Opportunities for pharmacists to recommend and administer routine vaccines

Jennifer E. Isenor, BSc(Pharm), PharmD^{ID}; Susan K. Bowles, BScPhm, PharmD, MSc

THE CANADIAN NATIONAL ADVISORY COMMITTEE ON IMMUNIZATION (NACI) makes recommendations for the use of vaccines.¹ Individual provinces and territories determine which vaccines will be funded and the schedules that are appropriate, based on their resources (e.g., funds, immunization providers, etc.).² Routine vaccinations recommended for previously vaccinated adults and those who are unimmunized or underimmunized are found in Table 1. This article will focus on influenza, tetanus, diphtheria, acellular pertussis (Tdap) and tetanus and diphtheria (Td) vaccines for routine vaccination, as well as measles, mumps and rubella (MMR), meningococcal and polio vaccines for adults requiring catch-up, with emphasis on pharmacy-based vaccination.³ Other articles in this special section on pharmacists as immunizers give information on pneumococcal, human papillomavirus (HPV), varicella and zoster vaccines.

Canadian pharmacists are highly accessible health care professionals. Approximately 60% of Ontarians reside within walking distance of a pharmacy and 91% within a 5 km drive, and similar results have been observed in Nova Scotia.^{4,5} This degree of accessibility and the resulting frequency of pharmacy visits (up to 14 times per year) provides pharmacists with multiple opportunities to assess for, recommend and administer routine vaccines for adults.⁶ However, there is considerable variation across provinces/territories regarding specific vaccines included within pharmacists' scope of practice.

Over 20 years ago, the American Pharmacists Association developed guidelines for pharmacy-based vaccination advocacy that are directly applicable to Canadian pharmacists today. Pharmacists were encouraged to engage their patients as educators (recommending vaccines), facilitators (hosting other immunizers in a pharmacy/clinic) or as immunizers.⁷ Evidence supports pharmacists in each of these roles to improve vaccination coverage among adult patients.⁸ Nowadays, vaccination is generally considered a standard of practice for pharmacists.

TABLE 1 NACI-recommended routine vaccinations for previously immunized adults and for adults who are unimmunized or underimmunized³

Immunization status	Routine/recommended vaccines*
Previously immunized adults—all childhood and adolescent vaccines received	<ul style="list-style-type: none"> • Herpes zoster • PNEU-P-23 • Seasonal influenza • Td • Tdap
Under/unimmunized adults (eligible for catch-up programs)	All vaccines above, plus: <ul style="list-style-type: none"> • HPV • IPV • Meningococcal (ACYW or C) • MMR • Varicella (depending on age)

Refer to the Canadian Immunization Guide for the latest recommendations.³

HPV, human papillomavirus; IPV, inactivated poliovirus; MMR, measles, mumps and rubella; PNEU-P-23, pneumococcal polysaccharide; Td, tetanus and diphtheria; Tdap, tetanus, diphtheria, acellular pertussis.

In addition, community-based pharmacists are in an excellent position to determine if their adult patients are up to date on recommended vaccines. Medication reviews offer the opportunity to create an “inferred diagnosis” from current drug therapies, which can then be used to identify the need for education and/or specific vaccine recommendations.⁹ This might include influenza vaccine for patients receiving insulin, diabetic supplies or respiratory medications used to treat asthma or chronic obstructive pulmonary disease (COPD).¹⁰

This series of articles has been accredited for 1.75 CEUs under CCCEP file #: 8002-2019-2888-I-P. To earn your CEUs, please review each article, then click on www.pharmacists.ca/immunizers to complete a series of short assessments.

© The Author(s) 2019

Article reuse guidelines:

sagepub.com/journals-permissions

DOI:10.1177/1715163519878473

Another potential opportunity to identify routine vaccination requirements is during travel medicine consultations that are offered by some pharmacists.

