

A scoping review on factors associated with influenza and pneumococcal vaccination coverage in Canadian adults with chronic upper respiratory illnesses

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10 On behalf of Immunize Canada Respiratory Working Group to increase vaccinations rates in
11 adults with respiratory issues.
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20 **Abstract**

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22 illnesses, as well as the factors influencing these rates. While rates varied greatly, and accurate
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32 **Key words**

33 vaccination, influenza, pneumococcal, immunization, respiratory
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Introduction

In Canada, the vaccination of adults for influenza and pneumococcal disease is a public health priority. A specific priority is the vaccination of adults with chronic respiratory illness (i.e., asthma and chronic obstructive pulmonary disease (COPD)), who are at high risk of complications and hospitalization. There are currently more than 3.8 million Canadians living with asthma and 2 million living with COPD¹. Along with other respiratory illnesses such as pulmonary hypertension, interstitial lung disease, and cystic fibrosis, these chronic illnesses have tremendous impact on the lives of Canadians and on healthcare. Canadian Institute for Health Information² recently released data from 2016-2017 outlining the most expensive health conditions in Canada. COPD ranked # 1 with annual hospital costs of \$753.3 M, and viral/unspecified pneumonia #3 costing \$505.8 M.

Adults living with COPD or asthma are more likely to acquire influenza, especially if they are being treated with corticosteroids, and once infected, they have a higher likelihood of experiencing respiratory exacerbations³.

For these reasons, both influenza and pneumococcal vaccinations are widely recommended by the National Advisory Committee on Immunization (NACI)⁴, but despite this, vaccine uptake in adults with chronic respiratory illnesses remains suboptimal⁵. Examining the reasons for this is important for implementing strategies to improve vaccination coverage. At present, little is known about the factors that impact vaccination choices in this population. We undertook a scoping review to examine vaccination coverage in adults with chronic respiratory illnesses, as well as the knowledge, attitudes and barriers to vaccination in this population. As the research area is relatively narrow and has not previously been covered by a literature review within Canada, a scoping review allows for the examination of any evidence that does exist as well as the development of future directions for immunization and respiratory illness research within Canada.

Methods

A literature search was completed from 1980 to the present using research databases including Pubmed, Science Director, and Google Scholar. This scoping review following the methodological framework developed by Arksey and O'Malley⁶ was conducted to answer two questions.

Question 1: *What is known from the existing literature about immunization coverage in Canadian adults with respiratory diseases?* To answer this question, we used the following combination of keywords to search each database: [adult, young adult, older adults, seniors] + [respiratory illness, respiratory disorder + terms above] + [immunization coverage, vaccination coverage, immunization, vaccination] + [Canada]).

Question 2: *What is known about the knowledge, attitudes, behaviours, and barriers to influenza and pneumococcal vaccination in adults with chronic upper respiratory illnesses?* The following combination of keywords were used to search each database: [adult, young adult, older adults, seniors] + [respiratory illness, respiratory disorder + terms above] + [influenza vaccine, influenza immunization, pneumococcal vaccine, pneumococcal immunization] + [knowledge, attitudes, behaviour, barriers].

Excluded from the study were papers that focused on patient populations without respiratory illnesses, non-human populations or did not collect information about vaccine uptake or factors impacting it.

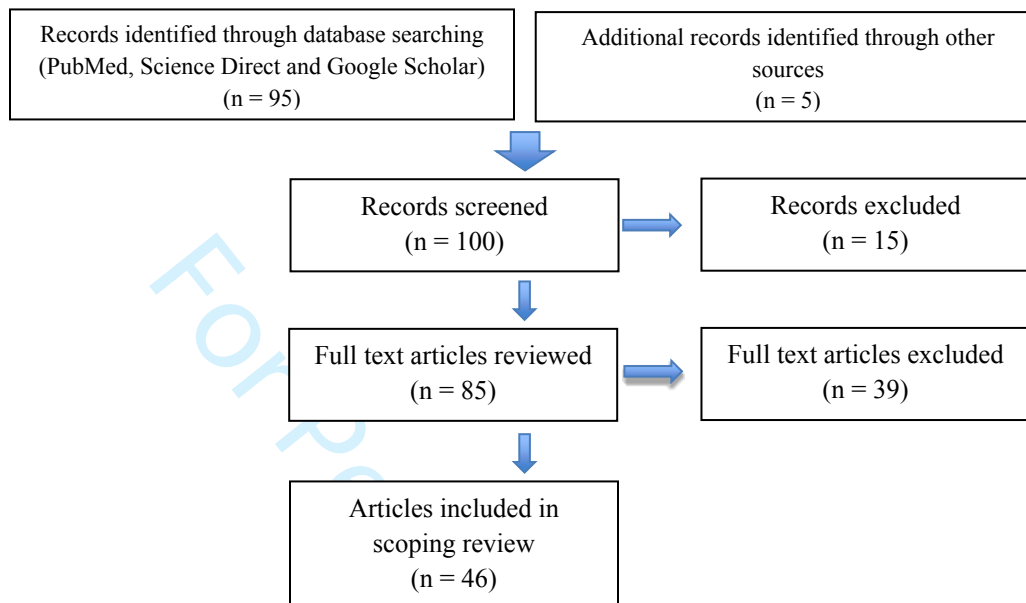


Figure 1 - Flow chart of search results

From each article, the citation information was recorded, as was the age group studied, the country the study took place in, the respiratory disorder targeted, and type of vaccine used. For question 1, reported vaccination rates were recorded. For question 2, any factors mentioned that influenced vaccine uptake were recorded.

