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Research

Trends in influenza vaccine coverage and vaccine hesitancy in Canada, 2006/07 to 2013/14: results from cross-sectional survey data

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Abstract

Background: Past studies have reported influenza vaccination coverage below national targets, but up-to-date estimates are needed to understand trends and to identify areas for intervention. The objective of this study was to describe recent trends in influenza vaccination in Canada, timing of uptake and reasons for not receiving the vaccine.

Methods: We pooled data from the 2007 to 2014 cycles of the Canadian Community Health Survey. Using bootstrapped survey weights, we examined influenza vaccine coverage by various groups, including by age and by presence of chronic medical conditions.

Results: The overall sample included 481 526 respondents. Across all survey cycles combined, 29% of respondents reported receiving seasonal influenza vaccination in the past 12 months. Coverage levels were fairly consistent during the study period, but varied by province or territory. Vaccination coverage decreased over time among those aged 65 years and older. Among those who received a vaccination, it was most common to do so in October or November. Among those not vaccinated, the most frequently cited reason was believing it was unnecessary.

Interpretation: Influenza vaccination coverage continues to fall below national targets, with substantial declines seen among those aged 65 years and older, a group for which vaccination is particularly important. More intensive efforts are needed to improve coverage in Canada, particularly for high-risk groups.

Annual influenza epidemics cause substantial mortality, morbidity, health care costs and lost economic productivity in Canada.[1–3] Influenza vaccination is the most effective way to prevent infection.[4] In 2001, national influenza vaccine coverage targets were set at 80% for high-risk groups, specifically adults aged 65 years and older, and individuals with chronic medical conditions that increase the risk of complications from influenza infection.[5] However, trends in influenza vaccination measured using nationally representative data up to 2005 demonstrated suboptimal coverage for high-risk groups; only those aged 75 years and older with chronic conditions reached the target.[6] At a meeting of vaccination experts in 2005, a goal of 80% coverage by 2010 was again set for those aged 65 years and older and those aged 18–64 years with chronic medical conditions.[5]

An earlier study by Kwong and colleagues also examined the impact of the introduction of publicly funded universal influenza vaccination in Ontario in 2000.[6] Many other provinces now provide universal influenza vaccination; by the 2013/14 influenza season, all provinces and territories except New Brunswick, Quebec and British Columbia had implemented comparable programs.[7] Additionally, several provinces (Prince Edward Island, Nova Scotia, New Brunswick, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia) have implemented policies allowing pharmacists to administer influenza vaccines to increase access to vaccination. So far, these policies have been associated with modest increases in vaccine coverage.[8] The benefits of influenza vaccination for both individuals and populations depend on the

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timing of vaccination (i.e., the month of vaccine receipt), particularly among high-risk groups.[9–12] Because vaccination is most beneficial before epidemics start, early administration of influenza vaccines is recommended.[4,13]

Timely and reliable estimates of vaccine coverage are crucial for evaluating vaccination programs and for identifying groups with suboptimal coverage. Understanding the reasons for not receiving influenza vaccines can guide the allocation of additional resources to increase coverage. Therefore, the objectives of this study were to describe the most recent Canadian and provincial trends in influenza vaccination, to examine variations in the timing of influenza vaccination and to characterize reasons for not receiving influenza vaccines.

Methods

Study population

We used nationally representative data from the 2007 to 2014 cycles of the Canadian Community Health Survey. This cross-sectional survey has been conducted annually by Statistics Canada since 2007 through telephone and in-person interviews, and it covers a range of questions related to health status, health care use and health determinants.[14] Using a multistage stratified cluster design, each cycle includes a sample of about 65 000 respondents aged 12 years and older. The survey excludes people living on Aboriginal reserves, full-time members of the Canadian military, people in institutions and 2 remote health regions in Quebec (with all of these exclusions representing < 3% of the population).[10] Response rates ranged from 65.6% to 77.6% across the cycles.[14] The current study was approved by the Ethics Review Board of Public Health Ontario.

Definitions

The dependent variable was self-reported influenza vaccination within the past 12 months, determined through responses to the questions, "Have you ever had a (seasonal) flu shot?" and "When did you have your last (seasonal) flu shot?" Individuals reporting receipt of their last flu shot in the preceding 12 months were considered vaccinated. These respondents were also asked, "In which month did you have your last flu shot?" Those whose response matched the month of the survey date were then asked, "Was that this year or last year?" We considered respondents who reported receipt of influenza vaccine during the same month as the survey date but in the preceding year as not vaccinated.

To determine the presence of chronic medical conditions, respondents were asked whether they had been diagnosed by a health professional with asthma, chronic obstructive pulmonary disease (COPD), heart disease, stroke, diabetes or cancer; people with these conditions are recommended to receive influenza vaccination.[4]

Two sets of age groups were considered in this analysis: 1) 12–19, 20–49, 50–64, 65–74 and 75–84 years, and 85 years and older; and 2) 12–49 and 50–64 years, and 65 years and older.

Risk groups were defined as high or low. Those deemed high risk were aged 65 years and older, or aged 12–64 years with at least 1 chronic condition. Individuals aged 12–64 years with no chronic conditions were considered low risk.

We defined universal influenza vaccination funding policies as provincial public funding for influenza vaccines for all residents aged 6 months and older. We defined pharmacist policies as having legislation permitting pharmacists to administer influenza vaccines. We set the start of these policies to coincide with the start of the corresponding influenza vaccination campaign, defined as Oct. 1.

Owing to small samples, the 3 territories were combined for certain analyses.