A 2018 survey of 4023 adults conducted by the Canadian Pharmacists Association found that 87% of Canadians trust pharmacists to provide advice on vaccinations, and recommendations from pharmacists regarding the need for receiving a specific vaccine are frequently accepted.^{9,11,12} Likewise, patients appreciate the convenience offered by pharmacists providing vaccinations in the pharmacy and in community sites, including workplaces.^{13,14}

The perceptions of the public surrounding pharmacist provision of routine vaccinations is an important consideration for many pharmacists when integrating vaccination services into their practice. While Canadian data are limited, patients generally report a high level of satisfaction with pharmacist administration of vaccines. In a survey of Nova Scotians who received influenza vaccine from a community pharmacist, most respondents reported the service was as good as (40%) or better than (50%) past experiences with other immunizers.¹³ In another study of patient satisfaction regarding pharmacist-administered influenza vaccination in Toronto, 92% of recipients were very satisfied with the services received.¹⁵ Moreover, 99% reported they would recommend that friends and family be vaccinated by a pharmacist.¹⁵

Influenza vaccination

Influenza is a respiratory illness associated with serious complications, such as secondary bacterial pneumonia or exacerbation of an underlying respiratory disease in vulnerable populations. It is estimated that an average of 23,000 cases of laboratory-confirmed influenza are reported annually, resulting in approximately 12,000 hospitalizations and 3500 deaths in Canada.¹⁰ Although overall vaccine effectiveness varies yearly, annual vaccination can reduce influenza-related complications in high-risk adults.¹⁰ NACI recommends annual vaccination for all individuals ≥ 6 months who do not have any contraindications to the vaccine.¹⁰ The highest priority should be given to those at greatest risk of developing influenza-related complications and those capable of transmitting influenza (such as health care workers) to high-risk persons. Those at the greatest risk of influenza-related complications include pregnant women, adults and children with certain medical conditions; adults ≥ 65 years; Indigenous peoples; and residents of nursing homes or other long-term care facilities. For adults and children ≥ 9 years, a single dose of influenza vaccine is recommended. Children < 9 years who have not received previous influenza vaccine should receive 2 doses of vaccine separated by a minimum of 4 weeks between doses.¹⁰

In Canada, 5 types of influenza vaccine are licensed: standard-dose trivalent inactivated vaccine (TIV), adjuvanted TIV, high-dose TIV, quadrivalent inactivated vaccine (QIV) and quadrivalent live-attenuated vaccine (quadrivalent LAIV).

Choice of product is based on age, underlying risk factors, availability through publicly funded (or private) programs in each province/territory and vaccine access through pharmacies. In contrast with TIV, which contains 2 strains of influenza A and 1 strain of influenza B, QIV vaccine contains 2 strains of influenza A and 2 strains of influenza B. When available, QIV is preferred for children and adolescents 2 to 17 years, given the burden of influenza B in children.¹⁰ Quadrivalent LAIV provides a noninjectable option for children and adults 2 to 59 years but (as a live vaccine) should not be used in pregnant women, the immunocompromised, children/adolescents 2 to 17 years receiving acetylsalicylic acid, health care providers or individuals with severe asthma.¹⁰ However, quadrivalent LAIV will not be available in Canada for the 2019-2020 influenza season.¹⁶

Annually, NACI makes recommendations regarding high-priority recipients and specific vaccine types.¹⁶ With many differences in influenza programs across provinces and territories, including considerable variability in vaccine products offered, pharmacists need to be familiar with these to best advise patients in their specific jurisdiction.

Tetanus, diphtheria, pertussis vaccination

Tetanus (lockjaw) occurs worldwide, with a case fatality rate in the unvaccinated ranging from 10% to over 80%. Tetanus is rarely seen in Canada due to vaccination. A wound that is exposed to soil, animal/human feces or dust contaminated with *Clostridium tetani* spores can lead to infection (as the spores germinate into bacilli that release a neurotoxin, which causes tetanus). Since the neurotoxin is the causative agent, there is no person-to-person transmission of tetanus and herd immunity does not protect the unvaccinated. Tetanus toxoid is not available on its own, only in combination with other vaccines. For adults, it is available with diphtheria and acellular pertussis (Tdap) or with only diphtheria (Td). For adults who have previously received tetanus toxoid-containing vaccine, NACI recommends that all adults ≥ 18 years receive a booster dose of Td every 10 years. Those who have not previously received a dose of Tdap in adulthood should receive 1 dose (which can be in place of the usual 10-year booster of Td).

