarding the provision of their injection services is not well understood. Pharmacist provided injection services have been studied primarily in the United States,(62) with few studies describing Canadian pharmacy practice.(41, 42, 63, 64)

1.2.2. Perceptions of pharmacists as immunizers

Patients perceive pharmacists as accessible healthcare providers that provide a range of services including medical dispensation, chronic disease management, health information delivery and immunizations.(65, 66) Community pharmacists are able to effectively establish relationships with patients and provide increased convenience and privacy to their patients.(67) A survey of patients regarding pharmacist provided immunization services indicated increased accessibility, lower wait times, and reduced exposure to potential infectious diseases as primary factors of acquiring immunizations at a pharmacy.(41, 67) Additionally, pharmacists have more frequent interactions with individuals who are chronically ill and therefore, more prone to contracting infectious diseases. This in turn presents an opportunity for pharmacists to expand their offerings to patients that would otherwise not be aware of their vaccination needs.

Physicians and other healthcare professionals have been more reluctant to accept the new dynamic in healthcare delivery pertaining to immunizations.(67) Anonymized opinions of physicians and other healthcare providers collected by the *Canadian Healthcare Network* regarding pharmacist's authorization to inject received mixed responses.(69) Some physicians were supportive of the practice and encouraged it to ensure closure of any healthcare delivery gaps and to improve population immunization coverage. Other physicians within the survey were against it on the grounds of pharmacists being unqualified, stepping into physician scope of practice or "territory" or being unable to handle any consequences of side effects that might happen due to immunizations.(69)

1.2.3. Pharmacist perspective

Pharmacists have embraced their expanded scope of practice with respect to injection administration. Pharmacists have been vocal in their support of the new legislative changes as it allows them to provide more services to their patients.(55, 66) Concern for public health and personal satisfaction are potent motivators for pharmacists to gain their authorization to inject.(65, 69)

Some pharmacists are also feeling an increased strain due to providing immunizations.(72) While immunizations are a staple of pharmacist services today, these services require considerable resources in terms of vaccine storage, safe handling and further training required. Additionally, pharmacists have to address vaccine hesitancy and general fear of needles for some patients.(41, 63) Pharmacists also have to manage limited time and resources when it comes to daily pharmacy operations. Issues with litigation and management of adverse effects of vaccinations are also deterrents for pharmacists to provide immunizations.(42, 71)

1.2.4. Pharmacist interventions to improve pneumococcal vaccine uptake

Over the past two decades, there have been numerous studies examining the impact of pharmacist interventions on vaccination rates.(62, 73, 74) Most information reported in previous systematic reviews and meta-analyses came from randomized controlled trials and have focused on quantifying the overall changes in vaccination rates for influenza, pneumococcal, hepatitis B, and other vaccines.(73, 74). Intervention strategies to impact pharmacist provision of immunization services has focused on collaborative strategies amongst pharmacy staff, screening tools, and patient communication techniques.(75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96) Pharmacists are uniquely positioned to impact pneumococcal

vaccination uptake within their communities by identifying eligible patients and addressing patient concerns. They are now tasked with helping close immunization gaps that exist throughout the population. By introducing comprehensive training programs for injections and adverse reaction management, pharmacists will feel more comfortable to provide immunizations. Identifying current regulatory and organizational barriers to immunization is also important to allow pharmacists to operate without hindrance and to aid in closing immunization gaps in the population.

1.3. Goals and objectives of thesis

1.3.1. Overall goal and objectives

The overall goal of this thesis is to develop foundational knowledge that will help inform a community pharmacy-based intervention aimed at improving pneumococcal vaccine uptake. The two projects of this thesis will help achieve this goal by: 1) describing the actions related to administering an injection, including the types of medications commonly administered; and, identify perceived barriers and facilitators pharmacists face when providing injection services and 2) identifying and describing community pharmacy-based intervention programs aimed at improving pneumococcal vaccine uptake. Given that Alberta pharmacists have been involved in providing injections to patients since 2007, insight gained from the first project will help shape future intervention programs to expand this service to patients. Learning from the work of others, the second project will help identify intervention strategies that have improved pneumococcal vaccine uptake.

1.3.2. Summary of projects

Project 1 of this thesis involves a survey of registered Alberta pharmacists. This survey aims to address the following objectives:

1. Characterize the frequency and types of drugs that pharmacists administer by injection.
2. Characterize the type of barriers that pharmacists in Alberta face when providing injection services.

Project 2 of this thesis consists of a review of intervention strategies employed in community pharmacy sites to impact pneumococcal vaccination uptake. The review assesses the focus of intervention strategies, including techniques and tools developed to impact vaccine uptake.

1.3.3. Conclusion

Pneumococcal pneumonia remains a public health concern in Canada, especially for immunocompromised and elderly individuals. While safe and effective vaccines are available to instill immunity within high-risk individuals, their uptake is suboptimal. Pharmacists are uniquely positioned to impact vaccination rates within their communities due to their increased accessibility and convenience. The aim of this thesis is to identify what authorized Alberta pharmacists are injecting and what barriers they are facing. As well, it explores the various intervention strategies that have been employed to impact pneumococcal vaccine uptake. Information gathered in this thesis may allow for the development of a comprehensive intervention program to address barriers and help improve pneumococcal vaccine uptake.

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2. Chapter 2: A survey of Alberta pharmacists' actions and opinions in regard to administering vaccines and medications by injection.

2.1. Introduction

Pharmacists administering injections dates back to the smallpox epidemic in late 19th century when they administered this vaccine throughout the United States.(1) As the development of vaccines accelerated, the role of pharmacists grew to include the storage, preparation, education, and promotion of vaccines.(1) The 1970s and 1980s saw increased efforts and advocacy by the American Pharmaceutical Association for pharmacists providing injection services through pilot projects and task forces. Changes to regulations accelerated in the 1990s when mass merchandizers employed pharmacists to promote and administer the seasonal influenza vaccine. Pharmacist training programs for injection techniques were developed in 1994 and spread nationwide by 1996. Training programs and increased advocacy continue to help pharmacists fulfill their role in promoting influenza and pneumococcal vaccinations.(1)

Alberta pharmacists have been able to acquire authorizations to prescribe medications and administer injections since 2007. Under provincial legislation that governs pharmacy practice, pharmacists with additional prescribing authorization can initiate or manage ongoing therapy if they feel the prescribing decision is in the best interests of the patient. Pharmacists authorized to administer drugs by injection can administer any drug, blood product, or vaccine as long as they are satisfied it is appropriate for the patient. This legislated authority enabled Alberta pharmacists to be the first in Canada who could administer other medications in addition to vaccines.(2, 3) Over 80% of Alberta pharmacists are authorized to administer injections, and compensation for injection services from the provincial government is available for publicly funded vaccines (influenza, pneumococcal, and diphtheria, Tetanus, acellular pertussis) as well as any medication listed as an injection in the provincial drug benefit lists.(4, 5) Injections that are not covered by the compensation plan require an out-of-pocket payment from the patient or third-party insurance coverage.(5) Although pharmacists in other Canadian health jurisdictions were initially only allowed to administer vaccines, health policies and regulations in most provinces have evolved over the years to now include other medications.(3) However, the authority to administer non-vaccine medications is still pending for pharmacists in British

Columbia and pharmacists in Ontario are only allowed to administer non-vaccine medications for education or demonstration purposes.(3)

Pharmacist provided vaccinations are considered essential in bridging the gap between public health recommendations and population coverage.(6, 7) In Alberta, there is growing recognition that pharmacists play an important role in vaccination campaigns. For example, pharmacists are now the most common provider of influenza vaccinations, administering 61% of all doses during the 2019-2020 program.(8) Community pharmacists have become the primary source of immunization information and provision for first time immunizers because of their accessibility to the public.(6, 9, 10, 11) During the COVID-19 pandemic, community pharmacists have also become the leading provider of COVID-19 vaccinations in Alberta.(12, 13) Indeed, community pharmacists have become the primary source of immunization information and provision for first time immunization recipients because of their accessibility to the public.(6, 9, 10, 11)

As the role of pharmacists providing injection services has increased, research in the area has highlighted major barriers to its provision. However, most of the previous research has been performed in the United States and highlights out-of-pocket expenses and lack of insurance coverage as major factors limiting pharmacist provided immunization services (Appendix Table).(14, 15, 16, 17) In Canada, previous studies have been limited to injection activities related to influenza vaccination and other publicly funded vaccines such as pneumococcal (13-valent and 23-valent), hepatitis (A and B), and diphtheria.(18, 19, 20) Due to regulatory limitations in other provinces, like British Columbia and Ontario,(3) there is a lack of information regarding non-vaccine injectable medications that pharmacists can administer. Information regarding pharmacist administration of non-vaccine injectable medications has been incidental. For example, previous studies asked participants what other intramuscular injections pharmacists should administer and found the most frequently listed were vitamin B12, testosterone, and denosumab.(18, 21, 22)

Pneumococcal vaccines were introduced in Canada in 1978 with a polysaccharide based 23-valent vaccine (PPSV23 / PNEU-P-23).(23, 24) A 7-valent conjugate vaccine (PCV-7 / PNEU-C-7) with higher immunogenicity was later introduced and expanded to a 13-valent vaccine (PCV-13 / PNEU-C-13).(23, 25) Health Canada recommends that adults over 65 years of age should be administered a PPSV23 vaccine.(23, 26) Pneumococcal vaccines (PNV) in general are effective at reducing the burden of disease from invasive pneumococcal infection in the elderly

and immunocompromised populations.(27, 28, 29) While PNV have reduced mortality and severity of pneumonia in Canada,(30) their uptake has remained suboptimal.(31, 32) The 2020-2021 adult Influenza Immunization Coverage Survey reported 55% of Canadians aged 65 years or older have received a PPSV23 vaccine,(32) and a population survey of people with diabetes in Alberta reported 53% uptake of PNV.(33) The gap in PNV coverage in Canada has remained steady and coverage is below the vaccination coverage goal of 80% in elderly (over 65) Canadians.(26) An increasing number of Albertans are hospitalized yearly due to invasive pneumococcal disease (34) of which, pneumococcal pneumonia is the primary cause.(35, 36, 37) This highlights the importance of preventative PNV administration.

Pharmacists are uniquely equipped to address this gap in coverage due to their accessibility to patients in the community and growing recognition as providers of vaccinations.(10, 11, 38, 39) This study is an initial step in developing an intervention program to address the pneumococcal vaccine coverage gap. To address this gap, we must first understand the actions and opinions of Alberta pharmacists regarding the administration of vaccines and medications by injection. The specific objectives are to describe the actions related to administering an injection, including the types of medications commonly administered; and, identify perceived barriers and facilitators pharmacists face when providing injection services.

2.2. Methods

2.2.1. Survey Development

The survey was developed using information from previous studies that examined pharmacy-based immunization services (Appendix 1) and the collective experience of the research team. Previous studies were identified from a Medline search that combined four topic areas of pharmacists; attitudes, beliefs, and knowledge; vaccines; and surveys. Of the 23-survey-based studies identified, 13 were conducted in the United States and the rest conducted in Canada (Appendix 1). Most surveys focused on describing characteristics of pharmacists providing injection services, patient-related barriers to providing injection services (e.g., out-of-pocket costs), or actions and opinions related to providing vaccination services. Few surveys focused on pharmacists administering non-vaccine medications.

The survey was divided into three parts: 1) general demographic information of participants and primary practice site characteristics, 2) actions related to pharmacists administering injections, and 3) opinions of pharmacists regarding the provision of injection

services. The first section collected information on the pharmacist's characteristics (age, sex), qualifications (source of pharmacy degree), and additional certifications (authorization to administer drugs by injection, additional prescribing authorization, certified diabetes educator, travel vaccines). Questions asked about primary practice site characteristics (community, hospital, primary care network, or other), role within (staff, manager, owner), and additional services provided (therapeutic drug management, chronic disease management, pharmacogenomics testing). The last set of questions in this section asked participants with the authorization to administer drugs by injection when they last administered an injection, and the number of injections administered in the past year.

In the second section of the survey, pharmacists who indicated administering at least one injection in the past year were asked questions about activities related to administering an injection. The first set of questions in this section asked participants how injection services were provided at their practice site, resources used to determine what vaccines are required for patients, and reasons patients provide when refusing a recommended medication or vaccine. These questions were followed by a comprehensive list of injectable medications that was developed by reviewing the lists of administered vaccines and other medications reported in previous studies (Appendix 1) and supplementing with information from Alberta College of Pharmacy standards,(40) and legislative guidelines established by Alberta Health.(41) The list was reviewed by 4 pharmacists who have active clinical practices where they frequently administer injections. Participants were asked if they have administered each vaccine or medication in the past year, or plan to offer it in the future.

The third section of the survey began with questions asking pharmacists about feedback they received from other healthcare professionals regarding their additional authorizations and their opinion regarding the authorization to administer drugs by injection contributing to their role as a pharmacist. The remainder of this section asked pharmacists for their opinions of possible barriers and benefits related to providing injection services at pharmacies.

Questions solicited opinions regarding storage-related barriers and practice-related barriers on a 4-point Likert scale (1="Not a barrier", 2="Minor barrier", 3="Moderate barrier", 4="Major barrier"). Storage-related barriers included education on cold chain requirements, space required and costs to purchase equipment to maintain the cold chain, and uncertainty regarding supply from the manufacturer. Practice-related barriers regarding injection services

explored the pharmacist's comfort administering an injection, comfort with managing adverse reactions, opinions of the documentation requirements related to injection services, and conflict with other healthcare professionals.

Questions recorded opinions of benefits to administering injections in pharmacies using a 4-point Likert scale (1="Not a Benefit", 2="Minor Benefit", 3="Major Benefit", 4="Major Benefit"). Potential benefits included bringing more people into the practice site, generating additional revenue, generating opportunities to provide other professional pharmacy services, improving knowledge of the medications administered by injection, improving job satisfaction, increasing the community vaccination rate, and reducing the risk of infection in the community.

The final set of questions in this section asked pharmacists to indicate their opinions regarding organizational, educational, and patient-related strategies that have been used in the past to improve the provision of injection services. The pharmacist's opinions of these strategies were recorded using a 4-point Likert scale (1="Not Helpful", 2="Somewhat helpful", 3="Helpful", 4="Essential"). Pharmacists indicated helpfulness of organizational strategies such as: adequate time to assess for appropriateness, administer the injection, and monitor for immediate reactions; adequate support from other pharmacists and technicians on staff; increased reimbursement for injection services; and lower out-of-pocket costs for patients. Questions regarding educational strategies included: advertising and promotional tools in the pharmacy to raise public awareness of injection services; continuing education for pharmacists regarding managing adverse reactions and vaccine indications; and decision aids for vaccine indications. Patient-related strategies included: access and automated reporting to provincial immunization registry; recall systems to contact patients; and personalized recommendations for vaccines based on indications.

2.2.2. Ethics and Administration

The study was evaluated and approved by the Health Research Ethics Board at the University of Alberta (Pro00103825). The survey was loaded into REDCap software (42) for secure administration and storage of responses. The server used to store responses was hosted at the Women's and Children's Health Research Institute at the University of Alberta. An email list of Alberta pharmacists who were willing to be contacted for research purposes was obtained from the Alberta College of Pharmacy. The initial email containing a brief description of the survey purpose with an individualized link was sent on 27 October 2020. Two reminders were

sent to participants who had not accessed the survey at one-week intervals, which is consistent with a modified Dillman method.(43) The survey was closed for submission on 19 November 2020.

2.2.3. Data Analysis

The Alberta College of Pharmacy provided the names and email addresses for 5714 registered pharmacists who were willing to be contacted for research purposes in 2020. An a priori recruitment target of 360 participants was set to achieve a 5% margin of error and 95% confidence interval.(44)

Demographic characteristics of participants were summarized using descriptive statistics and aggregated into categories to facilitate comparisons with previous literature. Characteristics regarding age, gender, years of experience, authorization to administer drugs by injection and additional prescribing authorization were compared with the Canadian Institute for Health Information 2020 Report (45) and Alberta College of Pharmacy 2020-2021 annual report (4) using a chi-square test to determine the representativeness of the study sample.

Participants were grouped into "Active", and "Non-Active" Providers based on responses to questions of injection authorization and administration in the first section of the survey. Active Providers indicated they had an authorization to administer drugs by injection and had administered at least one injection in the past year. Participants were considered Non-Active Providers if they either did not have an authorization to administer drugs by injection or had not administered an injection in the past year. Characteristics were compared between these two groups using chi-square tests for categorical variables and t-tests for continuous variables.

Objective 1: Actions related to administering an injection

Responses from Active Providers were used to examine actions related to administering an injection. First, we summarized the strategies used to promote injection services and methods for providing these services using bar graphs. The frequency of providing other professional pharmacy services was summarized using a frequency bar graph displayed as a tornado plot. In this subtype of frequency bar graphs, the proportion of participants who indicated the activity "Never" occurred were plotted to the left of 0% and proportion indicating the activity occurred in increasing categories of frequency were plotted to the right of 0%. Second, resources used to determine vaccine eligibility and reasons for patients refusing a recommended drug or vaccine were summarized using tornado plots. We also summarized the strategies employed when a

pharmacist was unable to provide a recommended injection using bar graphs. Third, the proportions of Active Providers who administered a vaccine or drug in the past year or who planned to administer it in the future were calculated from all Active Providers who responded to that item. The medications subsequently were ranked from most frequently administered to least frequently administered. Vaccines administered for travel purposes were analyzed separately.

Objective 2: Opinions regarding the provision of injection services

We addressed this study objective by examining summary scores for each category and the proportions of response options for each item within the category. A summary score for each category was calculated by adding the response value for each item within the category. For example, the storage-related barriers category had 4 items, creating a range from 4 (all items considered "not a barrier") to 16 (all items were considered a "major barrier"), Practice-related barriers had 6 questions so the range of scores was 6 to 24. The category of benefits to administering injections in pharmacies had 8 questions, creating a range from 8 (all items were considered as "not a benefit") to 32 (all items were considered a "major benefit"). The 10 questions asking about organizational strategies to improve the provision of injection services created a range of scores from 10 (all items considered as "not helpful") to 40 (all items considered as "essential"). There were 6 questions exploring opinions of educational strategies, creating a range of scores from 6 to 24, and the 5 questions exploring patient-related strategies created a range of scores from 5 to 20.

Each category was analyzed separately, and a respondent was excluded if they did not provide an answer to one or more items within the category. A box plot was constructed to illustrate the distribution of scores between Non-Active Providers and Active Providers and the Mann-Whitney U-test was used to determine if the observed difference between groups was statistically significant. If the difference between groups was not significant, then responses for each item were summarized for the entire study group using a tornado plot. In this graph, the proportion of respondents indicating the item was "not a barrier" were displayed to the left of 0% and proportions of respondents indicating the item was a minor, moderate, or major barrier were displayed to the right of 0%. If the difference between provider groups was significant, responses for each item were summarized according to Non-Active Provider and Active Provider groups in the tornado plot. In addition, we stratified the Active Provider group according to number of injections in the previous year: Infrequent Providers administered 1 to 48 injections, Moderately

Active Providers administered 49 to 150 injections, and Highly Active Providers administered over 150 injections. These subgroups were used to further examine respondent opinions regarding the authorization to administer drugs by injection using a box plot to display the distribution of scores according to frequency of injections and the Kruskal-Wallis H-test to determine if the observed differences between subgroups were statistically significant.

2.3. Results

2.3.1. Survey Administration

Our sampling frame consisted of 5102 pharmacists who were willing to be contacted for research purposes and had active email addresses, which is 87.8% of all 5814 registered pharmacists in Alberta in 2020.(4) Of those with active email addresses, 397 pharmacists completed the survey, resulting in a 7.8% response rate.

2.3.2. Demographics

Pharmacists who completed the survey had a mean age of 42± 11 years, 261 (66%) were female, and had a mean of 16± 12 years of experience in the profession (Table 2-1). Most respondents (n=361, 91%) stated that their entry to practice credential was a bachelor's degree in pharmacy and just over half (n=222, 56%) indicated receiving their first pharmacy degree at the University of Alberta. A total of 258 (65%) respondents held an additional prescribing authorization, and 325 (82%) primarily practiced in a community pharmacy. Although 363 (91%) pharmacists had an authorization to administer drugs by injection, 10 did not report administering an injection in the past year. Stratifying our study group according to 353 Active Providers and 44 Non-Active Providers revealed some important differences (Table 2-1). Active Providers were more likely to be male, obtained their pharmacy degree from a Canadian university, and practiced in a community pharmacy compared to Non-Active Providers.

Table 2-1: Demographics of survey respondents

		Non-Active* (n=44)	Active* (n=353)	Overall* (n=397)
Age, mean (+/- SD)		47.7 (+/- 10.4)	41.2(+/-11.3)	42.0 (+/-11.4)
Years as Pharmacist, mean (+/- SD)		23.3 (+/-11.4)	15.0 (+/-12.2)	15.9 (+/-12.4)
Gender	Male	7 (17.1%)	119 (34.0%)	126 (31.7%)
	Female	33 (80.5%)	228 (65.1%)	261 (65.7%)
	Prefer not to disclose	1 (2.4%)	3 (0.9%)	4 (1.5%)

Pharmacy Education	Bachelor of Science in Pharmacy	39 (88.6%)	322 (91.2%)	361 (90.9%)
	Doctor of Pharmacy (PharmD)	0 (0.0%)	22 (6.2%)	22 (5.5%)
	Post-Baccalaureate PharmD	4 (9.1%)	17 (4.8%)	21 (5.3%)
	Hospital Pharmacy Residency	6 (13.6%)	19 (5.4%)	25 (6.3%)
	Master of Science (MSc)	2 (4.5%)	16 (4.5%)	18 (4.5%)
	Doctor of Philosophy (PhD)	0 (0.0%)	5 (1.4%)	5 (1.3%)
	Other Degrees or Qualifications	1 (2.3%)	28 (7.9%)	29 (7.3%)
First Pharmacy Degree Location	University of Alberta	24 (60.0%)	198 (57.2%)	222 (55.9%)
	Another university in Canada	12 (30.0%)	66 (19.1%)	78 (19.7%)
	A university in the United States	0 (0.0%)	3 (0.9%)	3 (0.8%)
	University outside North America	4 (10.0%)	79 (22.8%)	83 (20.9%)
Authorization to administer drugs by injection		10 (22.7%)	353 (100.0%)	363 (91.4%)
Years with authorization to administer drugs by injection: median,(25%,75%)		4 (0,7)	7 (4,10)	7 (4,10)
Additional Prescribing Authorization		25 (56.8%)	233 (66.0%)	258 (65.0%)
Additional Certifications Acquired	Certified Diabetes Educator	2 (4.5%)	42 (11.9%)	44 (11.1%)
	Smoking Cessation	2 (4.5%)	32 (9.1%)	34 (8.6%)
	Women's Reproductive Health	0 (0.0%)	1 (0.3%)	1 (0.3%)
	Certified Asthma Educator	0 (0.0%)	6 (1.7%)	6 (1.5%)
	Mental Health	0 (0.0%)	3 (0.8%)	3 (0.8%)
	Travel Vaccines	0 (0.0%)	25 (7.1%)	25 (6.3%)
	Other	5 (11.4%)	33 (9.3%)	38 (9.6%)
Pharmacy Type	Community Pharmacies	16 (37.2%)	309 (88.3%)	325 (81.9%)
	Hospital, Long-term care facility, Primary Care Network, or other	27 (62.8%)	41 (11.7%)	68 (17.2%)
Role at primary practice site	Pharmacy Owner or Franchisee	2 (4.8%)	44 (12.5%)	46 (11.6%)
	Pharmacy Manager	1 (2.4%)	96 (27.4%)	97 (24.4%)
	Staff Pharmacist	35 (83.3%)	201 (57.3%)	236 (59.4%)
	Independent Contractor	4 (9.5%)	10 (2.8%)	14 (3.5%)
Hours per week spent at primary practice site	Less than 8 hours	0 (0.0%)	4 (1.1%)	4 (1.0%)
	8-16 hours	3 (7.0%)	18 (5.1%)	21 (5.3%)
	17-24 hours	10 (23.3%)	30 (8.5%)	40 (10.1%)

	25-40 hours	27 (62.8%)	222 (63.1%)	249 (62.7%)
	40+ hours	3 (7.0%)	78 (22.2%)	81 (20.4%)
Number of times received an influenza vaccine in the last 5 years	None	1 (2.4%)	13 (3.7%)	14 (3.5%)
	1-2	2 (4.9%)	12 (3.4%)	14 (3.5%)
	3-4	3 (7.3%)	48 (13.6%)	41 (12.8%)
	5	35 (85.4%)	280 (79.3%)	315 9.3%)

*Numbers reported may not add to the total sample size for some characteristics because some respondents did not provide an answer.