Results

In order to analyze vaccination rates, results were separated into Canadian research, American research and international research. These areas will be discussed in order.

Canadian studies:

There were six studies that included vaccination rates for Canadians with respiratory illnesses. Three of them addressed the seasonal influenza vaccine (Baron 2018⁷, Bourbeau 2008⁸, and Vozoris 2009⁹), two the pneumococcal vaccine (Kreuger 2010¹⁰ and Okapuu 2014¹¹) and one included information on both the seasonal influenza and the pneumococcal vaccine (Parkins 2009¹²).

Vaccination rates for these vaccines in individuals with respiratory illnesses ranged from 36.3% to 92.3%, depending on the type of vaccine, age of the individual, the province of residence and their respiratory diagnosis. In the study published by Baron et al., a Quebec population with respiratory illnesses self-reported seasonal influenza vaccination rates of 54.9%. The study by Bourbeau et al. found that COPD patients in Quebec and Ontario who had regular contact with their physician had vaccination rates of 80% for seasonal influenza, as reported by their primary doctors. Vozoris et al. used information from the 2003 Statistics Canada Community Health

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3 Survey to report that 36.3% of adults with asthma received the influenza vaccine, and 47.9% of
4 those with COPD.
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7 The study by Krueger et al. found that 60.4% of patients with respiratory illnesses, interviewed
8 in Brant County, Ontario were vaccinated for pneumococcal pneumonia, with the highest rates in
9 patients with emphysema (92.3%). The paper by Okapuu et al. estimated lower (65%) rates of
10 pneumococcal vaccination in Quebec for adult patients with asthma, previously published data
11 and incidence rates. Parkins et al. reported a 55% pneumococcal coverage rate for adults in
12 Toronto with respiratory comorbidities, and then examined influenza vaccine coverage in adults
13 by age and the presence of comorbidities. Those under 65 with comorbidities for whom the
14 NACI guidelines recommends vaccination were vaccinated in 38% of cases, and adults over 75
15 with the same comorbidities, were vaccinated 75% of the time. Despite the difficulty obtaining
16 accurate vaccination data across different risk groups, it is clear that Canada is not reaching the
17 recommended level of 75% vaccinated in at-risk groups.
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20 **US studies:**

21 There were five US studies which included coverage data for the seasonal influenza vaccine in
22 patients with respiratory illnesses (Arabyat 2018¹³, Gu 2010¹⁴, Lu 2017¹⁵, Machado 2018¹⁶ and
23 Mulpuru 2019¹⁷). These rates ranged from 26% to 53%, depending on patient age patient,
24 insurance coverage and type of respiratory illness.
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27 **International studies:**

28 There were four international studies that included vaccination rates. Ireland's vaccination rate
29 ranged from 19% to 36% (Giese 2019¹⁸), Finland has reported a rate of 58% (Honkanen 1996¹⁹),
30 Spain of 49% in patients with asthma and 77% in patients with COPD (Santos-Sancho 2012²⁰)
31 and China 31% in adults under 65 and 80% in adults over 65 with COPD (Shin 2017²¹).
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34 A similar approach was taken when looking at factors that influence vaccination rate. Six studies
35 that examined only Canadian data were included (Boerner 2013²², Farmanara 2018²³, Guthrie
36 2017²⁴, Lechelt 2013²⁵, Pei 2014²⁶ and Roy 2018²⁷), and the results of these studies are reported
37 below. Figure 2 examines the predictors of vaccine uptake, and figure 3 examines the strategies
38 recommended to increase vaccine uptake. A detailed chart detailing the predictors and
39 recommendations found in each study can be found in Appendix 2.
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Predictors of vaccine uptake in Canadian studies