Diphtheria occurs worldwide and is endemic in some countries. Although rare in Canada, cases imported from countries in which it is endemic have been reported, as well as cases of under/unimmunized Canadians acquiring it during travel. Death occurs in 5% to 10% of cases. Diphtheria is transmitted from the respiratory tract of humans. As with tetanus, diphtheria toxoid is not available on its own, only in combination with other vaccines. For adults, it is available with tetanus and pertussis (Tdap) or with only tetanus (Td).

Pertussis (whooping cough) is highly communicable; it is common in children and endemic worldwide. Severity and complications are greatest among infants, especially those who are under/unimmunized. Although mortality is rare in

Canada, deaths related to pertussis occur each year, most commonly in under/unimmunized infants, including those who are too young to have received vaccinations. Acellular pertussis is also not available on its own, only in combination with other vaccines. For adults, it is available with tetanus and diphtheria (Tdap). Refer to the Canadian Immunization Guide for details regarding timing of Tdap vaccine (1 dose in adulthood) in those who have previously (or not) received acellular pertussis vaccines as children/adolescents.¹⁷ Pertussis-containing vaccine (Tdap) should also be administered in every pregnancy, regardless of the mother's previous vaccination history, ideally between 27 and 32 weeks of gestation.¹⁸

In summary, all previously vaccinated adults require a dose of Td every 10 years. If they have not received a dose of pertussis-containing vaccine in adulthood, then a dose of Tdap should be administered as soon as the lack of a dose in adulthood is confirmed, followed by Td every 10 years thereafter.

Measles, mumps, rubella, meningococcal and polio vaccination (in under/unimmunized adults)

Measles is one of the most highly contagious diseases worldwide, with about 10% of people experiencing complications. As of 2019, outbreaks continue to occur internationally, including in developed countries such as Canada, particularly when vaccination levels decline.¹⁹ Mumps also occurs worldwide, with outbreaks in Canada. Complications are frequent; however, permanent sequelae are rare. Measles and mumps vaccine is available in combination with rubella (MMR), as well as a product that also contains varicella (MMRV). NACI recommends a single dose of measles and mumps-containing vaccine for adults born in or after 1970 who have not been previously vaccinated. Those born before 1970 are presumed to have acquired natural immunity. One or 2 doses may be considered for health care workers, travellers and military personnel deemed at risk, regardless of year of birth. Differences may exist across jurisdictions for catch-up recommendations.²⁰ Rubella is highly communicable and occurs worldwide, with approximately half of cases estimated to be subclinical. If a woman contracts rubella during pregnancy, her infant is at risk of congenital rubella syndrome (CRS), which has clinical manifestations that include cataracts/congenital glaucoma, congenital heart defects and sensorineural hearing loss. For under/unimmunized adults, a single dose of MMR should be given; however, dosing may be dependent more on measles and mumps risk and a second dose may be required. As a live-attenuated vaccine, MMR should be avoided in pregnancy and immunocompromised individuals. Women of childbearing age should be assessed for the need for MMR prior to planning pregnancy.²¹

Invasive meningococcal disease (IMD) is endemic in Canada, and although it occurs at low rates, mortality is approximately 10%, with 10% to 20% of survivors suffering long-term sequelae, including neurologic disabilities and amputations.