When compared to demographic information of pharmacists in Alberta, our study participants were similar in age and proportion of staff pharmacists as defined by the Canadian Institute for Health Information (Table 2-2).(4, 45) However, our study participants were more likely to be female, obtain their pharmacy degree from a Canadian university, practice for ≤ 10 years and hold authorizations to administer medications by injection and prescribe.

Table 2-2: Data Representativeness

			Canadian Institute for Health	
		Data Collected*	Information 2020 (45)	Significance
Observations		397	5,357	
Age n (%)	Age <40	185 (48%)	2467 (46%)	p = 0.71
	Age 40-59	170 (44%)	2436 (45%)	
	Age 60+	33 (9%)	414 (8%)	
Female n (%)		261 (66%)	3384 (61%)	p < 0.01
Pharmacy degree from a Canadian University n (%)		300 (76%)	3718 (67%)	p < 0.01
Community Pharmacists n (%)		325 (82%)	3994 (75%)	p < 0.01
Staff Pharmacists n (%)		236 (59%)	3382 (63%)	p = 0.22
Years of Experience n (%)	0-10	175 (44%)	1768 (32%)	p < 0.01
	11-20	94 (24%)	1802 (32%)	
	21-30	56 (14%)	1222 (22%)	
	30+	67 (17%)	783 (14%)	
		Data Collected	Alberta College of Pharmacy 2020-2021 Annual Report (4)	Significance
Observations		397	5892	
Authorization to administer drugs by injection n (%)		363 (91%)	4815 (82%)	p < 0.01
Additional prescribing authority n (%)		258 (65%)	3339 (57%)	p < 0.01

*Numbers reported may not add to the total sample size for some characteristics because some respondents did not provide an answer.

Objective 1: Actions related to administering an injection.

2.3.3. Promoting injection services

Active Providers indicated that the most common methods of promoting injection services were individual consultation with the patient (61%), corporate poster (59%), and in-store announcements (37%). Some pharmacists (5%) reported that they do not use any advertising for injection services (Figure 2-1).

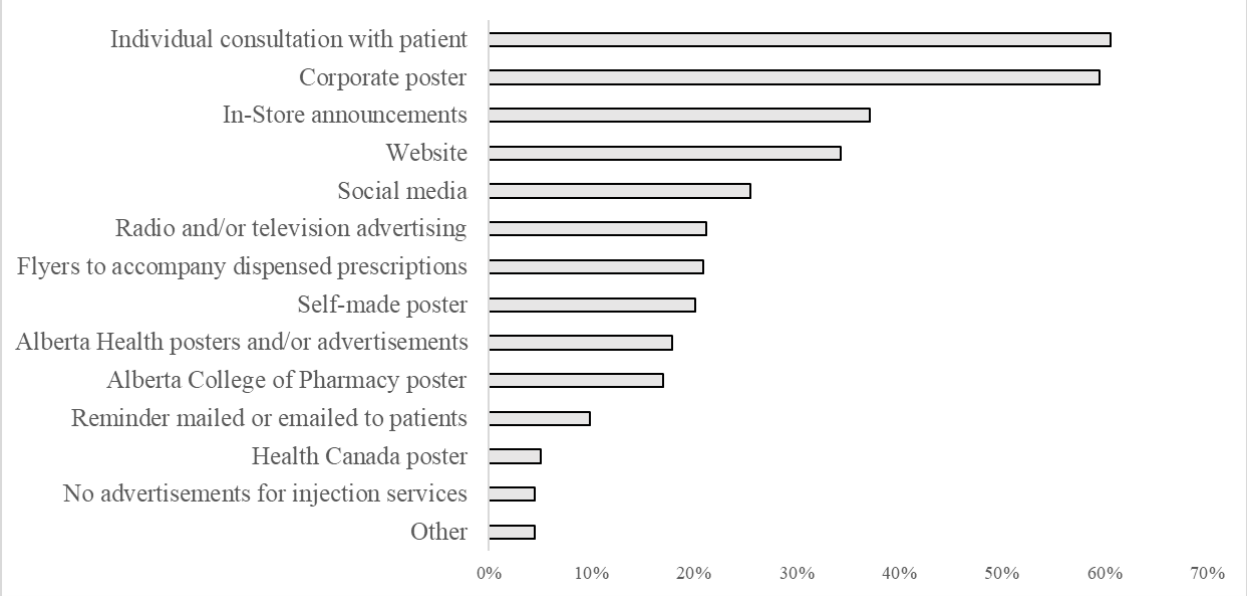

Figure 2-1: Strategies employed by Active Providers to advertise injection services (n=353)

The most common method for providing an injection service, reported by 85% of Active Providers, was on an ad-hoc basis through walk-in requests from patients (Figure 2-2). The next most common method was by appointment (74%), followed by predetermined clinic time, such as an influenza vaccine clinic. In contrast, very few (<5%) pharmacists reported offering injection services on weekends or evenings only. Most respondents (60%) indicated that they spend 10-15 minutes to assess and administer an injection.

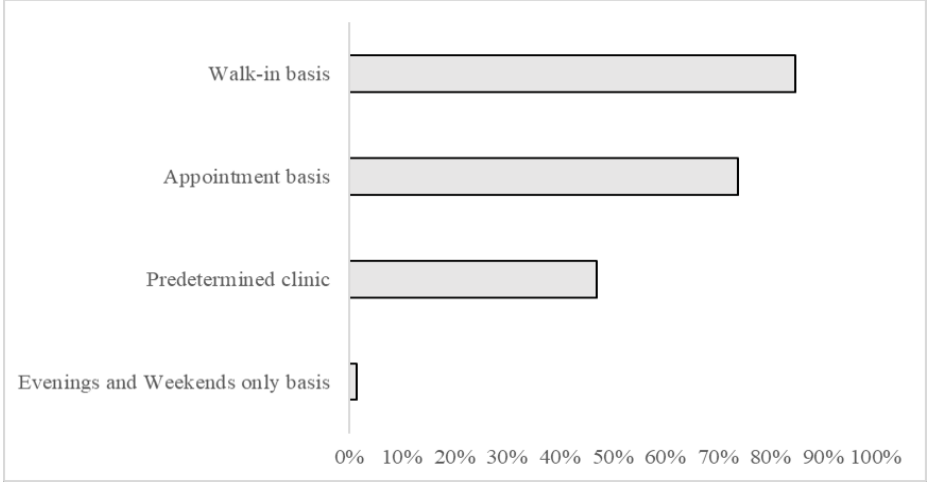

Figure 2-2: How injection services are provided by Active Providers (n=353)

In terms of other services provided, Active Providers reported using their additional prescribing authorization to initiate therapy on a daily to weekly basis (Figure 2-3). They also reported providing chronic disease recommendations to patients and other healthcare professionals on a regular basis. Therapeutic drug monitoring, point-of-care testing, and pharmacogenomic testing were either not provided at all, or provided on a monthly or less than monthly frequency.

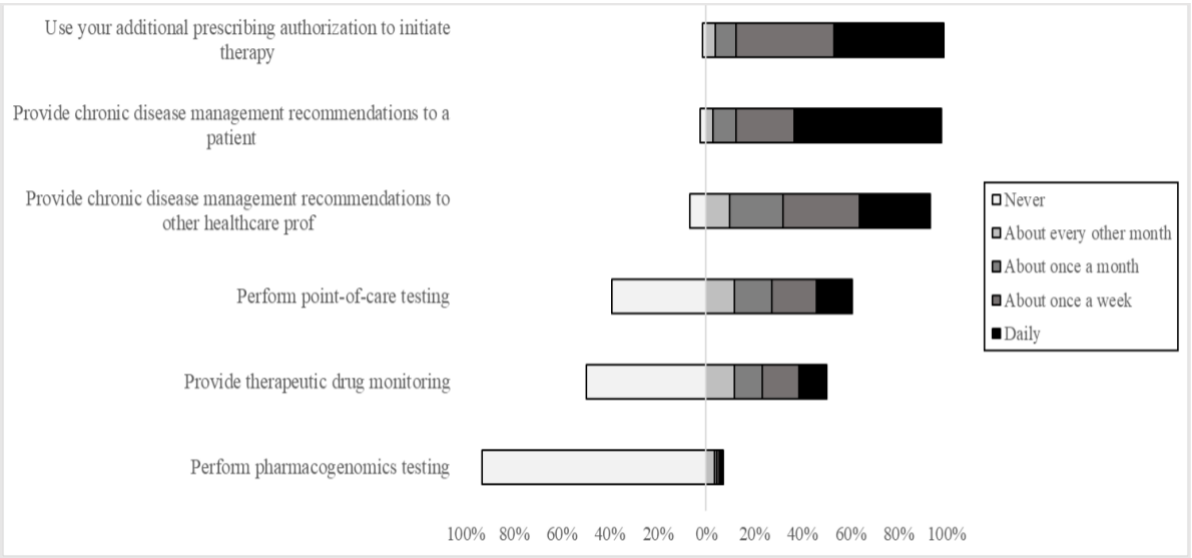

Figure 2-3: Other pharmacy services provided by Active Providers (n=353)

Active Providers indicated that patients request vaccines or vaccine-related information at least once a week, with 46% indicating they receive requests daily (Table 2-3). Many active providers use their authorization to administer drugs by injection as part of a broader

professional service to their patients. For example, 21% of active providers indicated they proactively offer injection services after conducting a medication review, and 14% educate patients about their injection service while providing other professional pharmacy services. About 1 in 5 Active Providers use the injection service as an opportunity to educate patients about other professional pharmacy services they can offer.

Table 2-3: When do Active Providers (n=353) use their authorization to administer drugs by injection

When do you use authorization to administer drugs by injection during visit?*	
When the patient asks or I receive a referral about a vaccine or drug, I perform the assessment and administer the injection	166 (47.0%)
When the patient asks or I receive a referral about a vaccine or drug, I take this opportunity to educate the patient about other professional pharmacy services while I perform the assessment to administer an injection	62 (17.6%)
I educate patients about the injection service (e.g., provide influenza vaccines during flu season) while providing another professional pharmacy service	47 (13.3%)
I offer the injection service upon reviewing the patient's medication and health history	74 (20.9%)
How often do patients request vaccines or information on vaccines from you?*	
Daily	159 (45.0%)
About once a week	128 (36.3%)
About once a month	28 (7.9%)
About every other month	8 (2.3%)
Only during influenza season	19 (5.4%)
Never	5 (1.4%)

* Numbers reported may not add to the total sample size because some respondents did not provide an answer.

2.3.4. Resources used to determine vaccine eligibility

Active Providers indicated that they primarily use the Canadian Immunization Guide (46) and product monographs to determine patient eligibility for vaccines (Figure 2-4). Respondents indicated that Alberta Health Services immunization programs standards manual (47) was most often utilized during influenza season compared to other resources listed. In addition, Travax® (48) was used by 16 pharmacists and Lexicomp® (49) was used by 7 for vaccine-related information. The Compendium of Pharmaceuticals and Specialties,(50) and Public Health Agency of Canada(46) were among the least used resources for vaccine-related information.

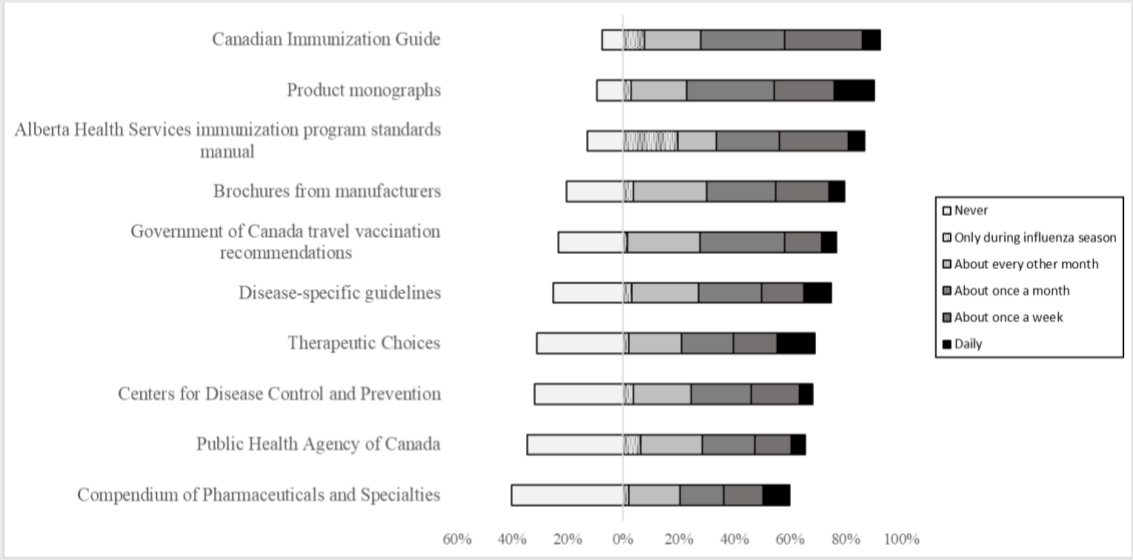

Figure 2-4: Resources used to determine vaccine eligibility (n=353)

2.3.5. Reasons for patient refusal to injection recommendations

The most common reason for refusal that Active Providers encountered when recommending an injection was the out-of-pocket expense was too high (Figure 2-5). Other common reasons included the patient's perceived lack of benefit and perceived lack of susceptibility to the disease. The least commonly cited reason for refusal was lack of available time.

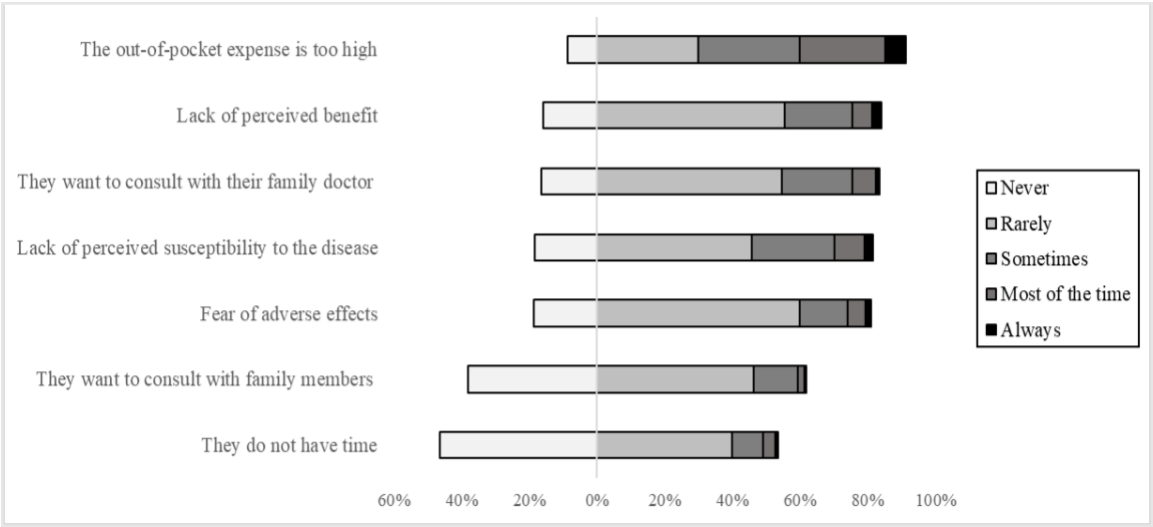

Figure 2-5: Pharmacist reported reasons for patient-refusal to an injection recommendation (n=353)

When a patient was willing to receive an injection, but the pharmacist was unable to provide it due to supply issues or other reasons, Active Providers referred the patient to a public

health nurse, a family physician, or provide educational material (Figure 2-6). Non-Active Providers would most often refer the patient to a pharmacist with an authorization to administer drugs by injection (Figure 2-6).

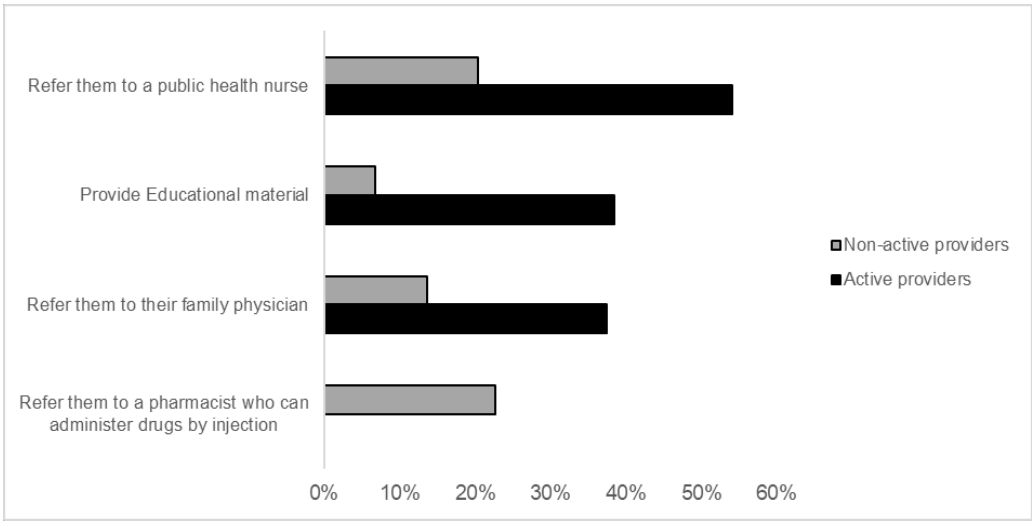

Figure 2-6: Strategies employed by Active Providers (n=353) and Non-Active Providers (n=44) when unable to provide an injection

2.3.6. Injections provided in the past year

Influenza vaccine was the most common vaccine, administered by 98% of Active Providers in the past year (Figure 2-7). Over 80% of Active Providers also reported administering herpes zoster, hepatitis B, hepatitis A, and the 23-valent pneumococcal polysaccharide vaccine in the past year. Other vaccines commonly administered included the 13-valent pneumococcal conjugate vaccine, human papillomavirus vaccine, and the tetanus, diphtheria, and pertussis vaccine.

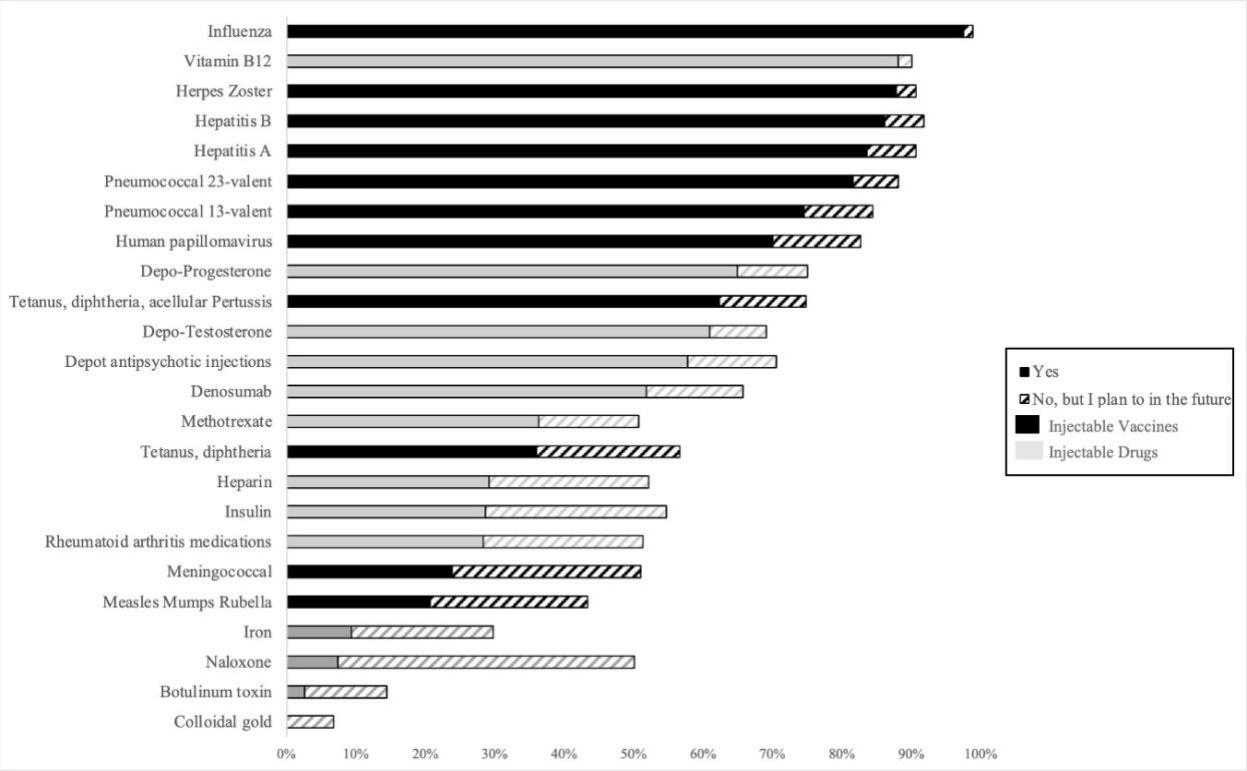

Figure 2-7: Proportion of Active Providers (n=353) who administered a medication in the past year or plan to offer in the future

Vitamin B12 was the most common drug administered by Active Providers over the past year (Figure 2-7). Other drugs commonly administered by Active Providers included depo-progesterone, depo-testosterone, depot antipsychotic injections, and denosumab. Injection activities for two other drugs are worth highlighting from Figure 2-7. Insulin, which is used daily by all patients with type 1 diabetes and some patients with type 2 diabetes, was administered by 28% of Active Providers in the past year. We found that pharmacists who were Certified Diabetes Educators were twice as likely to administer insulin compared to pharmacists without this certification ($p<0.001$). Naloxone, a drug used to treat an opioid overdose, was administered by less than 10% of Active Providers in the past year; however over 40% reported they planned to offer this drug in the future if needed, which was the highest proportion for this response category for any drug or vaccine.

A total of 266 (75% of 353 Active Providers) indicated that they provided travel vaccines in the previous year). The most common travel vaccines administered by these pharmacists were hepatitis A, hepatitis B, and typhoid vaccines (Figure 2-8).