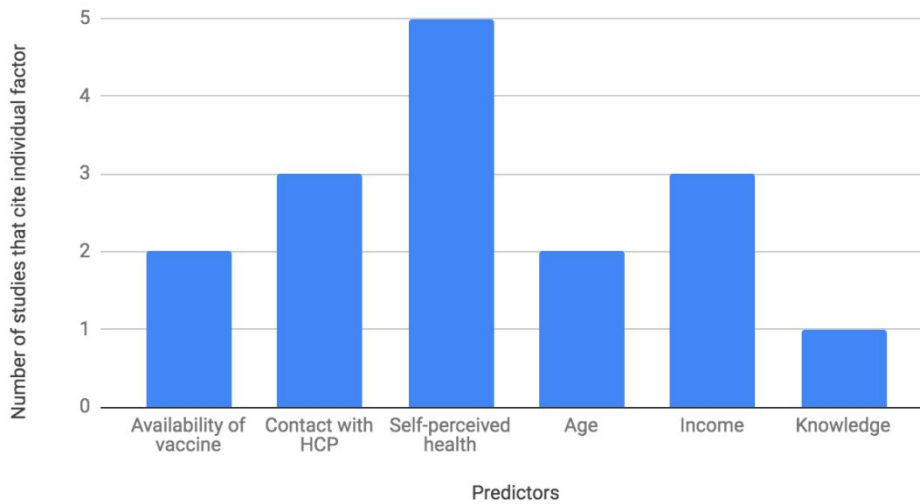


Figure 2. Predictors of vaccine uptake in Canadian studies

Strategies to increase vaccine uptake in Canadian studies

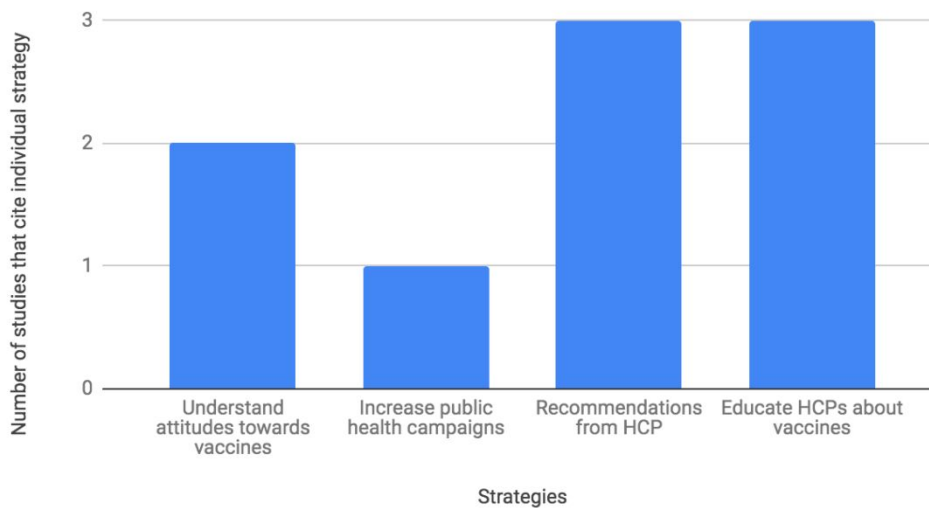


Figure 3. Strategies to increase vaccine uptake in Canadian studies

There was only one American study which reported on factors influencing vaccination. Older age, health insurance and access to health care, non-smoking status, health care provider (HCP) recommendations and severity of respiratory disease impacted vaccine uptake, suggesting that HCPs see every patient contact as a chance to vaccinate these populations (Lu 2015²⁸).

Internationally, there were 12 studies examining factors influencing vaccine uptake (Jiménez-García 2010²⁹, Bodeker 2015³⁰, Cheung 2016³¹, Chung 2018³², Geneev 2018³³, Jiménez-García 2009³⁴, Mangtani 2006³⁵, Palache 2014³⁶, Santos-Sancho 2012²⁰, Shin 2017²¹, and Siriwardena 2003³⁷). The results of these studies are discussed in the graphs below. Figure 4 examines factors that influence vaccine uptake, and figure 5 examines strategies recommended to increase uptake.

A detailed chart listing the predictors and recommendations found in each study can be found in Appendix 3.