For adults 18 to 24 years who have not been previously vaccinated, meningococcal vaccine may be indicated. The specific vaccine recommended differs among provinces and based on the patient's age.²²

Polio has not been eradicated globally, and a small risk exists for Canadians due to importation and for those travelling to polio-endemic countries. In adults who contract paralytic polio, the case fatality rate is 15% to 30%. Inactivated polio virus is available alone (IPV) or in combination with other vaccines (e.g., Tdap-IPV). Previously unimmunized adults who also require a primary series of tetanus toxoid-containing vaccine should receive the primary series of IPV as well. If they do not require the primary series of tetanus toxoid-containing vaccine, then those at high risk should receive the primary series of IPV and those who are not at high risk can receive the vaccine with their next Td or Tdap booster.^{16,23}

Evidence supporting pharmacists providing routine vaccines

Most data for pharmacist administration of vaccines come from the United States, where pharmacists have been providing vaccinations for over 2 decades. Pharmacists have consistently been shown to increase both influenza and pneumococcal vaccination rates.^{8,24-26} However, less is known about the potential impact of pharmacy-based vaccination on improving coverage rates for other vaccines.

Limited data exist regarding the effect of hospital pharmacists, primarily due to the availability of other hospital-based immunizers, including nurses. However, hospital pharmacists contribute to improving vaccination rates through a variety of interventions and may also access the best possible medication history to determine an individual's vaccination status in screening for specific vaccine requirements.²⁷ Once the need for vaccination is identified, hospital pharmacists can provide education, facilitate vaccination through policy development and use of standing orders and/or participate in pharmacy-led programs for specific populations.²⁸⁻³³

With specific regard to influenza vaccination, US studies have shown increased coverage rates in jurisdictions where pharmacists can administer influenza vaccine, with an absolute (and sustained) increase ranging from 2.9% to 5%.^{25,34,35} Furthermore, a greater number of pharmacists per 1000 population are associated with higher odds of influenza vaccination.³⁶ This may be due to the accessibility of pharmacists in comparison to other vaccination providers. Notably, data from a large US-based pharmacy chain showed that one-third of all influenza vaccines were administered during "off-hours" (evenings, weekends and holidays).³⁷ In Canada, incorporating pharmacists into publicly funded influenza vaccination programs has led to a modest increase in overall vaccination rates, ranging from 2% to 6%, although longer-term sustainability remains to be demonstrated.^{38,39} Importantly, incorporating pharmacists into influenza vaccination programs has been found to

be cost-effective.⁴⁰ It is also noteworthy that Canadians are increasingly getting their annual influenza vaccination through pharmacies, with the 2017-2018 Seasonal Influenza Vaccine Coverage Survey reporting that of those who received an influenza vaccine, 34.2% were vaccinated in a pharmacy compared to 30.4% in a physician's office.⁴¹ As more provinces and territories enable pharmacists to vaccinate, this number can be expected to grow.

Limited studies have evaluated the impact of pharmacist provision of Td and/or Tdap. One US study (2014) found that Tdap vaccination rates of close contacts of neonates were increased under a coordinated pharmacy and hospital Tdap vaccination program.⁴² It is also expected that pharmacists have the potential to greatly improve Td and Tdap vaccination in adults, especially pregnant women and their families, who are often in pharmacies frequently (e.g., purchasing prenatal vitamins). Notably, in Canadian jurisdictions where pharmacists are unable to provide publicly funded Tdap vaccines to pregnant women, pharmacists can provide a referral to other providers (e.g., family practitioners) to help optimize Tdap vaccination rates.

In general, studies have not assessed the impact of pharmacist provision of vaccinations in under/unimmunized adults (e.g., with measles, mumps, rubella, meningococcal and polio vaccines). Most studies addressing these vaccines have been surveys of which vaccines pharmacists are administering and have found that pharmacists currently deliver at least some of

these vaccines.^{43,44} To help protect against outbreaks of measles in particular, pharmacists can play an important role in vaccine administration (in jurisdictions where injection authority includes MMR vaccines), or by referring patients to other immunizers, to increase overall measles vaccination coverage.