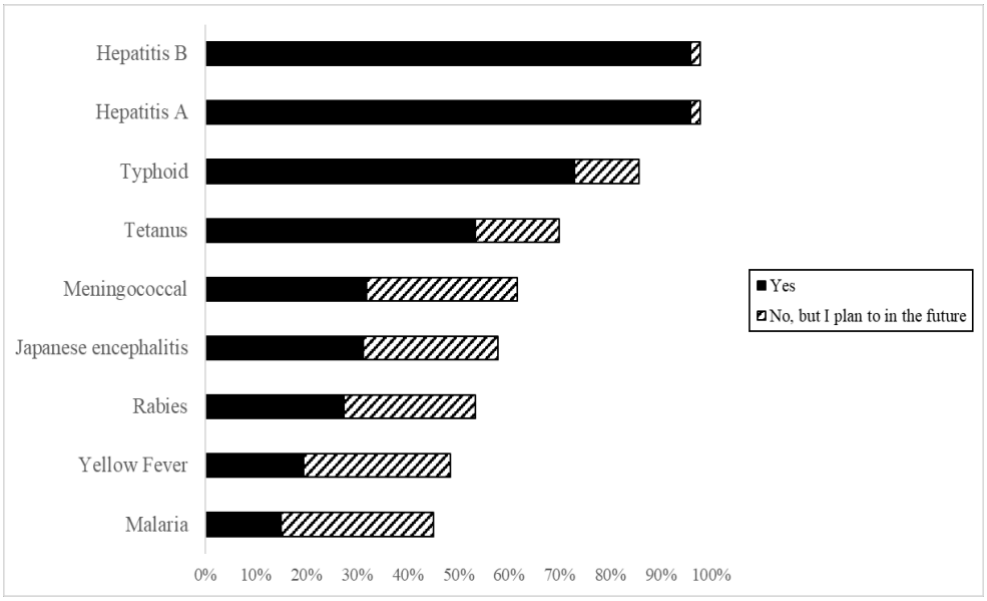

Figure 2-8: Proportion of Active Providers who administered a travel vaccine in the past year or planned to offer in the future (n=266)

2.3.7. Objective 2: Opinions regarding the provision of injection services

In general, pharmacists indicated that they received mostly positive feedback from other health care professionals regarding their scope of practice in Alberta (Figure 2-9). Over 80% of respondents reported receiving mostly positive feedback regarding the authorization to administer drugs by injection. When asked how this authorization contributes to their role as a pharmacist, almost 90% of respondents indicated this was an integral part of their professional practice.(Table 2-4)

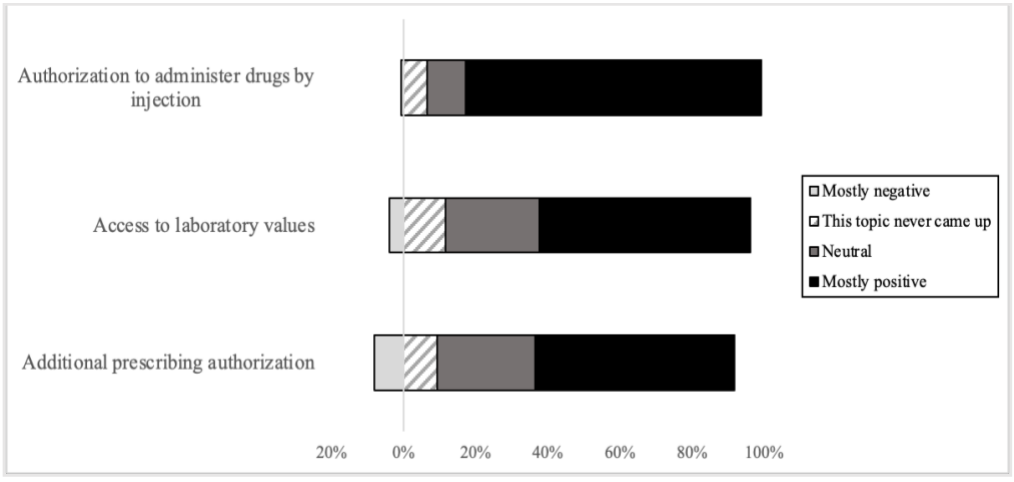

Figure 2-9: Reception of pharmacists' scope of practice from other healthcare professionals (n=397)

Table 2-4: Personal attitude of Active Providers (n=353) towards authorization to administer drugs by injection

How does the authorization to administer drugs by injection contribute to your role as a pharmacist?*	
It is an integral part of my responsibilities (e.g., I use it regularly)	313 (88.7%)
It is occasionally an important part of my responsibilities (e.g., I only use it during flu season)	32 (9.1%)
It is not an important part of my responsibilities (e.g., I use it rarely)	7 (2.0%)

*Numbers reported may not add to the total sample size because some respondents did not provide an answer.

2.3.8. Storage-Related barriers

A total of 380 pharmacists responded to all 4 questions in the storage-related barriers category and there was no difference between Non-Active and Active Providers regarding missing responses (p=0.63). The median score was 7 (interquartile range (IQR): 5 to 9), suggesting the items in this category were not considered barriers by survey respondents. The distribution of scores within this category were similar between Non-Active and Active Providers (Figure 2-10.; p=0.38).

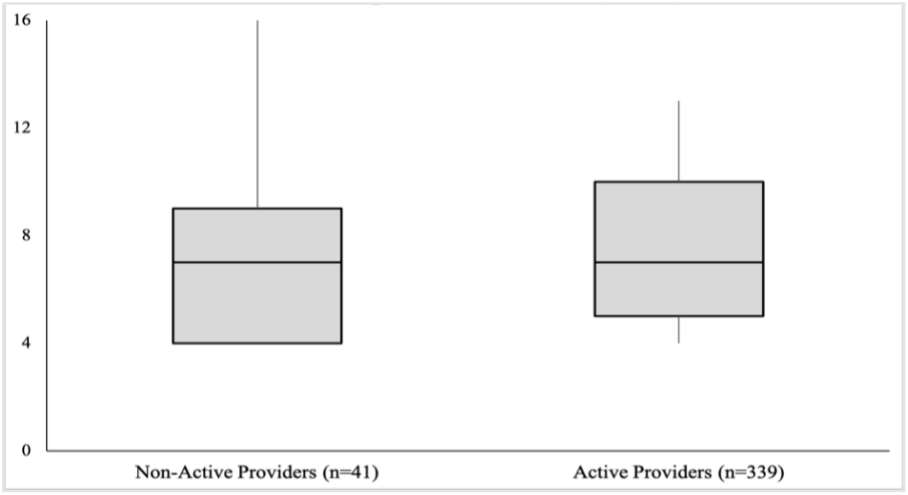

Figure 2-10: Overall perceived storage-related barriers identified by activity status (n=380)

Responses to individual questions revealed that uncertainty regarding vaccine supply was the biggest perceived barrier, with 39% of pharmacists indicating it was a moderate or major barrier. Over 60% of respondents indicated the costs and space required for equipment to maintain the cold chain were not considered barriers to providing vaccines in pharmacies. Similarly, 68% of respondents felt the education on cold chain requirements was not a barrier (Figure 2-11).

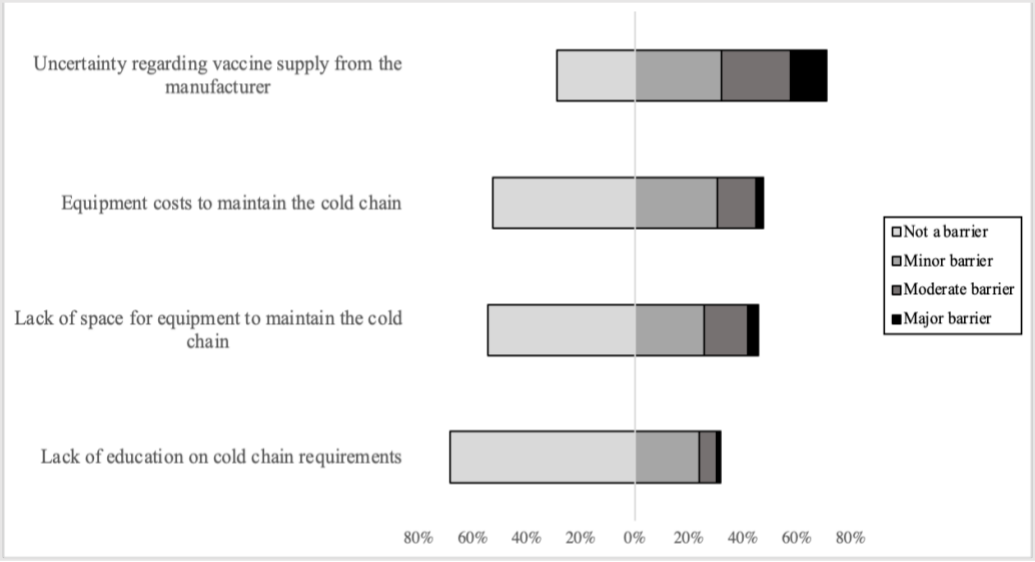

Figure 2-11: Pharmacist perception of storage-related barriers (n=380)

2.3.9. Practice-related barriers

All 6 questions in the practice-related barriers category were answered by 39 (89%) of 44 Non-Active Providers and 339 (96%) of 353 Active Providers (p=0.093). The median score was 8 (IQR: 7 to 11), suggesting items in this category were generally not considered barriers by survey respondents. However, when stratified by group, Non-Active Providers perceived more barriers in this category compared to Active Providers (Figure 2-12; p=0.0074). Furthermore, when scores were compared across categories of injection frequency within the Active Providers group (Figure 2-13.), Highly Active Providers reported very few practice-related barriers to administering medications by injection, while Infrequent Providers reported the most practice-related barriers (p=0.0001).

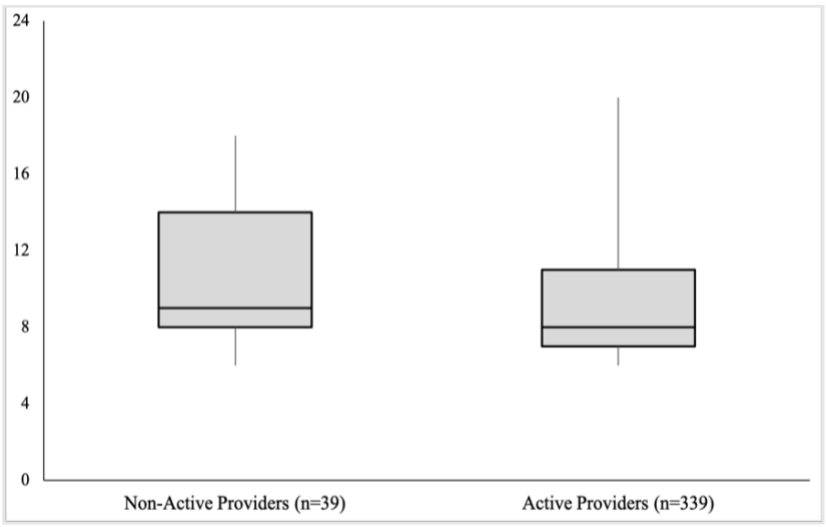

Figure 2-12: Overall perceived practice-related barriers by activity status (n=378)

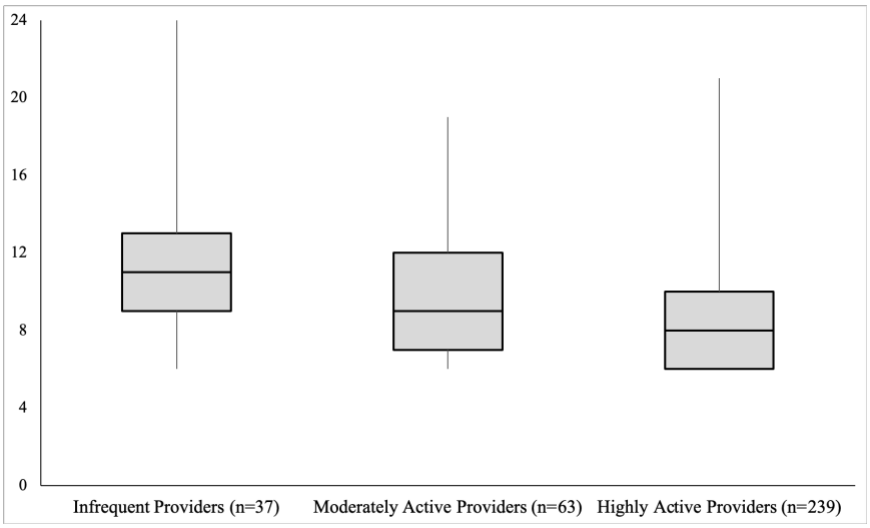

Figure 2-13: Overall perceived practice-related barriers by frequency of injections provided by Active Providers in the past year (n=339)

When responses to individual questions were examined, almost 60% of Non-Active Providers reported comfort with administering injections as a barrier, whereas over 75% of Active Providers reported this was not a barrier ($p<0.001$, Figure 2-14). Non-Active Providers were also more likely to report comfort with managing adverse reactions as a moderate or major barrier compared to Active Providers ($p=0.013$). In contrast, both groups indicated that concern with needle disposal after administering a drug by injection was not a barrier to offering this service to their patients.

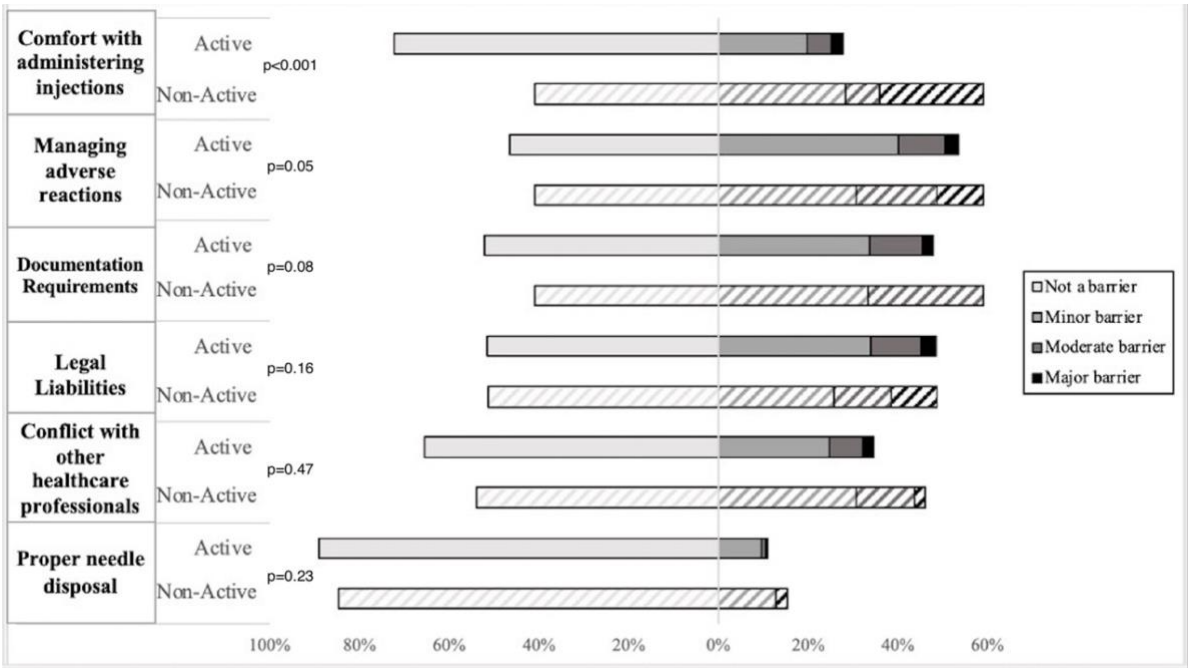

Figure 2-14: Pharmacist perceptions of practice-related barriers by activity status (n=378)

2.3.10. Benefits to administering injections in pharmacies

All 8 questions exploring perceived benefits to injection services were answered by 40 (91%) of 44 Non-Active providers and 334 (95%) of 353 Active providers (p=0.11). The median score was 27 (interquartile range 24 to 30), suggesting respondents considered many items in this category as benefits to providing injection services to their patients. When stratified by group, Active Providers reported more benefits compared to Non-Active Providers (Figure 2-14, p=0.011). Furthermore, when scores were compared across categories of injection frequency within the Active Providers group (Figure 2-15), Highly Active Providers reported the most perceived benefits, while Infrequent Providers reported the fewest (Figure 2-16, p<0.001).

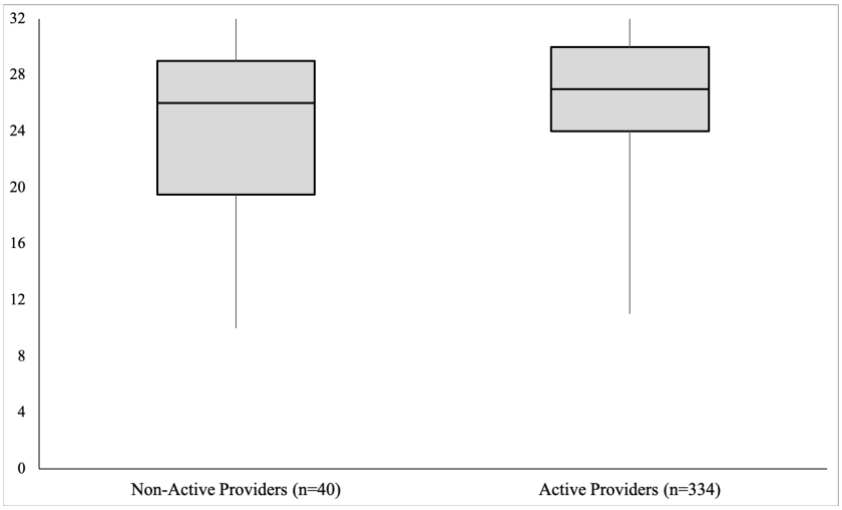

Figure 2-15: Overall perceived benefits of a pharmacist provided injection service by provider status (n=374)

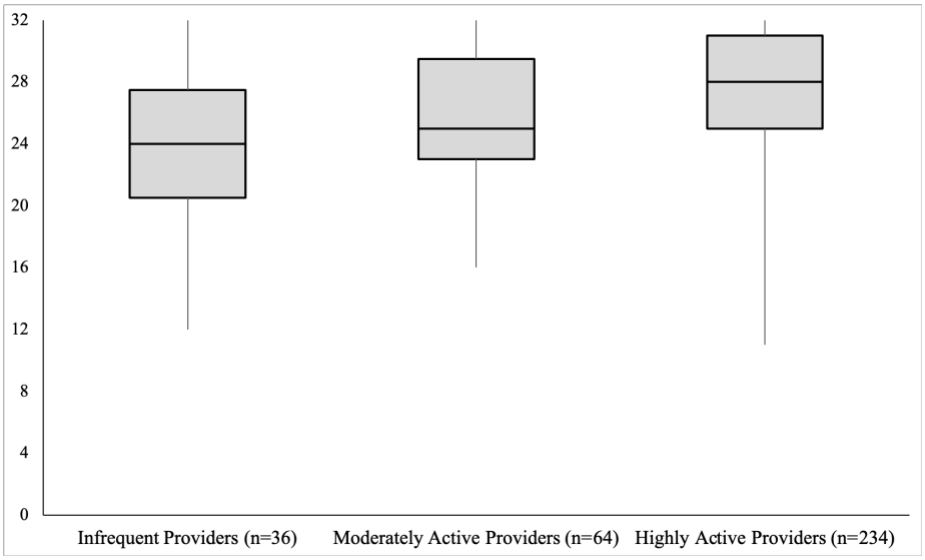

Figure 2-16: Overall perceived benefits of a pharmacist provided injection service by frequency of injections provided by Active Providers in the past year (n=334)

Over 90% of Non-Active and Active Providers reported that an increase in the vaccination rate and reduction in the risk of infections in their community were considered moderate or major benefits of providing injection services to their patients (Figure 2-17). The groups differed in their opinions regarding bringing more people into the practice site ($p=0.014$), generating opportunities to offer other services to patients ($p<0.001$), generating additional revenue ($p=0.012$), improving patient satisfaction with their services ($p<0.001$), and their job satisfaction ($p=0.003$).

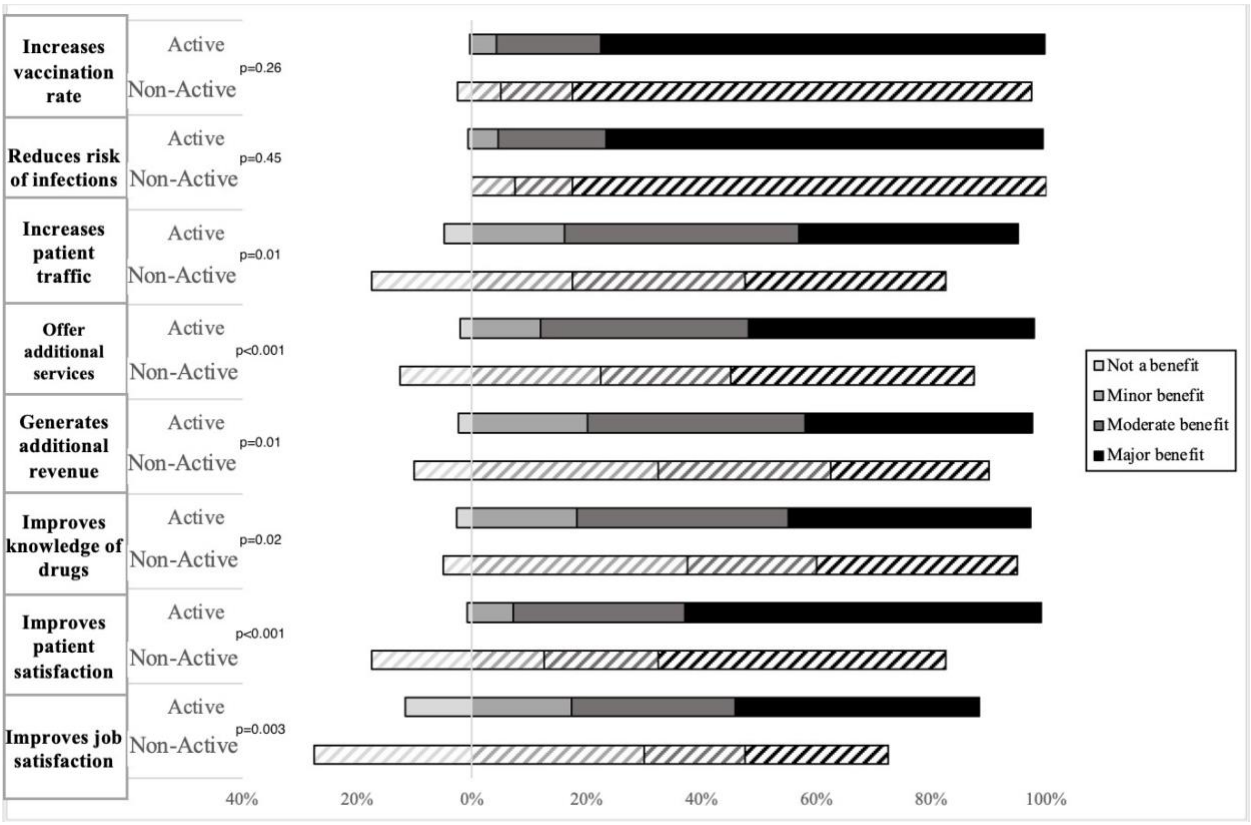

Figure 2-17: Perceived benefits of a pharmacist provided injection service by activity status (n=374)

2.3.11. Organizational strategies to improve provision of injection services

A total of 367 pharmacists provided responses to all 10 questions about organizational strategies that have been used to improve provision of injection services. There was no difference in the proportion of missing responses between Non-Active and Active Providers (p=0.77). The median score in this category was 33 (interquartile range 28 to 37), suggesting respondents felt these strategies would increase the frequency of providing injection services in pharmacies. The distribution of scores was similar between Non-Active and Active Providers (Figure 2-18; p=0.42).