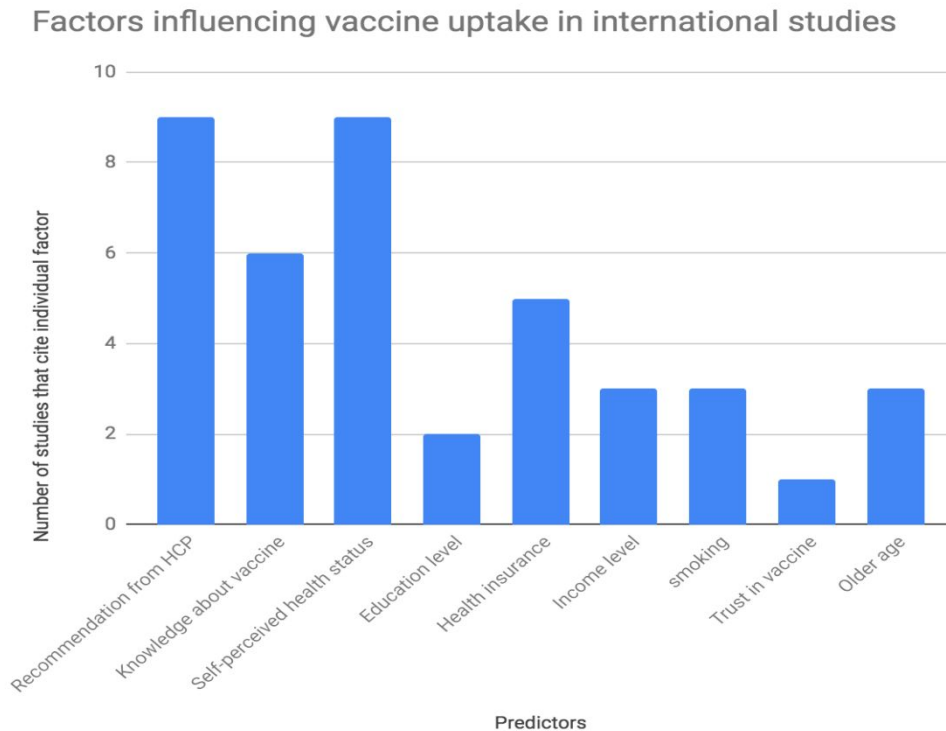


Figure 4. Factors influencing vaccine uptake in international studies

Strategies to increase vaccine uptake in international studies

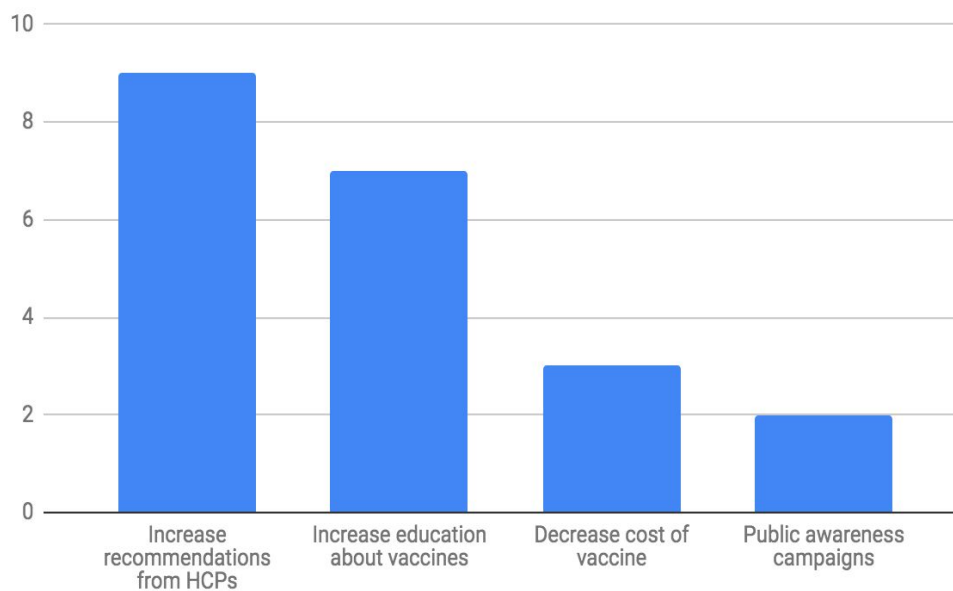


Figure 5. Strategies to increase vaccine uptake in international studies

Discussion

In Canada, there is a dearth of knowledge about the rate of vaccination in patients with respiratory illnesses. The few studies that included specific uptake rates ranged widely, and there is a need for further research that separates vaccine uptake by respiratory illness. However, it is clear in the few studies that do address vaccine uptake that the vaccination rates are below the ideal level of 75%, and that many individuals with respiratory illnesses are not receiving vaccinations. Internationally, this trend continues, with even lower rates of vaccination.

The factors that influenced the decision to get vaccinated in populations with respiratory diseases were fairly similar across different countries. In each Canadian study, vaccine uptake increased as self-perceived health declined. Another factor mentioned in each study was contact with HCPs - the more contact each patient had with their HCP, the more likely they were to be vaccinated. This was a consistent factor in each study, regardless of the type of vaccine or respiratory disease. In the American studies, both of those factors were present, but an additional factor identified was financial. Income level and health insurance status were highly correlated with the likelihood of vaccination.

Internationally, physician contact was the most common factor influencing vaccine uptake, as did self-perceived health status, financial ability to access the vaccine, age, and smoking status. Ex-smokers were the most likely to be vaccinated, and current smokers the least likely. In countries with free vaccine access, income level was not related to vaccine uptake. However, when vaccine access required out of pocket payment, vaccine uptake was related to income level and access to health insurance. Ensuring that vaccination is covered by public programs for all patients with respiratory illnesses, and that financial barriers such as travel costs are covered should also help to increase rates of vaccination.

Given that one of the most impactful factors influencing vaccination is contact with a HCP who recommended vaccination, increased education of HCPs on the importance of vaccination in those with respiratory illnesses, and of scheduling visits with high-risk patients to discuss vaccination should improve this situation.

In one example from a Spanish study published by Santos-Sancho et al., the introduction of multi-component public health campaigns that include free access to vaccinations, mass media campaigns that increase comfort and knowledge about vaccines in high-risk populations, and education of HCPs that increased their promotion of vaccines to high-risk patients successfully raised their vaccination rate from 66% before the campaign to 77% in patients with COPD. This aligned them with the WHO's recommended vaccination rate of 75%, and supports the idea that the combination of education programs aimed at patients with respiratory illnesses and increased direct recommendations from HCPs are an effective way to boost vaccine uptake in at-risk populations. Multi-component public education campaigns such as this could be effective in Canada.

Future Recommendations

While this scoping review gave an overview of factors impacting vaccine uptake, as well as an overview of the current strategies used to increase vaccine uptake, a complete understanding of routine vaccinations in patients with respiratory illness was limited by insufficient data. Future

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3 research should focus on targeting this population in order to understand the factors that
4 influence their decision to receive or not receive vaccinations, as well as the implications for
5 public health programs.
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8 The information gathered in this review can facilitate the development of more collaborative
9 efforts among groups of Canadian national organizations representing physicians and other
10 HCPs, patients, educators, policy makers and governments who can work together to improve
11 vaccination coverage in adults affected by respiratory disorders. As HCP recommendation has
12 emerged as the single most important factor influencing rates of vaccination, education and new
13 vaccination guidelines should be targeted towards HCPs to encourage further recommendations.
14 However, as many patients with respiratory illnesses may not come into contact with their
15 physicians enough to receive recommendations, efforts should also encourage proactive
16 communication from physicians to these patients, such as letters or phone calls, advising them to
17 come in and receive their vaccinations. As well, similar efforts can target pharmacists, who are
18 able to provide vaccines as well. Public health campaigns aimed towards educating patients
19 about the need to vaccinate as well as the safety and effectiveness of vaccination could increase
20 their comfort with vaccination and the likelihood that they'll ask their physicians or pharmacists
21 about receiving the vaccination.
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25 In closing, further research is necessary to understand the prevalence of vaccination within
26 populations with respiratory illnesses, and efforts should be focused on both patient and
27 physician education for maximum impact.
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31 review. The authors report no conflict of interests.
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Appendix 1: Reported Vaccination Rates