Pharmacist-administered routine vaccinations—Beyond influenza

Given that pharmacists are trusted and highly accessible vaccine providers, they have significant potential to affect routine vaccination rates and improve health outcomes. Pharmacists have the responsibility to provide immunizations and are ideally positioned to assess for the need for multiple routine vaccines, for example, during regular patient encounters, such as new prescriptions, medication reviews and influenza vaccine screening. Currently, pharmacy-based influenza vaccination programs are considered an unequivocal success—with pharmacists delivering over 34% of adult flu doses across Canada (according to 2018 survey data)—and research evidence supports vaccination by pharmacists to increase vaccine coverage rates.¹⁵ Building on this success and as the scope of pharmacy practice continues to expand, pharmacists have a tremendous opportunity to provide other routine vaccination services, with the goal of reducing additional infectious disease and complications through improved vaccine uptake. Future research is needed in this area in Canada. ■

From the College of Pharmacy and Faculty of Medicine, Dalhousie University; and the Canadian Center for Vaccinology, Halifax, Nova Scotia.
Contact jennifer.isenor@dal.ca.

Conflict of Interest Statement: The authors have received grant funding from the Dalhousie Pharmacy Endowment Fund, Drug Evaluation Alliance of Nova Scotia, Canadian Institutes of Health Research Canadian Immunization Research Network, the GSK group of companies and Sanofi Pasteur for unrelated pharmacists as immunizers-related projects. Susan Bowles has received honorarium from Rogers Publications as an author of unrelated immunization articles.

ORCID iD: Jennifer E. Isenor <https://orcid.org/0000-0003-1648-7362>

References

- Public Health Agency of Canada. *Immunization schedules by province and territory*. 2018. Available: <https://www.canada.ca/en/public-health/services/provincial-territorial-immunization-information.html?undefined&wbdisable=true> (accessed Mar. 8, 2019).
- Public Health Agency of Canada. *Provincial and territorial routine vaccination programs for healthy, previously immunized adults*. 2019. Available: <https://www.canada.ca/en/public-health/services/provincial-territorial-immunization-information/routine-vaccination-healthy-previously-immunized-adult.html> (accessed Mar. 9, 2019).
- Public Health Agency of Canada. *Canadian immunization guide: part 3—vaccination of specific populations*. 2018. Available: <https://www.canada.ca/en/public-health/services/publications/healthy-living/canadian-immunization-guide-part-3-vaccination-specific-populations/page-2-immunization-of-adults.html#p3c1t1> (accessed Mar. 8, 2019).
- Law MR, Dijkstra A, Douillard JA, Morgan SG. Geographic accessibility of community pharmacies in Ontario. *Healthc Policy* 2011;6(3): 36-46.
- Law MR, Heard D, Fisher J, Douillard J, Muzika G, Sketris IS. The geographic accessibility of pharmacies in Nova Scotia. *Can Pharm J (Ott)* 2013;146(1): 39-46.
- Eisenschmid P, Bates J. Pharmacists can do more to transform community health care. *The Hill Times* 2017.
- American Pharmacists Association. *Guidelines for pharmacy-based immunization advocacy*. 1997. Available: <https://www.pharmacist.com/guidelines-pharmacy-based-immunization-advocacy> (accessed Feb. 5, 2019).
- Isenor JE, Edwards NT, Alia TA, et al. Impact of pharmacists as immunizers on vaccination rates: a systematic review and meta-analysis. *Vaccine* 2016;34(47):5708-23.
- Bach AT, Goad JA. The role of community pharmacy-based vaccination in the USA: current practice and future directions. *Integr Pharm Res Pract* 2015;4:67-77.
- National Advisory Committee on Immunization. *Canadian Immunization Guide chapter on influenza and statement on seasonal influenza vaccine for 2018-2019*. 2018. Available: <https://www.canada.ca/content/dam/phac-aspc/>