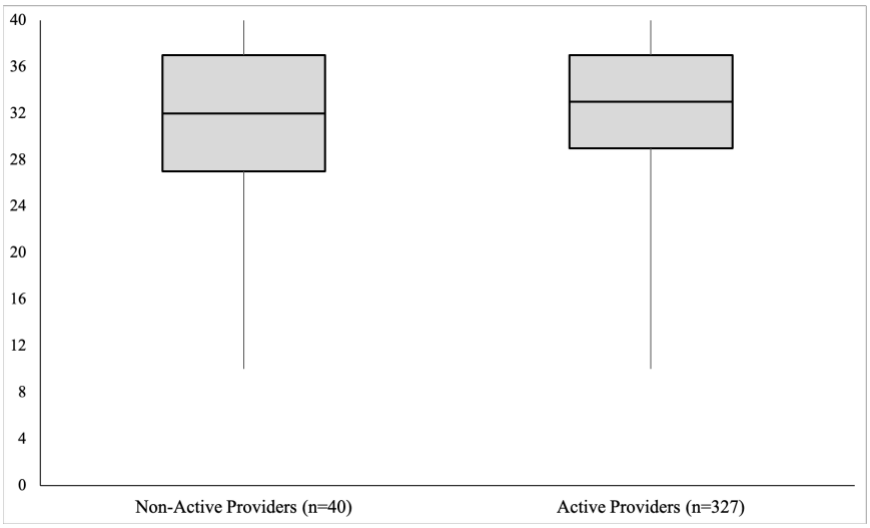

Figure 2-18: Overall perceived helpfulness of organizational strategies to increase the frequency of providing injection services in pharmacies by activity status (n=367)

Respondents indicated that time to assess a patient and administer the injection was the most important factor in providing the service (Figure 2-19). This was closely followed by adequate supply of vaccines and support from other staff on site including other pharmacists and technicians. Respondents indicated that instructions for vaccine storage and handling was the least helpful factor to increase provision of an injection service with 24% indicating it as not helpful.

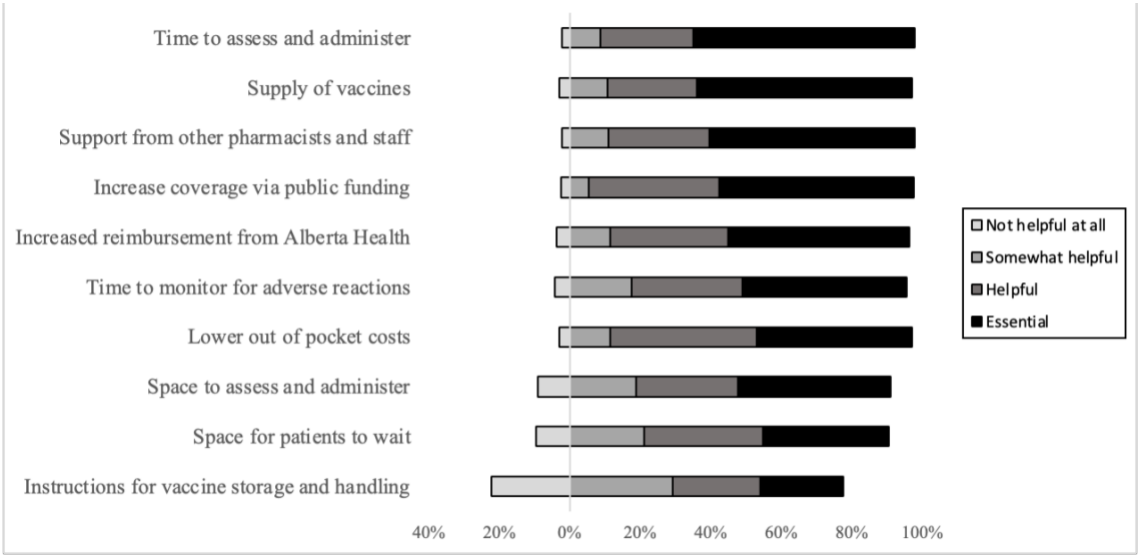

Figure 2-19: Perceived helpfulness of organizational strategies to increase the frequency of providing injection services in pharmacies (n=367)

2.3.12. Educational strategies to improve provision of injection services

All 6 questions asking for opinions of educational strategies to improve provision of injection services were answered by 39 (89%) of 44 Non-Active Providers and 329 (93%) of 353 Active Providers (p=0.064). The median score in this category was 18 (interquartile range 15 to 20), suggesting that most respondents felt these strategies would be generally helpful for increasing the frequency of providing injection services in pharmacies. When the scores were stratified by group, Active Providers considered more of these strategies helpful compared to Non-Active Providers (Figure 2-20; p=0.046). However, when the Active Provider group was stratified by frequency of injections, the distribution of scores in this category were similar (Figure 2-21; p=0.36).

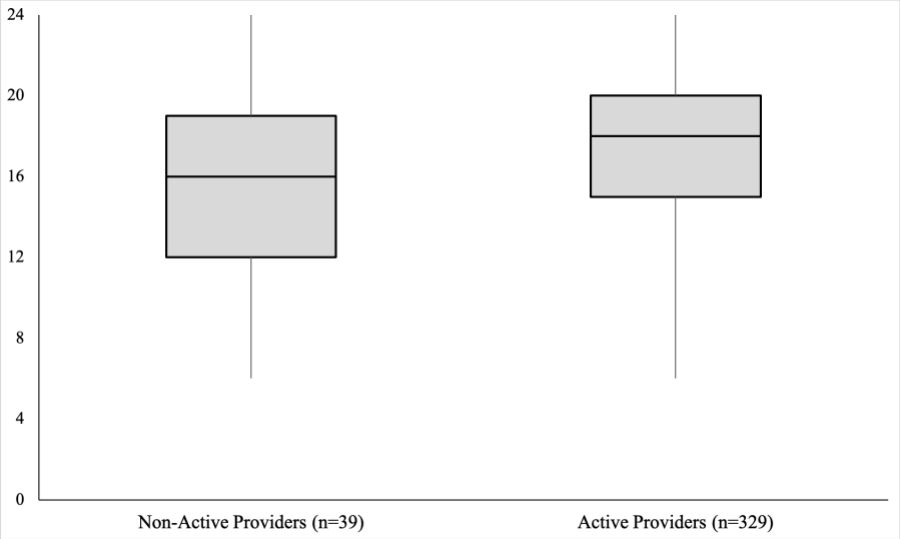

Figure 2-20: Overall perceived helpfulness of educational strategies to increase the frequency of providing injection services in pharmacies by activity status (n=368)

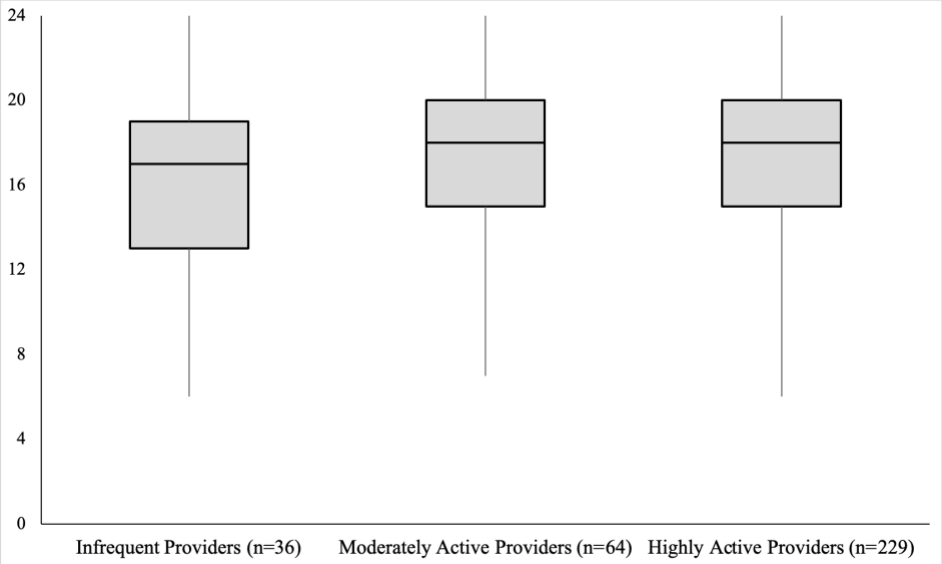

Figure 2-21: Overall perceived helpfulness of educational strategies to increase the frequency of providing injection services in pharmacies by frequency of injections provided by Active Providers in the past year (n=329)

Over 40% of both groups felt that education and training on administering medications by injection in an entry to practice program is essential for increasing the frequency of providing injection services in pharmacies (Figure 2-22, p=0.091). Both groups also had similar opinions on the value of pre-printed flyers and educational tools to include with dispensed medications (p=0.51), continuing education sessions on management of adverse reactions to vaccines (p=0.44) and indications for vaccines (p=0.32), and decision aids to help identify who should be vaccinated (p=0.28). Active Providers were more likely to consider advertising at their practice site as helpful or essential compared to Non-Active Providers (p<0.001).

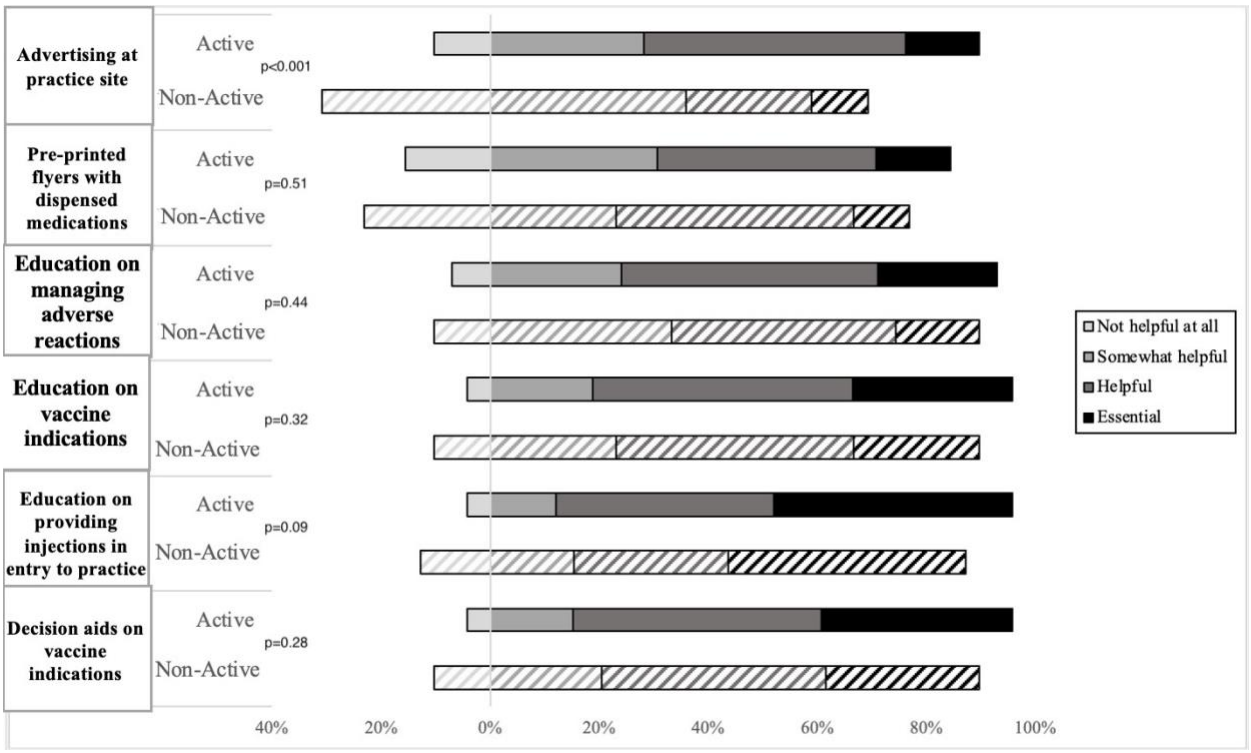

Figure 2-22: Perceived helpfulness of educational strategies to increase the frequency of providing injection services in pharmacies by activity status (n=368)

2.3.13. Patient-related strategies to improve provision of injection services

A total of 370 pharmacists responded to all 5 questions asking for opinions of patient-related strategies; and the proportion of individuals with missing information was similar between groups (p=0.59). The median score in this category was 17 (interquartile range 15 to 18), indicating these strategies were considered either helpful or essential for increasing the frequency of providing injection services in pharmacies. The scores in this category were similar between Non-Active and Active Providers (Figure 23; p=0.35).

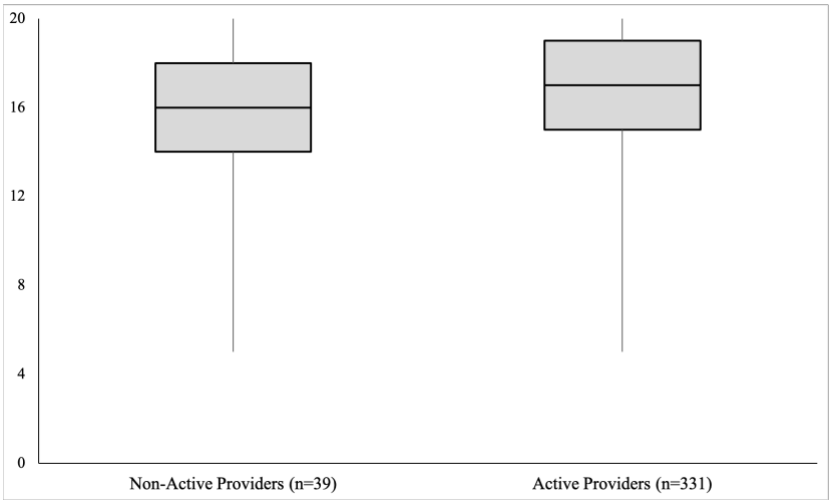

Figure 2-23: Overall perceived helpfulness of patient-related strategies to increase the frequency of providing injection services in pharmacies by activity status (n=370)

Almost 60% of respondents indicated that automated reporting to the provincial immunization registry would be essential to increasing the frequency of providing injection services in pharmacies (Figure 2-24). This was closely followed by access to provincial immunization registry to determine a patient's vaccination status as an essential strategy to increase injection activity. Personalized recommendations based on risk factors and indications, demand from patients, and a reminder or recall system were also considered helpful strategies.

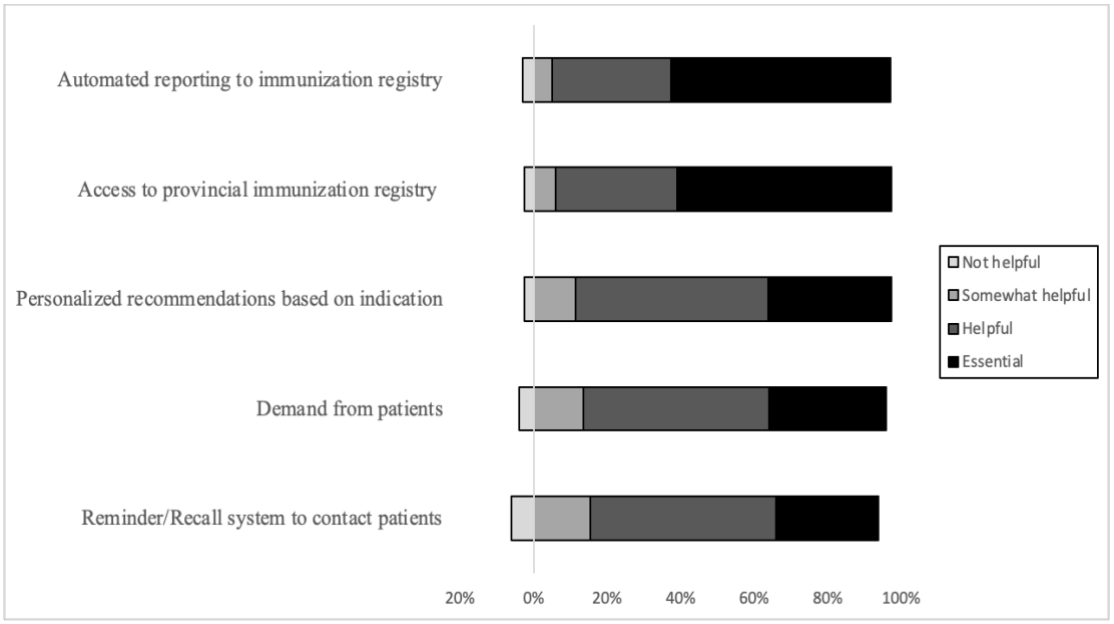

Figure 2-24: Perceived helpfulness of patient-related strategies to increase the frequency of providing injection services in pharmacies (n=370)

2.4. Discussion

2.4.1. Why this study is important?

Alberta pharmacists have been able to acquire authorization to administer injections in 2007, yet little was known about how this authorization is used in practice.(2) This study contributes information collected from Alberta pharmacists about the activities surrounding an injection service, the vaccines and medications that are commonly administered, and their opinions of common barriers, benefits, and strategies to increase provision of this service. Knowledge generated from this study will help guide development of future programs to support and expand pharmacy-based injection services.

This study also provides a snapshot of pharmacists' actions and opinions of injection services at a pivotal moment before introduction of COVID-19 vaccines. Opinions collected in November 2020 reflect pharmacy practice and experiences when offering influenza and other publicly funded vaccines as well as other injectable medications in Alberta. These activities and opinions precede the widespread public education of vaccines and viral born disease that became an integral part of daily life during the COVID-19 pandemic.(51)

2.4.2. Activities leading up to administering a medication by injection

To understand how Alberta pharmacists use their authorization to administer drugs by injection, we first looked at activities surrounding this service, such as strategies used to provide injection services to patients, resources used to determine vaccine indications, and reasons patients provide when refusing a recommended drug or vaccine. Pharmacists indicated that their primary method of promoting injection services was through individual consultations with patients, allowing for the opportunity to gather more information regarding their health history and inform of any health-related gaps that can be addressed by the pharmacist. Patients have previously indicated that they value convenience that community pharmacies are able to provide compared to doctor's clinics or a public health institution, therefore allowing pharmacists to provide a "one-stop-shop" healthcare experience that values patient's time and health needs.(1, 4, 7, 52) Pharmacists indicated that they primarily provided injections upon patient requests or referrals. Since pharmacists, and specifically community pharmacists, are the primary source of healthcare education for patients in their communities,(1, 4, 7, 52) there is an opportunity to proactively educate patients on their healthcare needs as it pertains to injections. This is further bolstered by pharmacists indicating that patients mostly inquire about vaccines or vaccine-related

information at least once a week (~83%), opening the opportunity for conversation surrounding other vaccinations or injections that may benefit the patient. It appears that pharmacists perceive patients' willingness to spend time with pharmacists and learn about injection recommendations because lack of available time was the least common reason for refusing a recommended injection.

Once a pharmacist made a recommendation for an injectable drug or vaccine, they encountered 3 common reasons if a patient refused to receive the injection. The most frequent reason was the out-of-pocket expense for the injected medication was too high. This reason makes sense because most of the commonly injected medications require direct payment from the patient for the full amount; or partial amount through Government of Alberta subsidized coverage,(53) or third-party insurance coverage. The cost can impact a patient's ability to receive an injection from the pharmacist. Indeed, the high direct cost or lack of coverage for patients has previously been documented as an important a barrier to increasing vaccine provision in many health jurisdictions.(14, 15, 17, 54) Two other common reasons pharmacists encountered for patients refusing a recommended injectable medication, especially vaccines, were the lack of perceived susceptibility to the disease and the lack of perceived benefit from the injection. These reasons are consistent with key elements of the Health-Belief model, a framework that can help explain patient decisions related to preventative health interventions, like a vaccination.(55) Since pharmacists did not report that lack of time was a common reason for patient refusal of a recommended drug or vaccine, there is an opportunity for pharmacists to educate patients about the benefits and harms related to the injection.(55, 56) Pharmacists should also consider other factors, like vaccine hesitancy and a rise in vaccine misinformation, that can play an important role in refusing a vaccination recommendation. Evidence based strategies such as focusing on motivational interviewing and accurate communication of benefits and harms should be employed by pharmacists to help address vaccine hesitancy.(56)

2.4.3. Medications Administered by Injection

Influenza vaccine was the most common injection, administered by 98% of Active Providers in the year before the survey was administered. The high proportion is consistent with previous studies from Canada and the United States that observed 82% to 100% of pharmacists administer influenza vaccines.(14, 15, 19, 22) Similarly, a high proportion of pharmacists administering herpes zoster vaccine, hepatitis A and B vaccines, and 23-valent pneumococcal

polysaccharide vaccine is consistent with reported rates in studies from the United States (14, 15, 17, 54) and other regions within Canada.(18, 19, 22) These vaccines are publicly funded for patients who meet eligibility criteria set by Alberta Health Services.(47) The high proportion of Active Providers who administered the 13-valent pneumococcal vaccine was unexpected because patients would have to pay out-of-pocket for the vaccine if they wanted this administered in a pharmacy.(57, 58)

Our observation that vitamin B12 was the second most frequently injected drug after influenza vaccine is consistent with the interests of pharmacists reported in previous Canadian surveys.(18, 21, 22) When asked what non-vaccine drugs should be administered by pharmacists, the most common reported was vitamin B12 injections, followed by intramuscular injections of depo-progesterone, depo-testosterone, and depo antipsychotic medications. The high proportion of Active Providers who have injected these medications in the year before the survey was administered illustrates that patients are willing to receive these injections from pharmacists. As patient awareness increases and the scope of medications that pharmacists can administer by injection increases in other provinces, we expect to see demand for this pharmacy service to grow.

We observed a high degree of interest from Alberta pharmacists willing to administer naloxone injections in the future if needed. Naloxone, an important harm-reduction intervention, has previously been provided free of charge at 2000 Alberta locations along with training and resources.(4, 59, 60) The expressed interest of our survey respondents is consistent with the pharmacist's role in the community as public health care providers. It also echoes messages in the 2019-2020 Alberta College of Pharmacy Annual Report highlighting the importance of naloxone administration by pharmacists to combat the opioid epidemic.(61)

We observed a high proportion of pharmacists administering insulin and heparin. These medications are commonly self-administered daily, and it is unknown from our survey how frequently pharmacists administered these medications to an individual. It is possible that these were one-time injections, but this hypothesis requires further inquiry to determine if pharmacists are providing the injections as a daily service or as a first-time demonstration to educate patients who are starting insulin or heparin therapy.

2.4.4. Perceived barriers, benefits, and facilitators of injection activity

Stratification of respondents according to their injection activity in the prior year allowed us to gather valuable information regarding pharmacist opinions of injection services. In general, we observed an inverse relationship between reported barriers and injection activity. Pharmacists who frequently administered medications by injection perceived few barriers, while pharmacists who did not provide injection services reported many barriers. This relationship would be expected as pharmacists administer more injections, they become more confident in providing this service to their patients. For example, respondents who either did not hold an authorization to administer drugs by injection or who had not administered an injection in the past year reported that comfort with this procedure was a major barrier. We also observed that Highly Active Providers (those who administered over 150 injections in the past year) were more likely to report uncertainty regarding vaccine supply as a major barrier compared to all other groups.

The top three barriers identified by Alberta pharmacists in this survey were uncertainty regarding vaccine supply, comfort with managing adverse reactions, and documentation requirements following injection administration. Previous studies, undertaken primarily in the United States, identified time constraints, staffing issues and reimbursement as primary barriers to providing injections as pharmacists.(15, 22, 62, 63) These studies also highlighted that owner support, cold chain management, and storage were the least frequently encountered barriers. Pharmacists in our study indicated that proper needle disposal and cold chain management were the least frequently encountered barriers.