Citation	Geographic Area	Reported Vaccination Rate
Arabyat (2018) ¹³	US	<ul style="list-style-type: none"> • 53% (flu)
Baron (2018) ⁷	Canada - QC	<ul style="list-style-type: none"> • 57%
Bourbeau (2008) ⁸	Canada - QC and ON	<ul style="list-style-type: none"> • 80-85% (flu)
Giese (2019) ¹⁸	Ireland	<ul style="list-style-type: none"> • 23% asthma • 19% respiratory • 36% 'lung disease'
Gu (2010) ¹⁴	US	<ul style="list-style-type: none"> • 52% insurance • 18% no insurance
Honkanen (1996) ¹⁹	Finland	<ul style="list-style-type: none"> • 58%
Krueger (2010) ¹⁰	Ontario	<ul style="list-style-type: none"> • 78.3% chronic bronchitis • 67.6% asthma • 92.3% emphysema
Lu (2017) ¹⁵	US	<ul style="list-style-type: none"> • 28.3% adolescents
Machado (2018) ¹⁶	US	<ul style="list-style-type: none"> • 26.6% respiratory – repeatedly vaccinated • 22.1% respiratory – occasionally vaccinated
Mulpuru (2019) ¹⁷	US	<ul style="list-style-type: none"> • 48% with flu, • 65% without flu
Okapuu (2014) ¹¹	Quebec	<ul style="list-style-type: none"> • 45-95%
Parkins (2009) ¹²	Canada	<ul style="list-style-type: none"> • 75% over 65 years of age • 38% under 65 years of age (flu) • 14% under 65 years of age • 55% over 65 years of age (pneumococcal)
Santos-Sanchez (2012) ²⁰	Spanish	<ul style="list-style-type: none"> • 49.40%
Shin (2017) ²¹	China	<ul style="list-style-type: none"> • 31% under 65 years of age • 80% over 65 years of age
Vozoris (2009) ⁹	Canada	<ul style="list-style-type: none"> • 48%

Appendix 2: Canadian Studies Addressing Predictors and Strategies to Increase Vaccination

Citation	Age	Disorders	Vaccine	Predictors	Strategies
Boerner (2013) ²²	Adults	All	H1N1	<ul style="list-style-type: none"> Roll out and availability of vaccine HCP access Media and public discourse personal risk perception and family risk perception 	<ul style="list-style-type: none"> understand habitual vaccine behaviours increase effective public health communication teach at-risk patients about the illness and about vaccines, preferably from an HCP
Farmanara (2018) ²³	Adults	All	influenza	<ul style="list-style-type: none"> Age Income Personal belief about vaccine Self-described health status 	<ul style="list-style-type: none"> HCP education about effectiveness and who needs the vaccine
Guthrie (2017) ²⁴	Adults	Asthma	Seasonal influenza	<ul style="list-style-type: none"> Self-described health status Knowledge about danger of influenza 	<ul style="list-style-type: none"> HCP education about asthma and influenza, importance of vaccine
Lechelt (2013) ²⁵	Elderly	All	H1N1	<ul style="list-style-type: none"> Perception of own health and health of others in their family influence of HCP past use of vaccines 	<ul style="list-style-type: none"> HCP should understand the perceived health of patient as well as immune status of the family when recommending vaccine
Pei (2014) ²⁶	Adults	All	influenza	<ul style="list-style-type: none"> Self-perceived health status Financial access Risky behaviour such as smoking or drinking HCP access 	<ul style="list-style-type: none"> Increase contact with HCP
Roy (2018) ²⁷	Adults	Chronic Respiratory Disorders	influenza	<ul style="list-style-type: none"> Age Gender Income Education level HCP access Perceived severity of illness 	<ul style="list-style-type: none"> Increase education from HCP

Appendix 3: International Studies Addressing Predictors and Strategies to Increase Vaccination