- documents/services/publications/healthy-living/canadian-immunization-guide-statement-seasonal-influenza-vaccine-2018-2019/canadian-immunization-guide-statement-seasonal-influenza-vaccine-2018-2019.pdf (accessed Feb. 6, 2019).
11. Thomas RE, Lorenzetti DL. Interventions to increase influenza vaccination rates of those 60 years and older in the community. *Cochrane Database Syst Rev* 2018;5:CD005188.
12. Canadian Pharmacists Association. *Canadians recognize value of pharmacists; want more publicly funded health care services delivered at pharmacy*. 2018. Available: <https://www.pharmacists.ca/news-events/news/canadians-recognize-value-of-pharmacists-want-more-publicly-funded-health-care-services-delivered-at-pharmacy/> (accessed Feb. 28, 2019).
13. Isenor JE, Wagg AC, Bowles SK. Patient experiences with influenza immunizations administered by pharmacists. *Hum Vaccin Immunother* 2018;14(3):706-11.
14. Beresford SE, Crawshaw JP, Bowles SK, Isenor JE. The impact of pharmacists as immunizers in Collaborative cOmmunity Offsite Pharmacy Practice (CO-OPP Phase 1). *Can Pharm J (Ott)* 2017;151(1):29-32.
15. Papastergiou J, Folkins C, Li W, Zervas J. Community pharmacist-administered influenza immunization improves patient access to vaccination. *Can Pharm J (Ott)* 2014;147(6):359-65.
16. Public Health Agency of Canada. *Canadian immunization guide chapter on influenza and statement on seasonal influenza vaccine for 2019-2020*. Available: <https://www.canada.ca/en/public-health/services/publications/vaccines-immunization/canadian-immunization-guide-statement-seasonal-influenza-vaccine-2019-2020.html> (accessed Aug. 9, 2019).
17. Public Health Agency of Canada. *Canadian immunization guide: part 4—active vaccines—diphtheria toxoid*. 2016. Available: <https://www.canada.ca/en/public-health/services/publications/healthy-living/canadian-immunization-guide-part-4-active-vaccines/page-4-diphtheria-toxoid.html> (accessed Mar. 8, 2019).
18. Public Health Agency of Canada. *Canadian immunization guide: table of updates*. 2019. Available: <https://www.canada.ca/en/public-health/services/canadian-immunization-guide/updates.html#t2018> (accessed Mar. 8, 2019).
19. Picard A. *The biggest health threat in 2019? Fear of vaccination*. 2019. Available: <https://www.theglobeandmail.com/canada/article-the-biggest-health-threat-in-2019-fear-of-vaccination/> (accessed Sept. 3, 2019).
20. Public Health Agency of Canada. *Measles vaccine: Canadian immunization guide*. 2018. Available: <https://www.canada.ca/en/public-health/services/publications/healthy-living/canadian-immunization-guide-part-4-active-vaccines/page-12-measles-vaccine.html> (accessed Mar. 8, 2019).
21. Public Health Agency of Canada. *Canadian immunization guide—recommended immunization schedules*. 2018. Available: <https://www.canada.ca/en/public-health/services/publications/healthy-living/canadian-immunization-guide-part-1-key-immunization-information/page-13-recommended-immunization-schedules.html#p1c12a7> (accessed Mar. 8, 2019).
22. Public Health Agency of Canada. *Immunization schedules by province and territory*. 2018. Available: <https://www.canada.ca/en/public-health/services/provincial-territorial-immunization-information.html> (accessed Mar. 8, 2019).
23. Public Health Agency of Canada. *Canadian immunization guide: part 4—active vaccines—poliomyelitis vaccine*. 2015. Available: <https://www.canada.ca/en/public-health/services/publications/healthy-living/canadian-immunization-guide-part-4-active-vaccines/page-17-poliomyelitis-vaccine.html> (accessed Mar. 8, 2019).
24. Baroy J, Chung D, Frisch R, Apgar D, Slack MK. The impact of pharmacist immunization programs on adult immunization rates: a systematic review and meta-analysis. *J Am Pharm Assoc (2003)* 2016;56(4):418-26.