We observed a gradient between perceived benefits and injection activity. For example, Highly Active Providers were more likely to report that a reduction in community infection rates and an increase in community immunization coverage were major benefits of pharmacist provided injection services. These observations suggest that Highly Active Providers resonate with more benefits for pharmacist provided injection services, which encourages them to engage in this service more than other groups. The primary benefits of an injection service identified by pharmacists in our study included increased vaccination coverage, reduced risk of infections, and increased patient satisfaction, mirroring previous research.(6, 10, 11, 39)

In terms of strategies that could facilitate an increase in injection services, Alberta pharmacists echoed their colleagues' opinions reported in previous studies, that time to conduct

an assessment and administer an injection, support from staff, and increased coverage for injections are critical in providing injection services to patients.(15, 17, 22, 54) The strategies that pharmacists in our study reported as the most helpful or essential for increasing injection services were improving access to electronic immunization records and automated reporting. Although pharmacist are now able to access to immunization records in the Alberta Netcare electronic medical record,(64) there is always room for improvement. For example, automated reporting of vaccine administration by pharmacists is only available for provincially funded influenza, dTap, and 23-valent pneumococcal polysaccharide vaccine. However, pharmacists in our study also commonly administer herpes zoster, hepatitis, and other vaccines. Automated reporting of these other vaccines to the provincial immunization database could facilitate an increase provision of this service by pharmacists.

2.5. Strengths, Limitations and Future Research

2.5.1. Strengths

This study provides a unique snapshot of pharmacist actions and opinions before the introduction of COVID-19 vaccines in Alberta. It allows us to better understand the challenges that pharmacists face and strategies they utilize to promote injection services in their communities. By breaking down the participant pool to active and non-active providers, we were able to discern differences in perceived barriers and facilitators to providing injection services. We were able to explore the benefits, organizational factors, education policies and patient-related strategies that pharmacists frequently employ to better help their patients. Lastly, we were able to identify the common vaccines and other medications that pharmacists administer by injection.

2.5.2. Limitations

Our study has several limitations to consider when interpreting the results. First, data were collected from a small sample (~7%) of the overall pharmacist population in Alberta; however, respondent demographics suggest our study sample was representative of this larger group. The small sample size did not allow for extensive analysis of differing actions and opinions by varying levels of activity based on the number of injections provided in the past year. This limits our understanding of differing actions and opinions of pharmacists based on experience. Second, our study collected opinions related to injection services in general, so we were unable to identify any barriers unique to provision of non-vaccine injections. As

pharmacists expand injection services beyond vaccines, this important knowledge gap should be addressed with future research. Third, the study depended on self-reported data and is prone to social desirability biases. We believe that anonymous collection of our survey responses mitigated the risk of this bias, especially since we observed important differences in reported barriers according to injection service activities. Fourth, our study did not explore the role of corporate policies impacting the provision of injection services at community pharmacies. Fifth, the high proportion of community pharmacists and pharmacists with an authorization to administer drugs by injection suggests some degree of volunteer bias. Pharmacists who chose to respond to the survey may have been more interested and involved in provision of injection services. Although 44 survey participants either did not have an authorization to administer drugs by injection or did not administer an injection in the past year, this group may underrepresent an important segment of pharmacists. Information from individuals who do not actively provide injection services would be valuable as we develop interventions to improve provision of injection services.

2.5.3. Future Research

Data gathered from this study has provided insight into the daily actions of pharmacists, barriers encountered, and strategies employed regarding administering injections. Identifying pharmacists' perceptions and attitudes regarding provision of injection services can allow for an increased understanding of scope of practice of pharmacists in Alberta and ideate on policies and organizational structures to facilitate increased injection efforts. Future research should 1) explore the effect of intervention strategies to increase provision of injection services in community pharmacies, 2) explore the role of pharmacists in combating the opioid epidemic through naloxone administration, 3) explore how drugs that are usually administered as daily injections, like insulin and heparin, are provided by pharmacists, and 4) explore patient opinions of pharmacy-based injection services.

2.5.4. Conclusions

This study allowed us to better understand the challenges that pharmacists face and strategies they use to provide injection services. By stratifying the participant pool to Active and Non-Active Providers, we identified benefits, organizational factors, education policies and patient-related strategies that pharmacists frequently employ to help their patients. This information will help us develop interventions to address gaps in vaccine coverage within our province.

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2.7. Appendices

Appendix 1. Previous studies examining pharmacist provided injection services

Paper No.	Primary Author (Year)	Year Survey Administered	Survey Sampling Frame	Questions regarding injection activity	Questions regarding opinions about injection activity
1 (65)	Kamal KM (2003)	Fall 2001	6000 pharmacists in the United States	**X**	**X**
2 (66)	Neuhauser M (2004)	Not stated	659 pharmacists in Texas	**X**	**X**
3 (15)	Kummer GL (2006)	2008	9945 pharmacists in North Carolina	**X**	**X**
4 (67)	Westrick SC (2009)	2009	526 pharmacies in Washington		**X**
5 (68)	Pilisuk T (2007)	2007	2500 pharmacists in California	**X**	
6 (69)	Westrick SC (2010)	2004, 2006-2007	526 pharmacies in Washington	**X**	
7 (62)	Pace AC (2009)	2009	350 pharmacists in Arkansas		**X**
8 (70)	Marra F (2010)	2009	151 pharmacists in British Columbia		**X**
9 (63)	Sauvageau C (2013)	Not stated	1664 community pharmacies in Quebec	**X**	**X**
10 (71)	Ko KJ (2014)	2012	11 Panelists in the field of pharmacy in California	**X**	**X**
11 (22)	Fletcher A (2014)	2012	3847 registered pharmacists in British Columbia	**X**	**X**
12 (72)	Valiquette JR (2013)	2013	201 community pharmacists in Quebec		**X**
13 (73)	MacDougall DM (2015)	Not stated	4023 completed surveys from the public and 1167 from healthcare professionals in Canada	**X**	**X**
14 (74)	Edwards E (2015)	Not stated	4125 pharmacists in Canada		**X**
15 (75)	Kelling SE (2016)	2015	205 small and independent pharmacies in Michigan	**X**	**X**
16 (22)	Fletcher A (2016)	2012	3847 pharmacists in British Columbia	**X**	**X**
17 (21)	Foong EA (2017)	Not stated	265 pharmacists in Ontario		**X**

18 (19)	Isenor JE (2018)	2013	635 pharmacists in New Brunswick	**X**	**X**
19 (54)	Westrick SC (2018)	2017	1880 pharmacies in the United States	**X**	**X**
20 (18)	Alsabbagh MW (2018)	2014	4307 pharmacists in Ontario	**X**	**X**
21 (76)	Huston SA (2019)	2014	50 community pharmacies in Alabama and California	**X**	**X**
22 (14)	Berce PC (2020)	Not stated	2000 pharmacists in Wisconsin	**X**	**X**
23 (77)	Kulczycki A (2020)	2018	9717 pharmacists in the United States		**X**

Appendix 2: Survey codebook for *"Pharmacist actions and opinions related to their authorization to administer dugs by injection"*

UNIVERSITY OF ALBERTA

University of Alberta
Women & Childrens Health Research Institute

Pharmacist actions and opinions related to the authorization to administer drugs by injection PID 5359

Codebook

Data Dictionary Codebook 04-04-2021 15:50

Collapse all instruments

#	Variable / Field Name	Field Label *Field Note*	Field Attributes (Field Type, Validation, Choices, Calculations, etc.)
Instrument: **BSP[a]&o wrt auth to inj** (bspao_wrt_auth_to_inj) Enabled as survey			Collapse
1	record_id	Record ID	text
2	ethics_info	Title of Study: Pharmacist actions and opinions related to the authorization to administer drugs by injectionPrincipal Investigator: Scot H. Simpson, BSP, PharmD, MScProfessor, Faculty of Pharmacy and Pharmaceutical SciencesUniversity of AlbertaPhone: 780 492-7538 email: scot@ualberta.caCo-Investigators: Daniyal Khan (MSc Student) email: dzkhan@ualberta.caTheresa Schindel, BSP, MCE, PhDChristine Hughes, BSc(Pharm), ACPR, PharmDInvitation to participate: You are invited to participate in this study because you are a licensed pharmacist in the province of Alberta.Purpose of study: The purposes of this study are: 1) to describe the frequency and types of drugs pharmacists administer by injection; and, 2) identify barriers pharmacists face when providing injection services. Pharmacists are responsible for over 55% of all influenza doses administered in Alberta; however, little is known about other vaccines and drugs that pharmacists routinely administer by injection. In addition, there are questions about the barriers (like lack of patient awareness, logistical challenges, and level of remuneration) that pharmacists face when providing this service. This cross-sectional survey will help us understand how pharmacists use the authorization to administer drugs by injection and their opinions related to this part of their practice. Information from this study will help us develop educational and support tools to improve pharmacist immunization services.Participation: If you wish to participate in this study, the survey begins at the end of this information letter. Your participation is completely voluntary and the survey should take about 15-20 minutes to complete. The survey has 4 parts. The first part consists of a series of questions about you and your pharmacy education. The second part asks a few questions about your primary practice site. The third part contains questions about drugs and activities related to the authorization to administer drugs by injection. The fourth part asks questions about challenges other pharmacists have reported that affect their ability to offer injection services.Benefits: There are no direct benefits for participating in this study. The information you share will allow us to better understand how Alberta pharmacists feel about the authorization to administer drugs by injection and how to better support provision of these services.Risks: There are no known risks associated with participating in this study.Confidentiality: The information that you provide will remain confidential. It will be utilized for the purpose of this study only. We recommend that you close your browser after you complete the survey. This will minimize the risk of a security breach and help ensure your confidentiality. Survey	descriptive

		responses are collected and stored in REDCap, which is hosted and supported on a secure server within the University of Alberta. Research personnel working on the project will be the only people authorized to access the data. The survey does not collect identifying information like your name, email address, or the IP address used. Responses are anonymous and no one will know if you participated in the study.The University of Alberta auditors and the research ethics committee may also have access to this research at any time. Access is granted as part of the official duties for these individuals and they are required to respect the confidentiality of participants.The survey software (REDCap) will send 2 reminders to complete the survey.Data storage: The information you share will be collected via REDCap, an online survey platform. Your data will be encrypted and stored on a password protected server at the University of Alberta. The data will be stored for a minimum of 5 years upon completion of the study. Voluntary Participation: You are under no obligation to participate. If you choose to participate, you are under no obligation to answer any questions that you do not wish to answer. If you wish to withdraw from the study while filling out the survey, please close the browser window at any point. When you complete the survey, your information will be submitted automatically. Once the responses are submitted, it is not possible to withdraw from the study because the information was collected anonymously.Consent: Your consent to participate in the study is implied upon completion of the survey.Further Information: If you have any questions or concerns, please contact Daniyal Khan at dzkhan@ualberta.ca or Dr. Scot Simpson (Principal Investigator) at scot@ualberta.ca or 780 492-7538.Ethics: The plan for this study has been approved by the University of Alberta Research Ethics Board. For questions regarding participant rights and ethical conduct of research, contact the Research Ethics Office at (780) 492-2615.Please print a copy of this form for your records. UofA Ethics ID: Pro00103825Version Date: 15 Sept 2020	
3	year_birth	Section Header: *Questions about you* What year were you born?	text (number, Min: 1900, Max: 2025)
4	gender	What is your gender?	dropdown 1 Male 2 Female 3 Other 4 Prefer not to disclose
5	year_pharm	How many years have you been a registered pharmacist? *Please enter a whole number (e.g. 5)*	text (integer, Min: 0, Max: 120)
6	qual	Which of the following qualifications do you have? (select all that apply)	checkbox 1 qual___1 Bachelor of Science in Pharmacy (BScPharm) 2 qual___2 Entry to Practice Doctor of Pharmacy (PharmD) 3 qual___3 Post-Baccalaureate PharmD 4 qual___4 Hospital Pharmacy Residency 5 qual___5 Master of Science (MSc) 6 qual___6 Doctor of Philosophy (PhD) 7 qual___7 Other Degrees or Qualifications
7	qual_other Show the field ONLY if: [qual(7)] = '1'	Please specify the other degrees or qualifications you have.	text

8	qual_deg	Where did you obtain your first pharmacy degree?	dropdown 1 University of Alberta 2 Another university in Canada 3 A university in the United States 4 University outside of North America
9	cert	Do you have any additional certifications?	yesno 1 Yes 0 No
10	cert_specify Show the field ONLY if: [cert]='1'	Which of the following certifications do you possess? (select all that apply)	checkbox 1 cert_specify___1 Certified Diabetes Educator 2 cert_specify___2 Smoking cessation 3 cert_specify___3 Women's reproductive health 4 cert_specify___4 Certified Asthma Educator 5 cert_specify___5 Mental Health 6 cert_specify___6 Travel vaccines 7 cert_specify___7 Other
11	cert_other Show the field ONLY if: [cert_specify(7)]='1'	Please specify the other certifications you possess.	text
12	apa	Do you have the Additional Prescribing Authorization on your Alberta practice permit?	yesno 1 Yes 0 No
13	inj_auth	Do you have the Authorization to Administer Drugs by Injection on your Alberta practice permit?	yesno 1 Yes 0 No
14	add_auth_fut Show the field ONLY if: [inj_auth]='0'	Are you considering applying for your authorization to administer drugs by injection?	radio 1 Yes - within the next few months 2 Yes - within the next year 3 Undecided 4 No
15	flu_vac	In the past 5 years, how many times have you been vaccinated for influenza?	dropdown 1 None 2 1-2 3 3-4 5 5
16	fsa	Section Header: *Questions about your pharmacy practice site* What are the first three digits of the postal code of your primary practice site?	text (postal_code_canadian_partial)

<table>
<tr><td>17</td><td>prim_site</td><td>Which of the following best describes your primary practice site?</td><td>dropdown<table><tr><td>1</td><td>Ambulatory Care Clinic</td></tr><tr><td>2</td><td>Banner pharmacy (e.g., IDA,Pharmasave, Value Drug Mart)</td></tr><tr><td>3</td><td>Chain pharmacy (e.g., Rexall, London Drugs)</td></tr><tr><td>4</td><td>Franchise (e.g., Shoppers Drug Mart, Medicine Shoppe)</td></tr><tr><td>5</td><td>Hospital pharmacy</td></tr><tr><td>6</td><td>Independent pharmacy</td></tr><tr><td>7</td><td>Long-term care or assisted living facility</td></tr><tr><td>8</td><td>Mass merchandiser / food store (e.g., CostCo, Safeway, Walmart)</td></tr><tr><td>9</td><td>Primary Care Network</td></tr><tr><td>10</td><td>Other</td></tr></table></td></tr>
<tr><td>18</td><td>prim_site_other
Show the field ONLY if: [prim_site]='10'</td><td>Please describe your primary practice site.</td><td>text</td></tr>
<tr><td>19</td><td>prim_site_hours</td><td>On average, how many hours per week do you spend at your primary practice site?</td><td>dropdown<table><tr><td>1</td><td>Less than 8 hours</td></tr><tr><td>2</td><td>8 - 16 hours</td></tr><tr><td>3</td><td>17 - 24 hours</td></tr><tr><td>4</td><td>25 - 40 hours</td></tr><tr><td>5</td><td>More than 40 hours</td></tr></table></td></tr>
<tr><td>20</td><td>prim_role</td><td>What is your role at your primary practice site?</td><td>dropdown<table><tr><td>1</td><td>Pharmacy Owner or Franchisee</td></tr><tr><td>2</td><td>Pharmacy Manager</td></tr><tr><td>3</td><td>Staff Pharmacist</td></tr><tr><td>4</td><td>Independent Contractor</td></tr></table></td></tr>
<tr><td>21</td><td>immun_prom</td><td>How are immunization services promoted at your primary practice site? (select all that apply)</td><td>checkbox<table><tr><td>1</td><td>immun_prom___1</td><td>Alberta College of Pharmacy poster</td></tr><tr><td>2</td><td>immun_prom___2</td><td>Alberta Health posters and/or advertisements</td></tr><tr><td>3</td><td>immun_prom___3</td><td>Corporate poster</td></tr><tr><td>4</td><td>immun_prom___4</td><td>Flyers to accompany dispensed prescriptions</td></tr><tr><td>5</td><td>immun_prom___5</td><td>Health Canada poster</td></tr><tr><td>6</td><td>immun_prom___6</td><td>Individual consultation with patient</td></tr><tr><td>7</td><td>immun_prom___7</td><td>In-Store announcements</td></tr><tr><td>8</td><td>immun_prom___8</td><td>Radio and/or television advertising</td></tr><tr><td>9</td><td>immun_prom___9</td><td>Reminder mailed or emailed to patients</td></tr><tr><td>10</td><td>immun_prom___10</td><td>Self-made poster</td></tr><tr><td>11</td><td>immun_prom___11</td><td>Social media (Facebook, Twitter)</td></tr><tr><td>12</td><td>immun_prom___12</td><td>Website</td></tr><tr><td>13</td><td>immun_prom___13</td><td>Other</td></tr><tr><td>14</td><td>immun_prom___14</td><td>No advertisements for immunization services are placed at the practice site</td></tr></table></td></tr>
</table>

22	immun_prom_other Show the field ONLY if: [immun_prom(12)]='1'	Please specify the other methods used to promote immunization services.	text
23	smma_num Show the field ONLY if: [prim_site]='2' or [prim_site]='3' or [prim_site]='4' or [prim_site]='6' or [prim_site]='8'	Section Header: *Questions about your professional pharmacy practice activities* In the past year, how many Standardized Medication Management Assessments (SMMA) (initial or follow-up) did you complete?	dropdown 1 None 2 1 - 10 3 10 - 20 4 20 - 35 5 35 - 50 6 50 +
24	cacp_num Show the field ONLY if: [prim_site]='2' or [prim_site]='3' or [prim_site]='4' or [prim_site]='6' or [prim_site]='8'	In the past year, how many Comprehensive Annual Care Plans (initial or follow-up) (CACP) did you complete?	dropdown 1 None 2 1 - 10 3 10 - 20 4 20 - 35 5 35 - 50 6 50 +
25	section_services	How often have you offered the following services at your primary practice site?	descriptive
26	apa_hz Show the field ONLY if: [apa]='1'	Use your additional prescribing authorization to initiate therapy	radio (Matrix) 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Never
27	cdm_pt	Provide chronic disease management recommendations to a patient	radio (Matrix) 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Never
28	cdm_prof	Provide chronic disease management recommendations to other healthcare professionals	radio (Matrix) 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Never
29	poc	Perform point-of-care testing	radio (Matrix) 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Never

<table>
<tr><td>30</td><td>genomics</td><td>Perform pharmacogenomics testing</td><td>radio (Matrix)<table><tr><td>1</td><td>Daily</td></tr><tr><td>2</td><td>About once a week</td></tr><tr><td>3</td><td>About once a month</td></tr><tr><td>4</td><td>About every other month</td></tr><tr><td>5</td><td>Never</td></tr></table></td></tr>
<tr><td>31</td><td>tdm</td><td>Provide therapeutic drug monitoring (e.g., INR, pharmacokinetic monitoring)</td><td>radio (Matrix)<table><tr><td>1</td><td>Daily</td></tr><tr><td>2</td><td>About once a week</td></tr><tr><td>3</td><td>About once a month</td></tr><tr><td>4</td><td>About every other month</td></tr><tr><td>5</td><td>Never</td></tr></table></td></tr>
<tr><td>32</td><td>adm_title
Show the field ONLY if: [inj_auth]='1'</td><td>Questions about your authorization to admininster drugs by injection</td><td>descriptive</td></tr>
<tr><td>33</td><td>auth_year
Show the field ONLY if: [inj_auth]='1'</td><td>What year did you gain your authorization to administer drugs by injection in Alberta?</td><td>dropdown<table><tr><td>2007</td><td>2007</td></tr><tr><td>2008</td><td>2008</td></tr><tr><td>2009</td><td>2009</td></tr><tr><td>2010</td><td>2010</td></tr><tr><td>2011</td><td>2011</td></tr><tr><td>2012</td><td>2012</td></tr><tr><td>2013</td><td>2013</td></tr><tr><td>2014</td><td>2014</td></tr><tr><td>2015</td><td>2015</td></tr><tr><td>2016</td><td>2016</td></tr><tr><td>2017</td><td>2017</td></tr><tr><td>2018</td><td>2018</td></tr><tr><td>2019</td><td>2019</td></tr><tr><td>2020</td><td>2020</td></tr></table></td></tr>
<tr><td>34</td><td>auth_cont
Show the field ONLY if: [inj_auth]='1'</td><td>How does the authorization to administer drugs by injection contribute to your role as a pharmacist?</td><td>dropdown<table><tr><td>1</td><td>It is an integral part of my responsibilities (e.g., I use it regularly)</td></tr><tr><td>2</td><td>It is occasionally an important part of my responsibilities (e.g., I only use it during flu season)</td></tr><tr><td>3</td><td>It is not an important part of my responsibilities (e.g., I use it rarely)</td></tr></table></td></tr>
<tr><td>35</td><td>inj_last_yr
Show the field ONLY if: [inj_auth]='1'</td><td>When was the last time you administered a drug by injection?</td><td>dropdown<table><tr><td>1</td><td>Within the last week</td></tr><tr><td>2</td><td>Within the last month</td></tr><tr><td>3</td><td>Within the last 3 months</td></tr><tr><td>4</td><td>Within the last 6 months</td></tr><tr><td>5</td><td>Within the last 9 months</td></tr><tr><td>6</td><td>Within the last 12 months</td></tr><tr><td>7</td><td>I have not administered a drug by injection in the last year</td></tr></table></td></tr>
</table>

36	inj_num Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	In the past year, approximately how many injections have you administered?	dropdown 1 - 11 12 - 48 49 - 99 100 - 150 More than 150
37	pastvacc_title Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Have you administered any of the following vaccines in the past year?	descriptive
38	adm_hepa Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Hepatitis A	radio (Matrix) Yes No, but I plan to offer in the future I do not plan to offer
39	adm_hepb Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Hepatitis B	radio (Matrix) Yes No, but I plan to offer in the future I do not plan to offer
40	adm_herz Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Herpes Zoster	radio (Matrix) Yes No, but I plan to offer in the future I do not plan to offer
41	adm_hpv Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Human papillomavirus (HPV)	radio (Matrix) Yes No, but I plan to offer in the future I do not plan to offer
42	adm_flu Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Influenza	radio (Matrix) Yes No, but I plan to offer in the future I do not plan to offer
43	adm_mmr Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Measles Mumps Rubella (MMR)	radio (Matrix) Yes No, but I plan to offer in the future I do not plan to offer
44	adm_men Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Meningococcal	radio (Matrix) Yes No, but I plan to offer in the future I do not plan to offer
45	adm_p13 Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Pneumococcal 13-valent (PCV13)	radio (Matrix) Yes No, but I plan to offer in the future I do not plan to offer
46	adm_p23 Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Pneumococcal 23-valent (PPSV23)	radio (Matrix) Yes No, but I plan to offer in the future I do not plan to offer

47	adm_polio Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Polio (injection formulation)	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
48	adm_rabies Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Rabies	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
49	adm_dtap Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Tetanus, diphtheria, acellular Pertussis (dTAP)	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
50	adm_td Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Tetanus, diphtheria (Td)	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
51	adm_other Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Other vaccines	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
52	adm_other_spec Show the field ONLY if: [adm_other]='1' or [adm_other]='2'	Please specify which other vaccines do you currently offer or plan to offer?	text
53	injdrugs_title Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Have you administered any of the following injectable drugs in the past year?	descriptive
54	adm_dr_box Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Botulinum toxin (Botox)	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
55	adm_dr_cog Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Colloidal gold	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
56	adm_dr_deno Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Denosumab (Prolia®)	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
57	adm_dr_asp Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Depot antipsychotic injections	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
58	adm_dr_test Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Depo-Testosterone	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer

59	adm_dr_prog Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Depo-Progesterone	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
60	adm_dr_hep Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Heparin	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
61	adm_dr_ins Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Insulin	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
62	adm_dr_iron Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Iron	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
63	adm_dr_meth Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Methotrexate	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
64	adm_dr_nalx Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Naloxone	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
65	adm_dr_arth Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Rheumatoid arthritis medications	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
66	adm_dr_vb12 Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Vitamin B12	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
67	adm_dr_othr Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Other	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
68	adm_dr_oth_spec Show the field ONLY if: [adm_dr_othr]='1' or [adm_dr_othr]='2'	Please specify which other injectable drugs you currently offer or plan to offer?	text
69	trav_vacc Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	Do you provide travel vaccines?	yesno 1 Yes 0 No
70	trav_header Show the field ONLY if: [trav_vacc]='1'	Which travel vaccines have you administered in the past year?	descriptive

71	trav_hepa Show the field ONLY if: [trav_vacc]='1'	Hepatitis A	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
72	trav_hepb Show the field ONLY if: [trav_vacc]='1'	Hepatitis B	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
73	trav_jap Show the field ONLY if: [trav_vacc]='1'	Japanese encephalitis	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
74	trav_mal Show the field ONLY if: [trav_vacc]='1'	Malaria	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
75	trav_men Show the field ONLY if: [trav_vacc]='1'	Meningococcal	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
76	trav_pol Show the field ONLY if: [trav_vacc]='1'	Polio (injection formulation)	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
77	trav_rab Show the field ONLY if: [trav_vacc]='1'	Rabies	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
78	trav_tet Show the field ONLY if: [trav_vacc]='1'	Tetanus	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
79	trav_typh Show the field ONLY if: [trav_vacc]='1'	Typhoid	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
80	trav_yell Show the field ONLY if: [trav_vacc]='1'	Yellow Fever	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
81	trav_oth Show the field ONLY if: [trav_vacc]='1'	Other	radio (Matrix) 1 Yes 2 No, but I plan to offer in the future 3 I do not plan to offer
82	trav_oth_spec Show the field ONLY if: [trav_oth]='1' or [trav_oth]='2'	Please specify which other travel vaccines you currently offer or plan to provide?	text

83	inj_adm Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	How do you provide your injection services to patients? (select all that apply)	checkbox 1 inj_adm___1 Walk-in basis (e.g., as needed/requested by the patient) 2 inj_adm___2 Appointment basis 3 inj_adm___3 Predetermined clinic (e.g., flu clinic) 4 inj_adm___4 Evenings and Weekends only basis 5 inj_adm___5 Other
84	inj_adm_other Show the field ONLY if: [inj_adm(5)]='1'	Please specify the other ways that you provide injection services to your patients.	text
85	inj_adm_time Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	On average, how much time does it take you to assess a patient and administer an injection? (in minutes)	text
86	inj_adm_when Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	When do you usually use your authorization to administer drugs by injection during a patient encounter?	dropdown 1 When the patient asks or I receive a referral about a vaccine or drug, I perform the assessment and administer the injection 2 When the patient asks or I receive a referral about a vaccine or drug, I take this opportunity to educate the patient about other professional pharmacy services while I perform the assessment to administer an injection 3 I educate patients about the injection service (e.g., provide influenza vaccines during flu season) while providing another professional pharmacy service 4 I offer the injection service upon reviewing patient's medication and health history
87	inj_info	How often do patients request vaccines or information on vaccines from you?	dropdown 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Only during influenza season 6 Never
88	resvaccine_title	How often do you consult the following resources to determine what vaccines are required for your patients?	descriptive
89	res_ahsman	Alberta Health Services immunization program standards manual	radio (Matrix) 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Only during influenza season 6 Never
90	res_man	Brochures from manufacturers	radio (Matrix) 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Only during influenza season 6 Never

91	res_naci	Canadian Immunization Guide (National Advisory Committee on Immunization [NACI] recommendations)	radio (Matrix) 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Only during influenza season 6 Never
92	res_cdcyellowbook	Centers for Disease Control and Prevention (CDC) Yellow Book	radio (Matrix) 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Only during influenza season 6 Never
93	res_cps	Compendium of Pharmaceuticals and Specialties (CPS)	radio (Matrix) 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Only during influenza season 6 Never
94	res_dxcpgs	Disease-specific guidelines (e.g., diabetes, heart failure, HIV, hypertension, etc)	radio (Matrix) 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Only during influenza season 6 Never
95	res_goctravel	Government of Canada travel vaccination recommendations	radio (Matrix) 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Only during influenza season 6 Never
96	res_mon	Product monographs	radio (Matrix) 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Only during influenza season 6 Never

97	res_phac	Public Health Agency of Canada	radio (Matrix) 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Only during influenza season 6 Never
98	res_rxtx	Therapeutic Choices	radio (Matrix) 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Only during influenza season 6 Never
99	res_oth	Other	radio (Matrix) 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Only during influenza season 6 Never
100	res_oth_spec Show the field ONLY if: [res_oth]>0 and [res_oth]<5	Please specify the other resources you consult to determine which vaccines are required for your patients.	text
101	patrefuse_title	How often do patients use the following reasons to refuse your recommendation to receive a drug or vaccine by injection?	descriptive
102	ref_adv	Fear of adverse effects	radio (Matrix) 1 0% of the time 2 About 25% of the time 3 About 50% of the time 4 About 75% of the time 5 100% of the time
103	ref_ben	Lack of perceived benefit	radio (Matrix) 1 0% of the time 2 About 25% of the time 3 About 50% of the time 4 About 75% of the time 5 100% of the time
104	ref_sus	Lack of perceived susceptibility to the disease	radio (Matrix) 1 0% of the time 2 About 25% of the time 3 About 50% of the time 4 About 75% of the time 5 100% of the time

105	ref_exp	The out-of-pocket expense is too high	radio (Matrix) 1 0% of the time 2 About 25% of the time 3 About 50% of the time 4 About 75% of the time 5 100% of the time
106	ref_time	They do not have time	radio (Matrix) 1 0% of the time 2 About 25% of the time 3 About 50% of the time 4 About 75% of the time 5 100% of the time
107	ref_fam	They want to consult with family members first	radio (Matrix) 1 0% of the time 2 About 25% of the time 3 About 50% of the time 4 About 75% of the time 5 100% of the time
108	ref_doc	They want to consult with their family doctor first	radio (Matrix) 1 0% of the time 2 About 25% of the time 3 About 50% of the time 4 About 75% of the time 5 100% of the time
109	inj_auth_unable Show the field ONLY if: [inj_auth]='1'	How often do you encounter people who could receive a vaccine, but you may not be able to provide (e.g., Pneumococcal vaccine to someone who is less than 65 years of age or the vaccine is out of stock)?	dropdown 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Never
110	inj_auth_unable_a Show the field ONLY if: [inj_auth_unable]>0 and [inj_auth_unable]<5	What do you normally do when you encounter these individuals? [select all that apply]	checkbox 1 inj_auth_unable_a___1 I provide educational material 2 inj_auth_unable_a___2 I refer them to a public health nurse 3 inj_auth_unable_a___3 I refer them to their family physician 4 inj_auth_unable_a___4 Other
111	inj_auth_unable_a_other Show the field ONLY if: [inj_auth_unable_a(4)] = '1'	Please specify what other actions you normally do when you encounter these individuals.	text
112	inj_noauth_unable Show the field ONLY if: [inj_auth]='0'	How often do you encounter people who could receive a vaccine, but you are unable to provide?	dropdown 1 Daily 2 About once a week 3 About once a month 4 About every other month 5 Never

<table>
<tr><td>113</td><td>inj_noauth_unable_a

Show the field ONLY if: [inj_noauth_unable]>0 and [inj_noauth_unable]<5</td><td>What do you normally do when you encounter these individuals? [select all that apply]</td><td>checkbox<table><tr><td>1</td><td>inj_noauth_unable_a___1</td><td>I provide educational material</td></tr><tr><td>2</td><td>inj_noauth_unable_a___2</td><td>I refer them to a pharmacist who is authorized to administer drugs by injection</td></tr><tr><td>3</td><td>inj_noauth_unable_a___3</td><td>I refer them to a public health nurse</td></tr><tr><td>4</td><td>inj_noauth_unable_a___4</td><td>I refer them to their family physician</td></tr><tr><td>5</td><td>inj_noauth_unable_a___5</td><td>Other</td></tr></table></td></tr>
<tr><td>114</td><td>inj_noauth_unable_a_other

Show the field ONLY if: [inj_noauth_unable_a(5)] = '1'</td><td>Please specify what other actions you normally do when you encounter these individuals.</td><td>text</td></tr>
<tr><td>115</td><td>profrecep_title</td><td>Section Header: The following questions ask for your opinion on issues related to pharmacist scope of practice and administering drugs by injection

In general, what kind of reception or feedback do you receive from other healthcare professionals (e.g. doctors or nurses) regarding the scope of practice in Alberta?</td><td>descriptive</td></tr>
<tr><td>116</td><td>recep_apa</td><td>Additional Prescribing Authorization</td><td>radio (Matrix)<table><tr><td>1</td><td>Mostly Positive</td></tr><tr><td>2</td><td>Neutral</td></tr><tr><td>3</td><td>Mostly Negative</td></tr><tr><td>4</td><td>This topic has never come up</td></tr></table></td></tr>
<tr><td>117</td><td>recep_ada</td><td>Authorization to Administer Drugs by Injection</td><td>radio (Matrix)<table><tr><td>1</td><td>Mostly Positive</td></tr><tr><td>2</td><td>Neutral</td></tr><tr><td>3</td><td>Mostly Negative</td></tr><tr><td>4</td><td>This topic has never come up</td></tr></table></td></tr>
<tr><td>118</td><td>recep_alv</td><td>Access to laboratory values</td><td>radio (Matrix)<table><tr><td>1</td><td>Mostly Positive</td></tr><tr><td>2</td><td>Neutral</td></tr><tr><td>3</td><td>Mostly Negative</td></tr><tr><td>4</td><td>This topic has never come up</td></tr></table></td></tr>
<tr><td>119</td><td>storrecep_title</td><td>Rate your opinion regarding the following as barriers related to storing vaccines in the pharmacy</td><td>descriptive</td></tr>
<tr><td>120</td><td>bar_stor_cc</td><td>Equipment costs to maintain the cold chain</td><td>radio (Matrix)<table><tr><td>1</td><td>Not a barrier</td></tr><tr><td>2</td><td>Minor barrier</td></tr><tr><td>3</td><td>Moderate barrier</td></tr><tr><td>4</td><td>Major barrier</td></tr></table></td></tr>
<tr><td>121</td><td>bar_stor_edu</td><td>Lack of education on cold chain requirements</td><td>radio (Matrix)<table><tr><td>1</td><td>Not a barrier</td></tr><tr><td>2</td><td>Minor barrier</td></tr><tr><td>3</td><td>Moderate barrier</td></tr><tr><td>4</td><td>Major barrier</td></tr></table></td></tr>
</table>

122	bar_stor_spc	Lack of space for equipment to maintain the cold chain	radio (Matrix) 1 Not a barrier 2 Minor barrier 3 Moderate barrier 4 Major barrier
123	bar_stor_unc	Uncertainty regarding vaccine supply from the manufacturer	radio (Matrix) 1 Not a barrier 2 Minor barrier 3 Moderate barrier 4 Major barrier
124	injrecep_title	Rate your opinion regarding the following as barriers to administering drugs by injection in pharmacies	descriptive
125	bar_pers_con	Conflict with other healthcare professionals who provide injection services (e.g., community health clinics)	radio (Matrix) 1 Not a barrier 2 Minor barrier 3 Moderate barrier 4 Major barrier
126	bar_pers_doc	Documentation requirements after administering a drug by injection	radio (Matrix) 1 Not a barrier 2 Minor barrier 3 Moderate barrier 4 Major barrier
127	bar_pers_unc	Your comfort with administering injections	radio (Matrix) 1 Not a barrier 2 Minor barrier 3 Moderate barrier 4 Major barrier
128	bar_pers_adv	Your comfort with managing adverse reactions to an injected drug or vaccine	radio (Matrix) 1 Not a barrier 2 Minor barrier 3 Moderate barrier 4 Major barrier
129	bar_pers_leg	Your concerns with legal liabilities associated with administering a drug by injection	radio (Matrix) 1 Not a barrier 2 Minor barrier 3 Moderate barrier 4 Major barrier
130	bar_pers_dis	Your concerns with proper disposal of needles after administering a drug by injection	radio (Matrix) 1 Not a barrier 2 Minor barrier 3 Moderate barrier 4 Major barrier
131	injben_title	Rate your opinion regarding the following as benefits to administering drugs by injection in pharmacies	descriptive

132	ben_prac	Brings more people into the practice site	radio (Matrix) 1 Not a benefit 2 Minor benefit 3 Moderate benefit 4 Major benefit
133	ben_rev	Generates additional revenue for the practice site	radio (Matrix) 1 Not a benefit 2 Minor benefit 3 Moderate benefit 4 Major benefit
134	ben_opp	Generates opportunities to offer other services to patients	radio (Matrix) 1 Not a benefit 2 Minor benefit 3 Moderate benefit 4 Major benefit
135	ben_kno	Improves my knowledge of both the benefits and harms of drugs administered by injection	radio (Matrix) 1 Not a benefit 2 Minor benefit 3 Moderate benefit 4 Major benefit
136	ben_sts	Improves my satisfaction with my job	radio (Matrix) 1 Not a benefit 2 Minor benefit 3 Moderate benefit 4 Major benefit
137	ben_psts	Improves patient satisfaction with the services I provide	radio (Matrix) 1 Not a benefit 2 Minor benefit 3 Moderate benefit 4 Major benefit
138	ben_prate	Providing vaccinations increases the vaccination rate in my community	radio (Matrix) 1 Not a benefit 2 Minor benefit 3 Moderate benefit 4 Major benefit
139	ben_risk	Providing vaccinations reduces the risk of infections in my community	radio (Matrix) 1 Not a benefit 2 Minor benefit 3 Moderate benefit 4 Major benefit
140	orgstrat_title	Do you believe the following organizational/policy strategies would help increase the frequency that you offer vaccines?	descriptive
141	org_stor	Adequate instructions for vaccine storage and handling	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential

142	org_wait	Adequate space for patients to wait during routine monitoring immediately after receiving an injection	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
143	org_spac	Adequate space to conduct an assessment and administer the injection	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
144	org_supl	Adequate supply of vaccines	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
145	org_supp	Adequate support from other pharmacists or pharmacy technicians so I can provide the service	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
146	org_time	Adequate time to conduct an assessment and administer the injection	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
147	org_mont	Adequate time to monitor the patient for adverse reactions to vaccines	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
148	org_cove	Increase coverage for patients via publicly funded vaccines	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
149	org_reim	Increased reimbursement from Alberta Health for injection services	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
150	org_oopc	Lower out of pocket costs for patients	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
151	edubarrier_title	Do you believe the following educational strategies would help increase the frequency that you offer vaccines?	descriptive

152	edu_adv	Advertising at my practice site	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
153	edu_mang	Continuing education sessions on management of adverse reactions to vaccines	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
154	edu_vacc	Continuing education sessions on vaccine indications	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
155	edu_dec	Decision aids to help identify who should be vaccinated	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
156	edu_flyr	Pre-printed flyers/educational tools to include with dispensed medications	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
157	edu_uedu	Education and training on administering drugs by injection in the entry to practice degree program	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
158	prsstrat_title	Do you believe the following patient-related strategies would help increase the frequency that you offer vaccines?	descriptive
159	pat_reg	Access to the provincial immunization registry to determine vaccination status	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
160	pat_rep	Automated reporting to the provincial immunization registry or Alberta Blue Cross after documentation is completed	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
161	pat_dem	Demand from patients	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential

162	pat_rec	Personalized recommendations to a patient based on their risk factors / indications for a vaccine	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
163	pat_folu	Reminder or recall system to contact patients	radio (Matrix) 1 Not at all helpful 2 Somewhat helpful 3 Helpful 4 Essential
164	future_recruit Show the field ONLY if: [inj_last_yr]>"0" and [inj_last_yr]<"7"	We are planning an intervention study to improve pneumococcal vaccination rates bypharmacists. Would you be willing to participate in the study?	dropdown 1 Yes 2 No 3 Unsure
165	ideas	If you could alter anything about a pharmacist scope of practice in Alberta or have anyideas to improve pharmacist intervention in patient care, please write down your views.	notes
166	end	~ Thank you for taking the time to participate in this survey ~	descriptive
167	bspao_wrt_auth_to_inj_complete	Section Header: *Form Status* Complete?	dropdown 0 Incomplete 1 Unverified 2 Complete

3. Chapter 3: A Systematic Review of Community Pharmacist Based Intervention Programs to Improve Pneumococcal Vaccine Uptake

3.1. Introduction and rationale

Pneumonia is an inflammatory condition of the alveolar sacs in the lungs which results in difficulty breathing, cough, fever and chills.(1) Community acquired pneumonia is a major public health concern because the annual incidence rate is approximately 1,600 to 2,000 cases per 100,000 individuals.(2) It remains a common cause for hospitalizations, and is the eighth leading cause of death in Canada.(3) While there are many viruses, bacteria and fungal pathogens that can cause community-acquired pneumonia, *Streptococcus pneumoniae*, a gram-positive non-motile bacterium, is the most commonly identified cause.(4, 5) Pneumococcal pneumonia can also progress to invasive pneumococcal disease (IPD), that can greatly increase the risk of hospitalization and death.(6) In Alberta, the incidence rate of IPD was 7.3 cases per 100,000 individuals in 2021.(7)

Vaccination against *S. pneumoniae* significantly reduces the risk of community acquired pneumonia and hospitalization for IPD.(8, 9, 10, 11) Based on strong clinical trial evidence, pneumococcal vaccines are recommended for individuals at high risk of adverse outcomes from IPD.(12) There are two groups considered at high risk of developing IPD: adults 18-64 years of age with pre-existing conditions, like asthma, diabetes or chronic obstructive pulmonary disease, and individuals 65 years of age and older.(13, 14) The Public Health Agency of Canada set a vaccination coverage goal of 80% among people 65 years of age and older; however, the most recent population-based data reported a pneumococcal vaccination coverage of 58% in this age group.(15, 16)

Pharmacists are well-positioned to provide vaccinations to high-risk populations due to their accessibility and familiarity within their communities.(17, 18, 19, 20, 21) As the

pharmacists' scope of practice expanded in North America,(22, 23) pharmacists initially acted as hosts for vaccination programs, advocated for vaccinations,(24) and have become a key resource for vaccine delivery.(23) For example, Alberta pharmacists are now the most common provider of influenza vaccinations, administering 61% of all doses during the 2019-2020 program.(25) Community pharmacists are the primary source of immunization information and provision for first time immunizers because of their accessibility to the public.(17, 18, 19, 20, 21) During the COVID-19 pandemic, community pharmacists are the leading provider of COVID-19 vaccinations in Alberta.(26, 27)

Over the past two decades, there have been numerous studies examining the impact of pharmacist interventions on vaccination rates.(28, 29, 30) Most information reported in previous systematic reviews and meta-analyses came from randomized controlled trials and have focused on quantifying the overall changes in vaccination rates for influenza, pneumococcal, hepatitis B, and other vaccines.(28, 29) To date, no review has been undertaken to summarize the available descriptions of strategies used to improve pneumococcal vaccination rates. Thus, the primary aim of this review is to identify and describe community pharmacy-based intervention programs aimed at improving pneumococcal vaccine uptake. Upon completion we will be in a better position to develop an intervention strategy to test in Alberta community pharmacies.

3.2. Methods

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.(31)

3.2.1. Search Strategy

The authors reviewed exemplar studies to begin generating search terms using the Patient Intervention Comparison and Outcome (PICO) strategy.(32) Working with a medical librarian, relevant keywords and controlled vocabulary were selected to capture all relevant literature

concerning pneumococcal vaccines and pharmacies. In collaboration with the research team, the medical librarian developed and executed comprehensive searches in Ovid MEDLINE, Ovid Embase, CINAHL, Scopus, and Web of Science Core Collection on January 7, 2022. All searches were limited to English language and no date limits were applied. Details of the search strategy are provided in the Appendix Table. Search results were loaded into Covidence software where duplicates were removed.(33) In addition to the subscription databases, two authors (DK, SHS) reviewed the first 200 results from a Google Scholar search for inclusion. The first 200 results has been demonstrated to be a reasonable number to screen since there is high overlap between Web of Science and Google Scholar.(34) Content of the literature search was scanned to determine if it contained a prespecified list of exemplar papers; thus, ensuring that all known relevant publications were captured. Bibliographies from included studies were also reviewed and any additional studies were loaded into Covidence for processing.

3.2.2. Inclusion and Exclusion Criteria

A study was included in the review if it met all of the following criteria: 1) it explicitly mentioned pneumococcal vaccine in the title or abstract, 2) it was conducted in a community pharmacy, 3) it clearly described an intervention to improve pneumococcal vaccine uptake, 4) the pharmacist role could be identified, and 5) the effect of the intervention was assessed using an experimental or quasi-experimental study design. A study was excluded if it: 1) was a review article, editorial, commentary, letter, or not a peer-reviewed article, 2) did not report results of the intervention on pneumococcal vaccine rates, 3) included pneumococcal vaccination as part of a comprehensive care plan, and 4) did not focus the intervention on adults.

3.2.3. Selection Process

Two authors (DK, SHS) independently reviewed the titles and abstracts for relevance. At this stage, a publication was selected for further review if one or both authors considered it to be

potentially relevant. Full articles were then reviewed to determine if all inclusion criteria and none of the exclusion criteria were met. Discrepancies were resolved by reaching consensus between the authors. A conference abstract was eligible for inclusion in the analysis if it met all the inclusion criteria. The authors contacted the researchers and conducted electronic searches including use of the full abstract title to determine if a subsequent peer reviewed publication was generated from the project that was not captured in the literature search. If this process did not identify a companion paper, then the conference abstract was used. Prior to fully removing an article from the review, it was examined to determine if we would miss any intervention strategies that had not been described in the included studies.

3.2.4. Data items and synthesis

The data abstraction tools built in Covidence allowed two authors (DK, SHS) to capture descriptive characteristics of the interventions used to increase pneumococcal vaccination rates. Abstracted information included the delivery method and content of the education program for pharmacists, who provided the intervention, any direct-to-consumer promotion strategies, practice tools, and the approach used to identify patients. Content of the education program could include technical training, service components, pneumococcal vaccine indications, strategies to identify eligible patients, and communication strategies. Pharmacists, pharmacy technicians, pharmacy students, and other healthcare professionals (nurses or physicians) were potential intervention providers. The pharmacist's role in the intervention was categorized using the American Pharmacists Association Guidelines for Pharmacy-based Immunization Advocacy and Administration.(35) The pharmacist level of involvement was defined as either 1) a facilitator (hosts others who immunize), 2) an advocate (educates on communicable and preventable diseases, and vaccines), or 3) an immunizer (provides the immunization).(35) Direct-to-consumer promotion strategies included media promotion, pharmacy advertisements, brochures,

and personal contact. Decision aids, automated screening tools, and software to connect pharmacy systems with immunization information systems were considered practice tools. Lastly, a patient identification strategy was considered proactive if the pharmacy patient roster was screed to determine eligibility based on medication and health history, followed by communication from the pharmacy to the patient. Patient identification was considered reactive if vaccine eligibility was assessed at the time a patient walked into the pharmacy to receive pharmacy services. Patient identification was considered passive if patients requested the vaccination themselves after being guided by direct-to-consumer marketing (e.g., pamphlets included with prescription medication, radio advertisements, etc.).