Citation	Geographic Area	Population	Disorder	Vaccine	Predictors	Strategies
Akturk (2017) ³⁸	Turkey	Adults	COPD	Influenza and pneumococcal	<ul style="list-style-type: none"> • recommendation from doctor • amount of knowledge • comorbidities • higher education • access to health insurance 	<ul style="list-style-type: none"> • train doctors to present information about vaccines and recommend vaccines to vulnerable patients
Bodeker (2015) ³⁰	Germany	Older adults	Underlying chronic disease	influenza	<ul style="list-style-type: none"> • self-perceived health • trust in vaccines • knowledge about flu 	<ul style="list-style-type: none"> • provide easy access information, especially on side effects and potential complications, preferably from their physician
Cheung (2016) ³¹	Hong Kong	Adults	Chronic respiratory disorders	Influenza	<ul style="list-style-type: none"> • non-smoking status • contact with HCP 	<ul style="list-style-type: none"> • increase understanding of risk • increase psychological flexibility
Chung (2018) ³²	South Korea	Adults	asthma	influenza	<ul style="list-style-type: none"> • age • self-perceived health • contact with HCP • health insurance • education about side effects 	<ul style="list-style-type: none"> • none
Geneev (2018) ³³	India	Adults	T2DM	All vaccines against respiratory illness	<ul style="list-style-type: none"> • financial access • lack of knowledge about vaccine 	<ul style="list-style-type: none"> • address costs • increase HCP awareness of vaccine and ability to educate patients on vaccine
Jiménez-García (2009) ³⁴	Spain	Adults	Chronic bronchitis	influenza	<ul style="list-style-type: none"> • older age • non or ex-smokers • chronic illnesses other than chronic bronchitis • visit to HCP in last thirty days (recommendation from HCP most impactful) 	<ul style="list-style-type: none"> • HCP suggest vaccine to at-risk groups, along with education campaigns targeted towards patients to increase knowledge of safety, efficacy, and benefits of vaccine
Jiménez-García (2010) ²⁹	Spain	Children and adults	asthma	influenza	<ul style="list-style-type: none"> • higher education level • higher income • smoking status • negative view of own health • HCP contact 	<ul style="list-style-type: none"> • teach HCPs to educate patients about the vaccine
Palache (2014) ³⁶	International	All ages	'Non communicable diseases'	influenza	<ul style="list-style-type: none"> • more likely to be vaccinated if aware of scientific evidence for vaccine 	<ul style="list-style-type: none"> • financial access to vaccines using awareness campaigns that are multicomponent and target areas that high risk

Citation	Geographic Area	Population	Disorder	Vaccine	Predictors	Strategies
					<ul style="list-style-type: none"> positive attitude towards vaccines in general 	<p>patients are in primary or tertiary care centers</p> <ul style="list-style-type: none"> target HCPs by including vaccination within guidelines for treating chronic disease so HCPs are able to advocate for vaccines in their patients
Santos-Sancho (2012) ²⁰	Spain	Adults	COPD	influenza	<ul style="list-style-type: none"> self-perceived health access to vaccine GP contact 	<ul style="list-style-type: none"> public health campaigns that provide free vaccinations effective promotion of vaccines by HCPs to at-risk patients mass media campaigns that target at-risk patients to increase their comfort and knowledge surrounding the vaccines
Shin (2017) ²¹	Korea	Adults	COPD	influenza	<ul style="list-style-type: none"> older age free access to vaccine contact with HCPs stable marriages self-perceived health 	<ul style="list-style-type: none"> public health campaign targeting at-risk groups, telling them to see their HCP more often and increasing knowledge about vaccine
Siriwardena (2003) ³⁷	UK	Older adults	High risk groups	Influenza and pneumococcal	<ul style="list-style-type: none"> lack of knowledge attitude of both patient and HCP negative views on vaccines perception of risk from both vaccine and illness 	<ul style="list-style-type: none"> direct education to teams of HCPs that used vaccine uptake rates as an outcome measure/performance measure education about scientific evidence around vaccines, at-risk groups appropriate education strategies for patients increased HCP recommendation to patients direct recommendation from HCP increased uptake

References

1. Public Health Agency of Canada. Report from the Canadian Chronic Disease Surveillance System. Asthma and Chronic Obstructive Pulmonary Disease (COPD) in Canada, 2018. Report cited 2019 July. Available at: <https://www.canada.ca/en/public-health/services/publications/diseases-conditions/asthma-chronic-obstructive-pulmonary-disease-canada-2018.html#ref>.
2. Canadian Institute for Health Information. Which health conditions are the most expensive in 2016-17? Canadian MIS Database and Discharge Abstract Database, Canadian Institute for Health Information website cited 2019 July. Available at: <https://www.cihi.ca/en/which-health-conditions-are-the-most-expensive>.
3. Rothbarth PH, Kempen BM, Sprenger MJ. Sense and nonsense of influenza vaccination in asthma and chronic obstructive pulmonary disease. *Am J Respir Crit Care Med*. 1995;151(5):1682-5.
4. Public Health Agency of Canada. National Advisory Committee on Immunization webpage cited 2019 July. Available at <https://www.canada.ca/en/public-health/services/immunization/national-advisory-committee-on-immunization-naci.html>
5. Buchan SA, Kwong JC. Influenza immunization among Canadian Health Care personnel: a cross-sectional study. *CMAJ*. 2016;4(3):479-488.
6. Arskey H, O'Malley L. Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology*. 2005;8(1):19-32.
7. Baron G, Gosselin V, Petit G, et al. Determinants of influenza vaccination among a large adult population in Quebec. *Human Vaccines & Immunotherapeutics*. 2018 14(11): 2722-2727.
8. Bourbeau J, Sebaldt RJ, Day A, Bouchard J, et al. Practice patterns in the management of chronic obstructive pulmonary disease in primary practice : The CAGE study. *Can Respir J*. 2008;15(1):13-9.
9. Vozoris NT, Loughheed MD. Influenza vaccination among Canadians with chronic respiratory disease. *Respir Med*. 2009;103(1):50-8.
10. Krueger P, St. Amant O, Loeb M. Predictors of pneumococcal vaccination among older adults with pneumonia : findings from the Community Acquired Pneumonia Impact Study. *BMC Geriatr*. 2010;10:44.
11. Okapuu JM, Chétrit E, Lefebvre B. How many individuals with asthma need to be vaccinated to prevent one case of invasive pneumococcal disease? *Can J Infect Dis Med Microbiol*. 2014;25(3):147-50.
12. Parkins MD, McNeil SA, Laupland KB. Routine immunization of adults in Canada: Review of the epidemiology of vaccine-preventable diseases and current recommendations for primary prevention. *Can J Infect Dis Med Microbiol*. 2009;20(3):e81-90. 20(3).
13. Arabyat RM, Raisch DW, Bakhireva L. Influenza vaccination for patients with chronic obstructive pulmonary disease: Implications for pharmacists. *Research in Social and Administrative Pharmacy*. 2018;14(2):162-169.
14. Gu Q, Sood N. Do People Taking Flu Vaccines Need Them the Most? *PLOS ONE*. 2011;6(12):e26347.
15. Lu PJ, O'Halloran A, Kennedy ED, et al. Awareness among adults of vaccine-preventable diseases and recommended vaccinations, United States, 2015. *Vaccine*. 2017;35(23):3104-3115.