25. Drozd EM, Miller L, Johnsrud M. Impact of pharmacist immunization authority on seasonal influenza immunization rates across states. *Clin Ther* 2017;39(8):1563-80.e17.
26. Taitel M, Cohen E, Duncan I, Pegus C. Pharmacists as providers: targeting pneumococcal vaccinations to high risk populations. *Vaccine* 2011;29(45):8073-6.
27. Carter MK, Allin DM, Scott LA, Grauer D. Pharmacist-acquired medication histories in a university hospital emergency department. *Am J Health Syst Pharm* 2006;63(24):2500-3.
28. Andrawis MA, Rehm SJ. Health-system pharmacists' role in improving immunization rates. *Am J Health Syst Pharm* 2012;69(1):74-6.
29. Cohen V, Jellinek-Cohen SP, Likourezos A, et al. Feasibility of a pharmacy-based influenza immunization program in an academic emergency department. *Ann Pharmacother* 2013;47(11):1440-7.
30. Flemming H, Campbell S, Fry A, Isenor JE, Van Zoost C. Pharmacy-initiated immunizations in the emergency department-HaliVax PIIE. *Can Pharm J (Ott)* 2018;151(2):98-101.
31. Meier-Stephenson V, McNeil S, Kew A, Sweetapple J, Thompson K, Slayter K. Effects of a pharmacy-driven perisplenectomy vaccination program on vaccination rates and adherence to guidelines. *Can J Hosp Pharm* 2014;67(4):262-7.
32. Queeno BV. Evaluation of inpatient influenza and pneumococcal vaccination acceptance rates with pharmacist education. *J Pharm Pract* 2017;30(2):202-8.
33. Robke JT, Woods M. A decade of experience with an inpatient pneumococcal vaccination program. *Am J Health Syst Pharm* 2010;67(2):148-52.
34. Grabenstein JD, Guess HA, Hartzema AG, Koch GG, Konrad TR. Effect of vaccination by community pharmacists among adult prescription recipients. *Med Care* 2001;39(4):340-8.
35. Steyer TE, Ragucci KR, Pearson WS, Mainous AG III. The role of pharmacists in the delivery of influenza vaccinations. *Vaccine* 2004;22(8):1001-6.
36. Gai Y, Feng L. Relationship between pharmacist density and adult influenza vaccination after controlling for individual and neighborhood effects. *J Am Pharm Assoc (2003)* 2017;57(4):474-82.e12.
37. Goad JA, Taitel MS, Fensterheim LE, Cannon AE. Vaccinations administered during off-clinic hours at a national community pharmacy: implications for increasing patient access and convenience. *Ann Fam Med* 2013;11(5):429-36.
38. Isenor JE, O'Reilly BA, Bowles SK. Evaluation of the impact of immunization policies, including the addition of pharmacists as immunizers, on influenza vaccination coverage in Nova Scotia, Canada: 2006 to 2016. *BMC Public Health* 2018;18(1):787.
39. Buchan SA, Rosella LC, Finkelstein M, et al. Impact of pharmacist administration of influenza vaccines on uptake in Canada. *CMAJ* 2017;189(4):E146-52.
40. O'Reilly DJ, Blackhouse G, Burns S, et al. Economic analysis of pharmacist-administered influenza vaccines in Ontario, Canada. *Clinicoecon Outcomes Res* 2018;10:655-63.
41. Public Health Agency of Canada. *Seasonal influenza vaccine coverage in Canada, 2017-2018*. Available: <http://publications.gc.ca/site/eng/9.866647/publication.html> (accessed Jul. 3, 2019).
42. Mills B, Fensterheim L, Taitel M, Cannon A. Pharmacist-led Tdap vaccination of close contacts of neonates in a women's hospital. *Vaccine* 2014;32(4):521-5.
43. Isenor JE, Slayter KL, Halperin DM, Mcneil SA, Bowles SK. Pharmacists' immunization experiences, beliefs and attitudes in New Brunswick, Canada. *Pharm Pract (Granada)* 2018;16(4):1310.
44. Islam JY, Gruber JF, Lockhart A, et al. Opportunities and challenges of adolescent and adult vaccination administration within pharmacies in the United States. *Biomed Inform Insights* 2017;9:1178222617692538.