We also captured details of the methods used to assess the pharmacist intervention. Information included the study design, targeted at-risk group, methods to measure vaccination rate and statistical analyses. Based on inclusion criteria, studies could be a randomized controlled trial or a quasi-experimental design that could be described using established definitions from previous pharmacy practice research studies.(36, 37) We used national guideline recommendations to define targeted at-risk groups as either adults aged 18-64 years with one or more prespecified conditions, or those aged 65 years and older. Various methods for measuring vaccination rates have been reported in previous systematic reviews and include raw counts of vaccines delivered, mean count across multiple study sites, proportion of eligible patients vaccinated, and the change in observed vaccination rate in the study.(28, 29, 30, 38, 39) Information was extracted by the lead author (DK) and verified by a second author (SHS) for comprehensiveness and accuracy.

3.2.5. Study risk of bias assessment and Certainty assessment

No comprehensive risk of bias assessments were conducted as the aim of this review was to describe intervention strategies employed by community pharmacists to improve

pneumococcal vaccination uptake. We did, however, collect information related to monetary incentives provided to either patients, pharmacists, or pharmacies to participate in the study as a potential source of selection bias.

3.3. Results

3.3.1. Study selection

After removing duplicates, 916 unique publications were identified from the electronic database searches and an additional 8 publications were identified from Google Scholar and reference lists (Figure 3-1). A total of 115 publications were considered potentially relevant from screening titles and abstracts. Of these, 93 publications were excluded: 55 were not based in community pharmacies, 21 did not report vaccination rates, 11 did not have a comparison group, 5 did not examine impact of an intervention, and 1 was an abstract companion to a subsequently published paper. Attempts to retrieve subsequent peer reviewed manuscripts were unsuccessful for 3 conference abstracts.(40, 41, 42) None of the excluded publications had a unique intervention strategy that was not identified in other studies. A total of 22 publications met all inclusion criteria; however, upon closer examination, we found that two publications examined different aspects of the same study.(43, 44) Therefore, we report information from 21 studies that was retrieved from 22 publications.(40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61) One study was conducted in Canada,(40) while the remaining 20 studies were conducted in the United States. The earliest study was conducted by Weitzel and Goode in 1998,(45) and the most recent study conducted by Heaton and colleagues in 2020.(61)

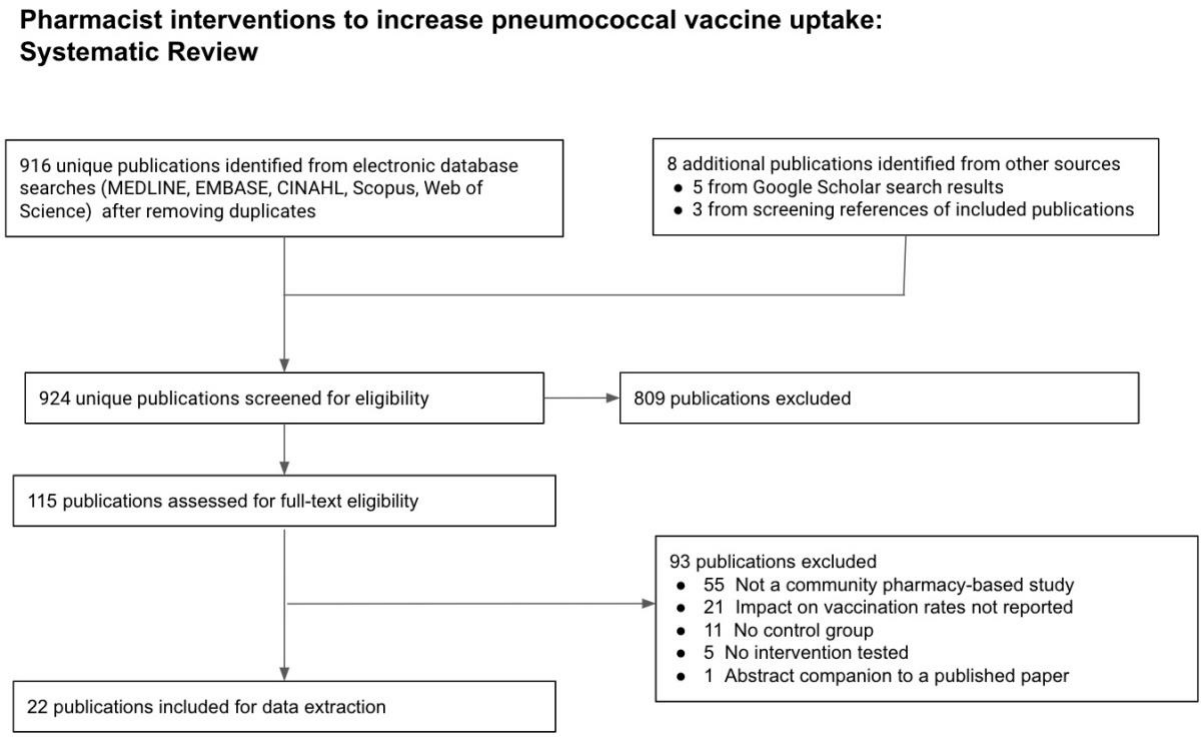

Figure 3-1: Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart of the systematic review.

Table 3-1: Description of intervention strategies identified in the review

		Weitzel (2000)	Taitel (2011)	Rager (2016)	Westrick (2016)	Caffrey (2018)	Klassing (2018)	Lin (2018) / Bacci (2019)*	Luder (2018)	Pickering (2018)	Polinski (2018)	Hohmann (2019)	Stolpe (2019)	Wehbi (2019)	Coley (2020)	Faggioni (2020)	Page (2020)	Percy (2020)	Skoy (2020)	Gatwood (2021)	Sheer (2021)	Heaton (2022)
Provider Education																						
Delivery Method	Web-based			x	x							x			x	x		x	x	x	x	x
	In-person	x			x	x		x							x		x			x		
	Not stated		x				x		x	x	x		x	x								
Content	Technical training (CPR, Injection administration)	x																	x			
	Service components (storage, billing, software, documentation)	x		x	x		x	x	x	x		x		x	x	x		x	x	x	x	x
	Indications for pneumococcal vaccination	x	x	x	x	x		x				x			x	x	x	x	x	x	x	x
	Screening strategies based on pneumococcal vaccine indications			x	x	x		x	x			x			x	x	x	x	x	x		x
	Coordinate with staff to deliver the intervention				x	x		x	x			x			x			x				
	Collaboration with other healthcare professionals	x																				
	Patient communication strategies			x	x	x		x				x			x	x	x		x	x		
	Not stated										x		x									
Intervention Providers																						
	Pharmacist	x	x	x	x	x		x	x	x		x		x	x	x	x		x	x	x	x
	Pharmacy Technician	x		x				x	x			x			x		x	x				
	Pharmacy Student	x																x				
	Nurses / Physicians	x																				
	Not stated						x				x		x									
Direct-to-Consumer Promotion																						
	Media promotional materials (Radio, Online, Social media, Television)	x			x	x					x	x		x		x						
	Advertisements in the pharmacy (posters, in-store announcements)	x		x	x		x					x		x		x			x			
	Brochures or printed material with prescription	x		x	x	x	x					x		x	x	x			x			
	Personal contact (seminars, mail, email, phone)	x		x		x	x		x		x	x	x	x	x							
	Incentive for patient participation (e.g., loyalty rewards)													x								
	Not stated		x					x		x							x	x			x	x
Practice Tools Developed																						
	Decision making aids			x		x										x			x			
	Automated screening tools							x		x	x				x						x	
	Software to connect with immunization information system				x			x						x	x		x					x
	Coaching to integrate intervention into workflow	x			x			x				x			x			x	x	x		
	Not stated		x				x		x				x									
Patient Identification																						
	Proactive (using patient-roster)						x		x	x					x		x				x	
	Reactive (upon identification)		x	x	x	x		x				x		x	x	x	x	x	x	x		x
	Passive (using educational/promotion materials, patient self-identification)	x		x							x		x									
	Not stated																					

* Two individual publications from the same intervention study

3.3.2. Provider Education

The method for educating pharmacists about the intervention was reported as web-based only in 7 studies,(40, 42, 51, 56, 57, 60, 61) in-person only in 4 studies,(43, 44, 45, 48, 55) a hybrid model with both web-based and in-person approaches in 3 studies,(47, 53, 58) and not described

in the remaining 7 studies.(41, 46, 49, 50, 52, 54, 59) The studies that primarily employed web-based education consisted of webinars, training modules, and an online communication system between the project team and participating pharmacists. In-person delivery primarily consisted of providing indication scenarios and recommendations for coordination with pharmacy technicians and interns to provide pneumococcal vaccines. Hybrid approaches employed online training modules for training on indications and in-person coaching to utilize screening and patient communication techniques.

Content of the pharmacist education mainly involved a review of national guideline recommendations for pneumococcal vaccines, screening strategies, and service components. A total of 15 studies reviewed pneumococcal vaccine recommendations from the Advisory Committee on Immunization Practices (ACIP) and Centres for Disease Control and Prevention.(62, 63) Both organizations recommend pneumococcal vaccination for all individuals aged 65 or older and adults aged 18 to 64 who have one or more prespecified conditions, like asthma, diabetes or chronic obstructive pulmonary disease. In addition to a review of indications, 13 studies gave pharmacists strategies for identifying patients, such as reviewing patient medication, health, and immunization history to identify at-risk patients. Some notable strategies included utilizing the patient roster to identify patients with incomplete immunization history,(46, 52) utilizing software to identify eligible patients using ACIP criteria,(53, 60) and reviewing patient medication dispensation history for diabetes medications to identify at-risk patients.(55) A subset of these studies also encouraged pharmacists to coordinate the screening activities with technicians and other pharmacy staff.(53, 56) Service components included establishing a single sign-on system to link state health record data to the pharmacy database,(54) establishing an appointment-based immunization model to coordinate medication

pickup and vaccination,(50) and setting up offsite immunization clinics in long-term care facilities to coordinate vaccination delivery.(45) Lastly, 9 studies included communication strategies in the education sessions. For example, pharmacists were given the opportunity to role play possible patient encounters to prepare for implementation of the study,(47, 48) to practice assertive communication techniques,(58) or to learn about motivational interviewing.(53) Some studies provided a list of "frequently-asked-questions" or reasons for refusing a vaccine along with suggested responses.(48)

We observed a gradual shift in the education content when examining studies by publication year. In the first published study included in our review, Weitzel and Goode focussed on introducing pharmacy-based immunization as a new concept.(45) Therefore, components of the education program were more technical, involving injection certification for pharmacists, developing injection protocols, obtaining authorization for administering vaccines, and educating other healthcare professionals about the new service that pharmacists can offer patients. Later studies focused the educational content on incorporating technology into the pharmacy workflow to track immunization activities and using assertive communication techniques to address vaccine hesitancy and perceived barriers.(58, 61)

3.3.3. Intervention Providers

The majority of interventions were delivered by pharmacists (n=17) working independently, or in collaboration with others. Pharmacists were pneumococcal vaccine providers in all included studies except for the study by Percy and colleagues where pharmacy extenders (interns and residents) were trained on identifying eligible patients.(56) Pharmacy technicians helped deliver the intervention in 8 studies by identifying eligible patients as well as assisting with billing and other service components related to the vaccination.(42, 43, 44, 45, 50, 51, 53, 55, 56) Pharmacy students and interns helped provide the pneumococcal vaccine intervention in 2 studies.(45, 56)

Weitzel and Goode reported the only study to incorporate a physician to guide the injection delivery training program and nurses to aid in immunization delivery alongside pharmacists.(45)

3.3.4. Direct-to-Consumer Promotion

Most studies included some form of direct-to-consumer promotion as part of the intervention program. Personal contact by the pharmacy staff via phone, mail, and email was a common strategy for raising awareness of the pneumococcal vaccination program. For example, Klassing and colleagues employed both mail and phone marketing strategies to promote pharmacy-based immunizations.(49) Brochures and promotional materials included with prescriptions were employed in a similar number of studies. Caffrey and colleagues employed a vaccination tracking card for patients to keep a record of all the immunizations received.(48) Polinski and colleagues, in partnership with the pharmacy chain, employed an online self-screen tool on the pharmacy's corporate website to allow patients to identify their eligibility for vaccination.(59) Only one study employed an incentive program to promote the vaccination program wherein eligible patients were offered loyalty rewards to the grocery store where the pharmacy was based.(54) Stolpe and colleagues reached out to patients using an automated phone script to advise them of their eligibility to receive an immunization.(52) Other methods of direct-to-consumer promotion included in-store announcements and posters, radio and television advertisements, social media posts, and online promotional materials.

3.3.5. Practice Tools

Our review identified four categories of practice tools that were developed as part of the intervention program. First, follow-up coaching to integrate the intervention to the pharmacy workflow was the most commonly identified tool. Studies employing this strategy provided additional assistance after the initial training by visiting the store and helping pharmacists incorporate patient identification steps and documentation into the specific workflow of the

pharmacy.(47, 48, 49, 50, 51, 56, 58) Second, some studies developed or implemented software to connect pharmacy systems to the government immunization records system. Examples of this practice tool ranged from providing single sign-on systems to allow for easier vaccine reporting,(54) to allowing access to the regional immunization records so pharmacists could identify eligible patients based on medical and immunization history.(61) Third, 5 studies used automated screening tools that could identify eligible patients from prescription records for specific chronic diseases, such as diabetes or asthma, that were part of the Centers for Disease Control and Advisory Council for Immunization Practices guidelines for pneumococcal vaccinations.(41, 43, 44, 53, 59, 60) Sheer and colleagues employed automated screening and vaccine eligibility reporting for the intervention group only,(60) whereas Coley and colleagues provided the automated screening tool to all participating pharmacies.(53) Fourth, decision support tools were developed by four studies, the most comprehensive of which was developed and implemented by Caffrey and colleagues.(48) In this study, a decision support flowchart based on patient history and presentation allowed pharmacists to identify vaccine eligible patients.

3.3.6. Patient Identification

A majority of studies (n=14) identified patients reactively, wherein pharmacists assessed patients for vaccine eligibility upon walk-in and communicated with them about their status and the importance of vaccination. Six studies utilized a proactive approach by screening the pharmacy patient roster and contacting individuals about their vaccine eligibility.(41, 49, 50, 53, 55, 60) For example, Luder and colleagues implemented an appointment-based model to coordinate medication pickup and vaccination delivery for eligible patients identified through the statewide immunization database and patient roster.(50) We identified 4 studies that utilized a passive approach to patient identification wherein patients self-identified as being vaccine

eligible using direct-to-consumer marketing, such as the online-self screening tool developed by Polinski, and a paper-based self-screening tool included with dispensed medication.(42, 45, 52, 59)

Table 3-2: Results of the intervention studies identified in the systematic review.

Pickering (2018)[4]	Polinski (2018)[5]	Hohmann (2019)[6]	Stolpe (2019)	Wehbi (2019)	Coley (2020)	Faggioni (2020)	Page (2020)	Percy (2020)	Skoy (2020)[3]	Gatwood (2021)	Sheer (2021)	Heaton (2022)[7]
x		x	x							x	x	x
	x											
				x	x	x	x	x	x			
	x											
x		x	x	x	x	x	x	x	x	x	x	x
x	x	x	x	x	x	x	x	x	x	x		x
x	x		x	x	x	x		x	x		x	x
Jan 2017 - Apr 2017	June 2014 - Oct 2015	Jun 2016 - Jan 2017	Mar 2015 - Jan 2016	Oct 2016 - Sep 2017	Sep 2016 - Aug 2017	Jan 2017 - Dec 2019	Nov 2018 - Feb 2019	Dec 2017 - Jan 2018	June 2016 - May 2018	Jul 2018 - Dec 2019	Jan 2017 - Jun 2017	Jan 2018 - Mar 2020
				x	x				x	x		
	x	x				x						
			x				x				x	x
x								x				
nr / nr	3.1 / 3.5 23.2 / 16.2	12 / 7.5	nr / nr	n/a / 12062	n/a / 955	n/a / 8.8	n/a / 28.6%	n/a / nr	n/a / 1526	nr / nr	nr / nr	11.5% / 11.3%
nr / nr	5.8 / 7.4 33.9 / 27.1	19 / 12	1.09 / 1.12	n/a / 10173	n/a / 1023	n/a / 12.9	n/a / 31.8%	n/a / nr	n/a / 1508	nr / nr	10.2% / 16.1%	13.4% / 11.9%
0.7 (0.4-1.4) 2.1 (1.6-2.7)	2.7 / 3.9 10.8 / 10.0	0 / 3.5	nr	-16%	7%	47%	17.6%	8%	7.7% 9.6%	-22.0% / 2.1%	nr	1.16 (0.96-1.41) 1.06 (0.86-1.29)
Odds Ratio (95% CI)	Difference in Differences (95% CI)	Mann-Whitney U test	t-test	nr	nr	nr	McNemar	t-test	Wilcoxon signed-rank test	chi2	chi2	Difference in Differences (95% CI)
nr	1.2 (0.1 to 2.3) 0.02 (-5.3 to 5.3)	0.14	nr	nr	nr	nr	<0.001	>0.05	<0.001 nr	0.34	<0.001	0.95 (0.80-1.14)

		Weitzel (2000)	Taitel (2011)	Rager (2016)	Westrick (2016)	Caffrey (2018)	Klassing (2018)[1]	Lin (2018) / Bacci (2019)[2]	Luder (2018)[3]
Design and Parameters									
Design	Randomized-Controlled Trail			x	x		x		x
	Untreated comparison group with pretest and posttest					x			
	One group pretest and posttest	x						x	
	Static group comparison		x						
Geographic Region	National		x		x				
	Regional	x		x		x	x	x	x
Targeted at-risk group	Age 18-64 with ≥1 prespecified condition	x	x	x	x	x	x	x	x
	Age ≥65	x	x	x	x	x		x	x
	Study Period	Sep 1998 - Jan 2000	Aug 2010 - Nov 2010	nr	Jan 2014 - Dec 2014	Jan 2013 - Dec 2015	Oct 2014 - Nov 2014	Sep 2015 - Aug 2017	Sep 2014 - Dec 2015
Measurement and Results									
Pneumococcal vaccination rate measured	Number of vaccinations	x						x	
	Mean number of vaccinations per pharmacy			x	x				x
	% of eligible patients vaccinated		x			x	x		
	Not stated								
Pneumococcal vaccination Rate Reported	Baseline Measurement Comparison / Intervention	n/a / 613	n/a / n/a	nr / nr	28.9 / 20.4	69.5% / 72.4%	nr / nr / nr	n/a / 4273	nr / nr
	Follow-up measurement Comparison / Intervention	n/a / 1200	2.9% / 4.9%	1.4 / 1.8	42.3 / 53.2	72.5% / 76.3%	55.7% / 59.7% / 61.9%	n/a / 3638	24.1 / 28.3 158.5 / 192.2
	Reported Rate Change (mean, n or %) Comparison / Intervention	nr	nr	nr	13.3 / 32.9	3.0% / 3.9%	nr	-14.9%	nr
Test for difference between measurements	Statistical test used	nr	2-proportion Z-test	nr	Repeated-measures ANOVA	t-test	chi2	nr	t-test
	p-value reported	nr	<0.001	0.22	0.032	0.01	0.76	nr	0.23 0.15

n/a = Not applicable, based on study design
nr = Not reported
[1] - Reported numbers correspond to control, phone-call, and letter groups respectively.
[2] - Vaccination numbers are obtained from Bacci 2019, both publications are part of a larger study.
[3] - Top and bottom row numbers correspond to PPSV23 and PCV 13 vaccine administration respectively
[4] - Top and bottom row numbers correspond to Adults 18-64 with 1 or more prespecified conditions and Adults over 65 years of age respectively.
[5] - Top and bottom numbers correspond to web-based campaign (online + email) and email-only campaigns respectively
[6] - Median values are reported for consistency as a Mann-Whitney U-test was used for statistical analysis
[7] - Top and bottom numbers correspond to reported rate changes in the comparison and intervention groups respectively

3.3.7. Assessment of the Intervention

Efficacy of the intervention was assessed using a randomized controlled trial design in 10 studies.(41, 43, 44, 47, 49, 50, 51, 52, 58, 60, 61) The remaining studies used a quasi-experimental design to assess efficacy of the intervention. Eight studies employed a one group pre-test post-test study design,(40, 43, 44, 45, 53, 54, 55, 56, 57), two studies employed an untreated comparison group pre-test post-test design,(48, 59) and one study employed a static comparison group design.(46) Eighteen studies recruited pharmacies within a defined region, such as one city, one to three states, or one province. The remaining three studies recruited pharmacies within a nationwide chain,(46, 59) or across the United States.(47) Two studies provided financial incentives to the pharmacies for participation. Westrick and colleagues provided pharmacies with $1000 for participating in the intervention.(47) Bacci and colleagues developed an incentive-based model of $6 to $18 per vaccination to improve performance in the participating pharmacies.(43) Most studies (n=16) offered the pneumococcal vaccine intervention to all eligible adults, four studies focused on adults 18 to 64 years of age with one or more prespecified conditions,(49, 51, 55, 58) and one study focused on adults over 65 years of age.(60)

The pneumococcal vaccination rate was measured by counting the total number of vaccines dispensed or administered in 6 studies,(43, 44, 45, 53, 54, 57, 58) or mean number of vaccinations per pharmacy in 6 studies.(40, 42, 47, 50, 51, 59) Seven studies measured the proportion of eligible patients who received a pneumococcal vaccine.(46, 48, 49, 52, 55, 60, 61) Two studies did not specify how pneumococcal vaccinations were measured but reported the change in rate.(41, 56) The intervention programs created higher pneumococcal vaccination rates from baseline or relative to a comparison group in 19 studies. However, only 7 studies reported

these differences were statistically significant.(46, 47, 48, 55, 57, 59, 60) Two studies reported lower pneumococcal vaccination rates after the intervention was implemented.(43, 44, 54)

3.4. Discussion

Vaccination is an efficient and effective public health tool for providing protection against communicable and preventable diseases. Although pneumococcal vaccination rates are below national targets, community pharmacists are well-positioned to address this important healthcare gap. This review allowed us to examine the various intervention strategies used in community pharmacies and the roles pharmacists play, from facilitator to advocate to immunizer, in delivering pneumococcal vaccines. Our review focused on identifying the keyways that pharmacists are educated about intervention strategies, methods for identifying eligible patients, and approaches to measuring the impact of an intervention program aimed at improving vaccination rates in the community. Information from this review will help inform development of an intervention strategy that will be implemented in community pharmacies.

Examining how the intervention strategies evolved over time, there are three major observations that we would like to highlight. Firstly, we observed a shift in the focus of educational content over time. Beginning with the first study by Weitzel and Goode in 1998, pharmacists received mostly technical training of injection delivery.(45) Content moved to focus on indications for vaccine eligibility, and finally to emphasize communication techniques such as motivational interviewing with patients to address hesitancy.(58) Secondly, we observed a shift in the types of direct-to-consumer advertising. Earlier studies used brochures and pamphlets handed out with prescriptions as a primary means of raising awareness of vaccine eligibility.(45) Later studies incorporated personalized approaches by contacting individuals directly.(52) The incorporation of personalized contact via email, mail, or telephone may be more impactful in improving vaccine uptake as this format created an opportunity for pharmacists and pharmacy

staff to discuss the benefits of vaccination and directly address patient concerns. Thirdly, we observed a shift of the intervention training from in-person to a hybrid, or entirely web-based delivery. As telecommunication platforms are increasingly adopted, we expect web-based delivery to be the primary method of intervention training. Incorporation of an in-person training element, such as live patient scenarios and workflow adaptation, alongside web-based training may allow for better adoption of the intervention.