16. Machado A, Kislaya I, João AJ, et al. Factors associated to repeated influenza vaccination in the Portuguese adults with chronic conditions. *Vaccine*. 2018;36(35):5265-5272
17. Mulpuru S, Li L, Ye L, et al. Effectiveness of Influenza Vaccination on Hospitalizations and Risk Factors for Severe Outcomes in Hospitalized Patients With COPD. *CHEST*. 2019;155(1):69–78.
18. Giese C, Mereckiene J, Danis K, et al. Low vaccination coverage for seasonal influenza and pneumococcal disease among adults at-risk and health care workers in Ireland, 2013: The key role of GPs in recommending vaccination. *Vaccine*. 2016;34(32):3657-3662.
19. Honkanen PO, Keistinen T, Kivela SL. Factors associated with influenza vaccination coverage among the elderly: role of health care personnel. *Public Health*. 1996;110(3):163-168.
20. Santos-Sancho JM, Jimenez-Trujillo I, Hernández-Barrera V, et al. Influenza vaccination coverage and uptake predictors among Spanish adults suffering COPD. *Human Vaccines & Immunotherapeutics*. 2012;8(7): 938-945.
21. Shin HY, Hwang HJ, Chung JH. Factors Influencing Influenza Vaccination Among Patients With Chronic Obstructive Pulmonary Disease : A Population-Based Cross-sectional Study. *Asia Pacific Journal of Public Health*. 2017;29(7):560-568.
22. Boerner F, Keelan J, Winton L, et al. Understanding the interplay of factors informing vaccination behavior in three Canadian provinces. *Human Vaccines & Immunotherapeutics*. 2013;9(7):1477-1484.
23. Farmanara N, Sherrard L, Dubé È, et al. Determinants of non-vaccination against seasonal influenza in Canadian adults : findings from the 2015 – 2016 Influenza Immunization Coverage Survey. *Can J Public Health*. 2018;109(3):369-378.
24. Guthrie JL, Fisman D, Gardy JL. Self-rated health and reasons for non- vaccination against seasonal influenza in Canadian adults with asthma. *PLOS ONE*. 2017;12(2): e0172117.
25. Lechelt LA. Information vulnerability in seniors and its influence on H1N1 influenza vaccine uptake - 2013. University of Alberta Centre for Health Promotion Studies website. Report cited 2019 July. Available at: <https://era.library.ualberta.ca/items/6d143f95-2d37-443a-bb32-2bbd0e89cc1e>.
26. Pei BY. What influences the influenza vaccination rate of Canadians - 2014? University of Ottawa Department of Economics website. Report cited 2019 July. Available at https://ruor.uottawa.ca/bitstream/10393/31616/1/Pei_Yi_researchpaper.pdf.
27. Roy M, Sherrard L, Dubé È, et al. Determinants of non-vaccination against seasonal influenza. *Health Rep*. 2018;29(10):12-22.
28. Lu P, O'Halloran A, Ding H, et al. Uptake of Influenza Vaccination and Missed Opportunities Among Adults with High-Risk. *The American Journal of Medicine*. 2015;129(6):636.e1-636.e11.
29. Jiménez-García R, Hernández-Barrera V, Carrasco-Garrido P, et al. Coverage and Predictors of Adherence to Influenza Vaccination among Spanish Children and Adults with Asthma. *Infection*. 2010;38(1):52-7.
30. Bödeker B, Remschmidt C, Schmich P, et al. (2015). Why are older adults and individuals with underlying chronic diseases in Germany not vaccinated against flu ? A population-based study. *BMC Public Health* 2015;618:1–10.
31. Cheung KW, Mak YW. Association between Psychological Flexibility and Health Beliefs in the Uptake of Influenza Vaccination among People with Chronic Respiratory Diseases in Hong Kong. *Int. J. Environ. Res. Public Health* 2016;13(2):155.