We identified three general categories of intervention programs which were implemented. The first group of intervention programs focused on managing workflow related to immunization delivery by increasing the division of labour and involve other pharmacy staff. For example, Luder and colleagues, implemented a pharmacy technician led coordination of medication pickup and immunization consultation with the pharmacist.(50) The second group of intervention programs focused on patient communication strategies to address patient hesitation regarding immunizations. For example, Gatwood and colleagues trained pharmacists to utilize assertive communication techniques to address vaccine-related concerns.(59) The third group of intervention strategies involved utilizing automated screening to assess vaccine eligibility. This approach, utilized by Coley and colleagues, allowed for pharmacists to focus their effort and time on educating patients regarding immunizations rather than use it to evaluate a patient's eligibility and requirement reactively.(53)

In general, the vaccination rates improved after implementation of the community pharmacy intervention. However, two studies reported a decrease in pneumococcal vaccination rates.(43, 44, 54) Both of these studies identified a decrease in marketing efforts for pneumococcal vaccine by manufacturers in the intervention period as contributing to a reduction in uptake from the baseline period.(43, 44, 54) We identified two studies that incorporated a payment system to

incentivize pharmacists to participate in the studies.(43, 47) It is important to recognize that appropriate compensation for injection services provided by pharmacists is necessary to incentivize its provision in the future.

National vaccination targets and population-based surveys of vaccine uptake use the proportion of eligible adults to report the vaccination rate; however, 12 of 21 studies included in our review reported the number of pneumococcal vaccines administered. We do not know what proportion of eligible individuals were already vaccinated at baseline, nor do we know how far the intervention advanced the vaccination rate towards a national target. More importantly, none of the studies included in our review reported reasons for individuals refusing a pneumococcal vaccine. All interventions helped raise awareness of pneumococcal vaccines and pushed the process of care to a patient decision, so it would be informative to know why patients refused vaccine as it represents another strategy to address in improving vaccine uptake.

Initially, we aimed to evaluate the impact of each intervention program to identify what strategy or components of a strategy would be most effective at improving pneumococcal vaccine uptake. We observed a variety of methods to measure vaccination rates, from raw counts to proportions of eligible individuals, and a variety of statistical analyses. The differences in assessment methods did not allow for direct comparisons between intervention strategies. There are, however, some common techniques and protocols that we identified which may be useful to improve vaccine uptake in community pharmacies. First, training programs should focus on integration of vaccine recommendations into screening strategies. Since the indications for pneumococcal vaccination are consistent across a variety of national guidelines,(12, 62, 63) pharmacist education could focus on how to utilize patient health and medication dispensation history to identify eligible individuals. Second, the training program should implement workflow

management training by incorporating the entire pharmacy team to deliver the intervention. This collaborative strategy to deliver immunizations would allow for increased time for addressing patient concerns and contacting eligible patients. Third, utilize a dual-pronged approach to providing immunizations by proactively contacting eligible patients to inform them of their status, and perform eligibility assessments reactively if a walk-in patient presents with indications for a vaccine. Finally, intervention programs should incorporate motivational or assertive communication techniques to identify and address vaccine hesitancy and other patient concerns with vaccination. For example, utilization of a frequently asked question list with suggested responses, as Caffrey and colleagues created.(48)

3.4.1. Strengths and limitations

Our review provides insight into different training techniques and emphasis on varying portions of the immunization delivery cascade in community pharmacies impact vaccination delivery. The focus of this research on pneumococcal vaccinations is also a key strength as it focuses pharmacist efforts on vaccines that have a pre-determined eligibility criteria for at-risk individuals with underlying medical conditions that need to be identified before administration. This is in contrast to intervention efforts focusing on influenza as it has a much lower threshold for eligibility. Lastly, our review is not limited to randomized controlled trials to allow for an expansive observation of intervention programs and strategies.

There are two key limitations that we would like to identify. Firstly, it is difficult to draw conclusions regarding the efficacy of each intervention program due to differences in study design and varying presentation of results. To address this, this review has focused on identifying and describing the range of intervention strategies that have been employed and highlighted key similarities and differences amongst them. Secondly, it is difficult to generalize the findings in the review as all studies took place in North America. It may be difficult to draw key strategies

to incorporate in community pharmacies in other regions of the world due to varying health care systems.

3.4.2. Conclusion

Pharmacist involvement in immunization delivery has allowed for greater pneumococcal vaccination uptake within communities in the United States and Canada. Implementation of strategies to further improve uptake should focus on proactive screening strategies, collaboration with staff and other providers, and communication techniques to address individual patient information needs and vaccine hesitancy.

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3.6. Appendices

Appendix Table: Search Strategy

Database	Search Strategy
MEDLINE **Ovid MEDLINE (R) ALL** 1946 to January 06, 2022	1. exp Pneumococcal Vaccines/ 2. (pneumococc* adj3 (vaccin* or revaccinat* or re-vaccinat* or shot* or jab* or inject* or booster* or dose* or dosing* or dosage*)).mp. 3. pneumococcal polysaccharide vaccin*.mp. 4. (pneumococc* and (immunis* or immuniz* or reimmunis* or reimmuniz* or re-immunis* or re-immuniz* or inoculat* or reinoculat* or re-inoculat*)).mp. 5. (PPSV23 or PCV13 or PCV7 or Prevnar or Pneumovax).mp. 6. or/1-5 7. pharmac*4.mp. 8. exp Community Pharmacy Services/ 9. exp Pharmacists/ 10. or/7-9 11. 6 and 10 12 limit 11 to english language
Embase **Embase (Ovid)** 1974 to 2022 January 06	1. exp Pneumococcus vaccine/ 2. (pneumococc* adj3 (vaccin* or revaccinat* or re-vaccinat* or shot* or jab* or inject* or booster* or dose* or dosing* or dosage*)).mp. 3. pneumococcal polysaccharide vaccin*.mp. 4. (pneumococc* and (immunis* or immuniz* or reimmunis* or reimmuniz* or re-immunis* or re-immuniz* or inoculat* or reinoculat* or re-inoculat*)).mp. 5. (PPSV23 or PCV13 or PCV7 or Prevnar or Pneumovax).mp. 6. or/1-5 7. pharmac*4.mp. 8. exp "pharmacy (shop)"/ 9. exp pharmacist/ 10. or/7-9 11. 6 and 10 12 limit 11 to english language
CINAHL	S1 (MH "Pneumococcal Vaccine") S2 (pneumococc* N3 (vaccin* or revaccinat* or re-vaccinat* or shot* or jab* or inject* or booster* or dose* or dosing* or dosage*)) S3 pneumococcal polysaccharide vaccin*

	S4 (pneumococc* and (immunis* or immuniz* or reimmunis* or reimmuniz* or re-immunis* or re-immuniz* or inoculat* or reinoculat* or re-inoculat*)) S5 PPSV23 or PCV13 or PCV7 or Prevnar or Pneumovax S6 S1 OR S2 OR S3 OR S4 OR S5 S7 pharmacy or pharmacies or pharmacist* S8 (MH "Pharmacy Service+") S9 (MH "Pharmacists") S10 S7 OR S8 OR S9 S11 S6 AND S10 Limiters: English language
Scopus	TITLE-ABS-KEY (pneumococc* W/3 (vaccin* OR revaccinat* OR re-vaccinat* OR shot* OR jab* OR inject* OR booster* OR dose* OR dos ing* OR dosage*)) OR "pneumococcal polysaccharide vaccin*" OR (pneumococc* AND (immunis* OR immuniz* OR reimmunis* OR reimmuniz* OR re-immunis* OR re-immuniz* OR inoculat* OR reinoculat* OR re-inoculat*)) OR (ppsv23 OR pcv13 OR pcv7 OR prevnar OR pneumovax) AND TITLE-ABS-KEY (pharmacy OR pharmacies OR pharmacist*) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "re")) AND (LIMIT-TO (LANGUAGE , "English"))
Web of Science Core Collection	TS=((pneumococc* NEAR/3 (vaccin* or revaccinat* or re-vaccinat* or shot* or jab* or inject* or booster* or dose* or dosing* or dosage*)) or "pneumococcal polysaccharide vaccin*" or (pneumococc* and (immunis* or immuniz* or reimmunis* or reimmuniz* or re-immunis* or re-immuniz* or inoculat* or reinoculat* or re-inoculat*)) or PPSV23 or PCV13 or PCV7 or Prevnar or Pneumovax) AND TS=(pharmacy or pharmacies or pharmacist*) Refined by: Languages (English)
Google Scholar	(pneumococcal vaccines OR pneumococcal immunization OR pneumococcal immunisation OR PPSV23 OR PCV13 OR PCV7 OR Prevnar OR Pneumovax) AND (pharmacists OR pharmacy OR pharmacies)

4. CHAPTER 4: SUMMARY, CONCLUSIONS, AND IMPLICATIONS

4.1. General Summary

Pharmacist-provided injection services, including vaccines, have increasingly become common practice in community pharmacies over the last few decades.(1) For example, pharmacists in Alberta have become the leading provider of influenza vaccines and played a critical part in COVID-19 pandemic by providing accessible vaccination services.(2, 3) In addition to vaccines, pharmacists also provide non-vaccine medication injections, such as vitamin B-12. However, there is an information gap regarding the other vaccines and medications pharmacists administer by injection, and more crucially, the types of barriers they encounter when providing this service. Understanding the types of barriers that pharmacists encounter while providing injections is critical to developing intervention strategies to enhance this service.

There have been attempts at improving vaccination rates at community pharmacies by incorporating automation, education, and communication techniques.(4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19) However, to date there has not been a comprehensive review summarizing the variety of intervention strategies. Understanding the scope of intervention strategies that have been employed may allow for the development of a more comprehensive intervention program aimed at improving vaccine uptake.

The overall aim of this thesis was to develop foundational knowledge that will help inform a community pharmacy-based intervention aimed at improving pneumococcal vaccine uptake. This was achieved by first observing the various types of medications and vaccines that Alberta pharmacists routinely provide and identifying the barriers and facilitators they encounter whilst providing this service (Chapter 2). Once we understood the various barriers that pharmacists face, we systematically reviewed intervention strategies that have been used to improve pneumococcal vaccine uptake in community pharmacies (Chapter 3). In the following two sections, we will explain the decisions made during execution of these two projects.

4.2. Summary Chapter 2

The purpose of my first thesis project was to understand how Alberta pharmacists use their authorization to administer injections and the different facilitators and barriers they face when providing this service. My initial plan was to focus on understanding how pneumococcal vaccines are provided to people with diabetes as a proxy for understanding injection services in

general. The rationale for this plan was based on two initial observations. First, people with diabetes are at higher risk of contracting pneumococcal disease and suffering more severe consequences from this infection.(20, 21, 22) Second, uptake of pneumococcal vaccines has plateaued and remains suboptimal.(23, 24) One of the guiding papers for this initial plan was an observational study by Gilani and colleagues that reported 53% of Albertans living with diabetes had received a pneumococcal vaccine.(25)

Following input from my supervisory committee, the scope of the project was expanded to gain a more comprehensive understanding of how Alberta pharmacists use their authorization to inject. Although surveys of pharmacy-based immunization activities have been conducted previously in Ontario,(26) Quebec,(27) and British Columbia,(28) there was an opportunity to explore a broader injection service in Alberta. Under the Health Professions Act of 2007 Alberta pharmacists have been able to administer any drug, blood product, or vaccine as long as they are satisfied it is appropriate for the patient.(29, 30) We could not only ask pharmacists about the vaccines they administer, but also ask about other injectable medications – something that had not been reported in the literature previously. Research regarding pharmacist opinions of their scope of practice further reinforced that Alberta pharmacists enjoyed a distinct advantage in providing non-vaccine injectables, and other jurisdictions aimed for a similar scope.(26, 29, 31) This project provided an opportunity to gather additional insight into the facilitators and barriers that Alberta pharmacists face when providing vaccines and other injectable medications.

The project used an online survey to gather information from registered Alberta pharmacists who had agreed to be contacted for research purposes. We reviewed previous surveys of pharmacy-based immunization services to generate questions for our survey. A draft of the questions was reviewed by my supervisory committee, other graduate students in the Faculty of Pharmacy and Pharmaceutical Sciences, and four pharmacists who frequently use their authorization to administer injections. This review provided reassurance that the questions covered all common medications administered by injection, the usual activities related to an injection service, and common facilitators and barriers that pharmacists encounter when providing this service. The survey was launched in October 2020, a time point before introduction of COVID-19 vaccines.

To address the first objective of this project, develop an understanding of how Alberta pharmacists use their authorization to administer injections, I evaluated responses from 356

pharmacists who had administered an injection in the past year. As expected, the influenza vaccine was the most common injection, administered by over 98% of these active providers. The second most common injection was vitamin B-12, which is consistent with the interests of pharmacist identified in previous surveys when asked about other injectable vaccines and medications they would like to administer.(26) The high proportion of Active Providers who administered the 13-valent pneumococcal vaccine was unexpected because patients would have to pay out-of-pocket for the vaccine if they wanted this administered in a pharmacy, which was the leading reported reason for not getting injections in a pharmacy (Figure 2-5). Additionally, we also observed that pharmacists were willing to administer naloxone in the future if needed.

The examination of objective 2 (perceptions of barriers, benefits and facilitators to providing injection services) was performed by evaluating complete responses within individual subcategories. We wanted to explore if differences in barriers would be reported amongst Non-Active and Active Providers, as well as if the perceived barriers were different amongst infrequent, active, and highly active providers. We evaluated the data using a Mann-Whitney U-test and a Kruskal-Wallis H-test for non-parametric data. We observed that Non-Active Providers were more likely to indicate their personal comfort with administering injections ($p<0.001$) and managing adverse reactions (0.05) as significant barriers to providing injection services compared to Active providers. Additionally, they were less likely to report offering additional services ($p<0.001$), improved patient satisfaction ($p<0.001$) and improved job satisfaction ($p=0.003$) as benefits of providing an injection service. Both groups indicated that having time to properly assess and administer an injection, automated reporting, and access to provincial immunization registry as facilitators for providing injection services.

Over 55% of all respondents stated that increased coverage via publicly funded vaccines would be essential to increase injection services (Figure 2-19). Currently, in Alberta, pharmacists are able to provide 3 publicly funded vaccines: influenza; diphtheria, tetanus and pertussis (dTap); and 23-valent pneumococcal vaccine (only to individuals over the age of 65) as per Ministerial Order 606/2022,(32) as well as, COVID-19 vaccine under a special Ministerial Order Provision 645/2020.(33) While 13 and 23-valent pneumococcal vaccines are publicly funded for use in individuals aged 18-64 with prespecified conditions, such as asthma or COPD, pharmacists are unable to provide them without an out-of-pocket expense for the patient.(34, 35) Policy changes to expand the list of publicly funded vaccines that pharmacists are able to provide

would lead to increased immunization uptake. As well, policy changes that would increase the pharmacy compensation to be more consistent with the time required to assess, administer and monitor the patient for immediate adverse reactions would enable more pharmacists to provide this service.

The results of project 1 were expected in some ways, such as highlighting that pharmacists require more time to administer an injection. Results were also consistent with findings previously, for example, studies where in a high degree of interest by pharmacists to provide vitamin B-12 injections was reported if policies were expanded to include this injection.(26) The high proportion of Active Providers who administered the 13-valent pneumococcal vaccine was unexpected because patients would have to pay out-of-pocket for the vaccine if they wanted this administered in a pharmacy.(34,35) We reported that Alberta pharmacists provide a wide array of injections at their sites, from influenza to insulin, and they identify themselves as providing an important service within their communities. Conclusions and recommendations regarding barriers and facilitators to providing injection services should be interpreted cautiously due to a small and disproportionate sample size of Non-Active Providers.

4.3. Summary Chapter 3

Knowledge gained in my first project provided us with insight regarding what pharmacists commonly administer by injection, and what barriers and facilitators they encounter when providing this service. The next step in my thesis project work was to identify community pharmacy-based intervention strategies that have been used previously. Observations from this study, combined with knowledge of the barriers and facilitators to offering injection services will help guide development of an intervention strategy to improve pneumococcal vaccine uptake.

Previous literature reviews of intervention programs were primarily aimed at improving influenza vaccine uptake, based in a hospital pharmacy setting, or focussed on quantifying the overall change in vaccination rate.(36, 37) Initially, I wanted to evaluate which intervention strategy would be the most effective, but this objective would require limiting our review to randomized controlled trials. In addition, we discovered in a preliminary review of the literature that important information on intervention strategies could be obtained from quasi-experimental studies, which are commonly used in pharmacy practice research.(38) With these issues in mind, we decided to conduct a systematic review to describe community pharmacy-based intervention strategies used to improve pneumococcal vaccine uptake.

In a stepwise manner, we established the search strategy, inclusion and exclusion criteria, screened title and abstracts for potential relevance, reviewed full articles for inclusion, and abstracted data. A list of exemplar papers identified during a preliminary literature review were used to guide development of this study. We used these exemplar papers to verify that our search strategy would capture relevant studies. Janice Kung, a health sciences librarian, ran the systematic search and uploaded 916 potentially relevant articles for Dr. Simpson and me to review. To supplement the electronic database searches, we reviewed the first 200 results of a Google Scholar search and reference lists of included studies. After screening titles and abstracts, we reviewed the full text of 115 publications that were considered potentially relevant and subsequently included 19 papers and 3 conference abstracts. We were concerned that our selection process may have excluded unique intervention strategies. To mitigate this concern, we reviewed the intervention strategies in the excluded studies and determined there were no other strategies that may have been missed.

We discovered that the earliest community pharmacy-based intervention was in 1998 wherein pharmacists were trained and authorized to administer injections, but also acted as hosts in long-term care facilities where nurses would administer injections.(19) In the most recent intervention study, pharmacists used an online portal to review patient immunization history and indications to recommend a vaccine to the patient.(39) We expected an increased presence of automated screening and recommendation interventions in later years but this was not the case because this strategy was not consistently observed in all studies. We observed an increase in educational strategies focusing on communication with patients in later years.(5, 16, 40) Additionally, we observed that interventions primarily involved community pharmacists (n=17), 8 studies involved pharmacy technicians, 2 studies used pharmacy interns and students, and only 1 study involving nurses or physicians. We observed 2 interesting intervention strategies. First, the implementation of a flowchart decision making tool based on patient indications that was implemented by Caffrey and colleagues.(41) Additionally, they also provided pharmacists with a "frequently-asked-questions" sheet to help answer any patient questions regarding the vaccine and address their hesitancy. Second, an assertive communication intervention was implemented by Gatwood and colleagues wherein pharmacists were trained on asking probing questions to address patient hesitancy.(5) Other notable interventions included using an automated phone

script to eligible patients to promote pneumococcal vaccines,(42) and an appointment-based model to organize medication pick-up and vaccine consultation.(15)

Our review of 21 studies included 10 randomized controlled trials with 20 out of the 21 studies taking place in the United States. A total of 16 studies focused intervention and screening strategies on both patients 18-64 years of age at high-risk of pneumococcal disease and patients 65 years of age and older. Due to the various measurement methods employed by the studies, it was not feasible to directly compare effectiveness of the interventions. However, we did observe that all intervention strategies were designed to increase patient awareness of their pneumococcal vaccine eligibility and that all but 2 studies reported improvements in vaccination rates. With an increase in patient awareness of the eligibility, it would be important to identify why patients refused to be vaccinated. Unfortunately, reasons for patient refusal of pharmacist recommendations were not captured in any of the studies included in our review. Collection of that information using the Health-Belief model framework would provide valuable insight to help address patient perceptions of disease susceptibility and vaccine efficacy.

This review allowed us to explore the various intervention strategies that have been employed and identify important elements for a future intervention to improve pneumococcal vaccination rates in community pharmacies. We recommend that future interventions should focus efforts on screening strategies using decision making aids for pharmacists, distributing the workload of the injection service process amongst pharmacy staff, proactively screen the patient roster to identify eligible patients, and train pharmacists on motivational interviewing techniques to address vaccine hesitancy. Assessment of these strategies should also include methods to collect reasons why a patient refuses the recommended vaccine. These strategies will be more important as number of publicly funded vaccines that pharmacists can administer increases.

4.4. Limitations

I recognize that there are some limitations that should be considered when interpreting the results of my thesis, including:

1. Data collected in project 1 is a small sample size (n=393). An analysis did suggest that our respondents are representative of the larger Alberta pharmacist population.
2. While all surveys are susceptible to social desirability bias, an anonymous collection mechanism would mitigate this risk.

3. We must also consider volunteer bias in our sample as there was a greater proportion of "Active Providers" compared to "Non-Active Providers" in our sample. The opinions of people who do not actively provide vaccines may be under-represented within our sample. Since we observed that these individuals perceive more barriers to providing injection services, it would be important to learn more about their opinions to overcome these barriers.
4. In project 2, we were unable to draw definitive conclusions from our systematic review and do in-depth statistical analysis due to the varying measurement methods and study designs. To address this, we reoriented our review to focus on identifying and describing the various intervention strategies that have been implemented to increase pneumococcal vaccine uptake.
5. Our review may not be generalizable to community pharmacies in other countries as all included studies took place in North America with most of them taking place in the United States. As the pharmacist scope of practice varies greatly across the globe and even within one country, some strategies may not be easily implemented in some regions.

4.5. Recommendations and future research

Future studies exploring pharmacist opinions regarding injection services should focus on whether there is a difference in barriers faced by pharmacists between providing vaccinations or medications. Studies should determine whether pharmacists are providing insulin injection services to patients as a demonstrational resource (an initial demonstration, educational technique), or if it is being provided as an ongoing medication administration service to patients.

The systematic review will guide the development of an intervention protocol to increase pharmacy-based pneumococcal vaccines. The intervention should address the individual's beliefs that could be modified as suggested by the Health-Belief model. For example, targeting patient attitudes towards vaccination and susceptibility towards the disease, and perceived severity of the disease. We recommend that a future intervention strategy involve education on indications and collaboration strategies amongst pharmacy staff to expediate and enhance vaccination. Other intervention strategies that we recommend are automated screening of the patient roster for identifying eligible patients and training pharmacists on communication techniques (motivational interviewing, assertive communication) to educate patients and address vaccine hesitancy.

This systematic review also identified an important knowledge gap regarding reasons for refusing a pneumococcal vaccine recommendation. Future research should address reasons for patient refusal to recommendation of an injection.

4.6. Policy Implications

This thesis has provided insight into how Alberta pharmacists provide injection services to patients and what barriers they are experiencing. These barriers may be addressed by allowing pharmacists more time to assess and administer injections by incorporating technicians, interns and students in the injection process. Additional injection provision training of pharmacy students during their entry to practice degree would allow them to feel more comfortable and confident in providing this service. As the number of pharmacist-provided injections services has increased over the years, appropriate remuneration that reflects their time and efforts should be considered by provincial health authorities. This thesis highlights the importance of pharmacist provided injection services, especially regarding vaccines. Policy changes that increase the number of publicly funded vaccines that pharmacists can administer and provide compensation that is consistent with the time required to deliver this service would allow for greater uptake of immunization services.

4.7. Conclusions

The overall goal of this thesis was to develop foundational knowledge that will help inform a community pharmacy-based intervention aimed at improving pneumococcal vaccine uptake. Community pharmacists provide preventative and effective protection against diseases via vaccinations. In Alberta, they provide a wide variety of medications and vaccines by injection, but also encounter practice-related, organizational, and systematic barriers when providing this service. Strategies to improve vaccination uptake in community pharmacies varied and require a multi-pronged approach which involves collaboration with staff and effective communication with patients. The findings from these two different and interconnected projects provide foundational knowledge for a community pharmacy intervention protocol.

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