32. Chung JH, Kim TH, Han CH. Factors influencing influenza vaccination among South Korean adult asthma patients : A nationwide population-based cross-sectional study patients : A nationwide population-based cross-sectional study. *Journal of Asthma*. 2018;55(3):294–299.
33. Geneev C, Mathew N, Jacob JJ. Vaccination Status , Knowledge, and Acceptance of Adult Vaccinations against Respiratory Illness among Patients with Type 2 Diabetes Mellitus. *Indian J Endocrinol Metab*. 2018;22(2):280-282.
34. Jiménez-García R, Hernández-Barrera V R, Carrasco-Garrido P, et al. Predictors of influenza vaccination in adults with chronic bronchitis. *Respiratory Medicine*. 2009;103(10):1518-1525.
35. Mangtani P, Breeze E, Stirling S, et al. (2006). Cross-sectional survey of older peoples' views related to influenza vaccine uptake. *BMC Public Health* 2006;6,249:1–7.
36. Palache A, Tainijoki-Seyer J, Collins T. The Link between Seasonal Influenza and NCDs : Strategies for Improving Vaccination Coverage. *Health*. 2014;6(19):2724–2735
37. Siriwardena AN. The impact of educational interventions on influenza and pneumococcal vaccination rates in primary care – 2003. University of Lincoln, College of Social Science, School of Health & Social Care website. Report cited July 2019. Available at: <http://eprints.lincoln.ac.uk/2345/>.
38. Aktürk ÜA, Dilektaşlı AG, Şengül A, et al. Influenza and Pneumonia Vaccination Rates and Factors Affecting Vaccination among Patients with Chronic Obstructive Pulmonary Disease. *Balkan Med J*. 2017;5;34(3):206-211.
39. Chen Y, Yi QL, Wu J, et al. Chronic disease status, self-perceived health and hospital admissions are important predictors for having a flu shot in Canada. *Vaccine*. 2007;25(42): 7436-7440.
40. Chiu APY, Dushoff J, Yu D, et al. International Journal of Infectious Diseases Patterns of influenza vaccination coverage in the United States from 2009 to 2015. *International Journal of Infectious Diseases*. 2017;65:122–127.
41. Kandeil W, Atanasov P, Avramioti D, et al. Expert Review of Vaccines The burden of pertussis in older adults : what is the role of vaccination? A systematic literature review. *Expert Review of Vaccines*. 2019;18(5):439–455.
42. Khader, AKA. Vaccines in Chronic Respiratory Diseases, *Pulmon*, 2013;15(3):7–10.
43. Kim S, Hughes CA, Sadowski CA. A review of acute care interventions to improve inpatient pneumococcal vaccination. *Preventive Medicine*. 2014;67:119–127.
44. Kwong JC, Maaten S, Ross EG, et al. The Effect of Universal Influenza Immunization on Antibiotic Prescriptions: An Ecological Study. *Clinical Infectious Diseases*. 2009;49(5):750–756.
45. Leblanc JJ, ElSherif M, Ye L, et al. Burden of vaccine-preventable pneumococcal disease in hospitalized adults : A Canadian Immunization Research Network (CIRN) Serious Outcomes Surveillance (SOS) network study. *Vaccine*. 2017;35(29):3647–3654.
46. Lu PJ, Gonzalez-Feliciano A, Ding H, et al. Influenza A (H1N1) 2009 monovalent and seasonal influenza vaccination among adults 25 to 64 years of age with high-risk conditions—United States, 2010. *American Journal of Infection Control*. 2013;41(8):702–709.
47. Ogilvie I, El Khoury A, Cui Y, et al. Cost-effectiveness of pneumococcal polysaccharide vaccination in adults : A systematic review of conclusions and assumptions. *Vaccine*. 2009;27(36):4891–4904.

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48. Schwarze J, Openshaw P, Jha ASR, et al. Influenza burden, prevention, and treatment in asthma - A scoping review by the EAACI Influenza in asthma task force. *Allergy*. 2018;73(6):1151-1181.
 49. Polisena J, Chen Y, Manuel D. The proportion of influenza vaccination in Ontario, Canada in 2007/2008 compared with other provinces. *Vaccine*. 2012;30(11):1981-1985.
 50. Rudnick W, Liu Z, Shigayeva A, et al. Pneumococcal vaccination programs and the burden of invasive pneumococcal disease in Ontario, Canada, 1995-2011. *Vaccine*. 2013;31(49):5863-5871.
 51. Schaffner W, Chen WH, Hopkins RH, et al. Effective Immunization of Older Adults Against Seasonal Influenza. *The American Journal of Medicine*. 2018;131(8):865-873.
 52. Sehatzadeh, S. Influenza and Pneumococcal Vaccinations for Patients With Chronic Obstructive Pulmonary Disease (COPD): An Evidence-Based Review. *Ont Health Technol Assess Ser*. 2012;12(3):1-64.
 53. Ting EEK, Sander B, Ungar WJ. Systematic review of the cost-effectiveness of influenza immunization programs. *Vaccine*. 2017;35(15):1828-1843.
 54. Trachtenberg AJ, Dik N, Chateau D, et al. Inequities in Ambulatory Care and the Relationship Between Socioeconomic Status and Respiratory Hospitalizations: A Population-Based Study of a Canadian City. *Ann Fam Med*. 2014;12(5):402-407.
 55. Whitaker JA, von Itzstein MS, Poland GA (2018). Strategies to maximize influenza vaccine impact in older adults. *Vaccine*. 2018;36(40):5940-5948.
 56. Chen Y, Wu J, Qi-Long Y, et al. Reasons for not having received influenza vaccination and its predictors in Canadians. *Vaccine : Development and Therapy*. 2012;2:23-33.