The definitions of education, household income, smoking status, body mass index, racial/cultural background, immigration status, marital status, rural residence, self-reported health, and having a regular doctor have been previously described.[15,16]

Statistical analysis

We pooled individual-level responses from all survey cycles. We used cross-tabulations to estimate the proportion of people who reported receipt of influenza vaccination in the past 12 months for: a) the overall population aged 12 years and older; b) various subgroups defined by sociodemographic characteristics, including province of residence; and c) risk groups for influenza vaccination. Analyses were repeated restricting to respondents who were surveyed between February and August. We also used cross-tabulations to compare the reasons that people who were not considered vaccinated reported for not receiving influenza vaccination. Reasons for not receiving the flu shot were examined by whether or not the respondent reported never having received a flu shot or if they had not received one in the last 12 months. We also examined the reasons for not receiving a flu shot by province, age group and presence of chronic conditions. Reported month of receipt of last influenza vaccination was also examined by season, risk group and province. We grouped those who reported receiving their vaccine between March and August owing to small numbers.

We used sampling weights to account for an unequal probability of selection in the sample. We calculated all estimates of coverage and coefficients of variation using bootstrap weights, with normalized weights used for tests between proportions due to large samples. All tests were 2-sided and used a significance level of $p < 0.05$. We compared estimates of coverage for the 2006/07 influenza season with those for the 2013/14 season, but only differences of 5 or more percentage points were considered to have public health relevance. We used SAS statistical software (version 9.4) for all analyses.

Results

Trends in influenza coverage

Across the 8 influenza seasons overall, 29% of respondents reported receiving a seasonal influenza vaccine during the previous 12 months (Table 1; Appendix 1, available at www.cmajopen.ca/content/4/3/E455/suppl/DC1). The annual proportion vaccinated was fairly consistent throughout the study period, but the level was lowest during the 2009/10 influenza A/H1N1 pandemic. The 2010 survey cycle was the only one that included

questions about the pandemic influenza vaccine. Of this cycle's respondents, 19% of respondents reported receiving both the pandemic and the seasonal vaccines, 52% reported receiving neither vaccine, 24% received the pandemic vaccine but not the seasonal vaccine, and 5% received the seasonal vaccine but not the pandemic vaccine. Seasonal influenza vaccine coverage remained

Table 1: Characteristics of respondents reporting influenza vaccination within the previous 12 months in the 2006/07 to 2013/14 influenza seasons

	% of respondents, *n* = 481 526*									
Characteristic	Total	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	Overall
Overall	100.0	32	30	30	26	28	28	28	31	29
Sex										
Male	49.0	29	26	27	23	25	24	25	27	26
Female	51.0	35	33	33	28	31	31	30	34	32
Chronic conditions										
≥ 1	22.5	51	47	47	42	45	45	45	47	46
Heart disease	4.7	63	60	60	53	58	56	57	59	58
Stroke†	1.0	61	55	54	53	50	55	55	46	53
Diabetes†	6.1	61	57	57	50	57	54	54	55	55
Cancer	1.9	55	56	53	56	59	53	49	54	54
Asthma	8.2	40	37	37	34	35	35	34	38	36
COPD†	2.2	67	60	58	48	55	58	54	55	55
None	77.5	27	25	25	21	23	23	23	26	24
Income quartile‡										
Lowest†	5.6	32	30	27	23	27	25	25	27	27
Lower-middle	14.2	34	33	33	29	33	31	31	33	32
Upper-middle	27.5	33	30	30	26	29	30	29	31	30
Highest	44.2	30	28	28	24	27	26	26	30	27
Province or territory										
Newfoundland and Labrador†	1.5	22	23	25	23	25	24	24	27	24
Prince Edward Island	0.4	33	28	27	26	30	32	28	35	30
Nova Scotia†	2.8	40	40	37	43	47	43	40	45	42
New Brunswick†	2.2	28	30	28	32	36	34	35	37	33
Quebec	23.4	25	25	25	16	21	22	22	24	22
Ontario	39.1	37	34	34	27	31	29	30	33	32
Manitoba	3.4	28	25	27	31	26	26	27	30	27
Saskatchewan	2.9	27	28	28	26	30	30	25	30	28
Alberta	10.8	28	26	29	29	29	27	27	31	28
British Columbia	13.3	32	28	29	29	28	30	28	32	30
Yukon	0.1	29	27	24	45	33	27	27	30	31
Northwest Territories	0.1	35	33	30	33	39	36	29	35	34
Nunavut	0.1	37	34	44	42	43	26	27	33	35
Presence of universal funding for influenza vaccines										
Yes	51.7	37	34	33	27	31	29	29	33	31
No	48.3	28	27	28	24	24	25	25	27	26

Note: COPD = chronic obstructive pulmonary disease.
*Representing 27 291 380 Canadians.
†Changed by ≥ 5 percentage points during the study period.
‡8.6% did not report their income over the study period; the percent reporting vaccination in this group was 30% overall.

depressed for the initial 3 postpandemic seasons until returning close to prepandemic levels for the most recent (2013/14) season.

Females and older age groups consistently achieved higher coverage. Among the provinces and territories, Nova Scotia consistently achieved the highest coverage, which increased by 5% (from 40% in 2006/07 to 45% in 2013/14) during the study period. The greatest net increase was observed in New Brunswick, from 28% in 2006/07 to 37% in 2013/14. Whereas Quebec had the lowest coverage levels, Ontario experienced the greatest drop during the study period (from 37% to 33%). Coverage was higher in provinces that provide universal funding of influenza vaccines for their residents. Coverage was stable in all income groups except for the lowest quartile, for whom a drop from 32% to 27% was observed.

The results did not change when the analysis was restricted to those surveyed between February and August (data not shown).

Coverage by risk group

National vaccination coverage decreased 9% over time for individuals aged 65 years and older, with a drop of 11% for those aged 85 years and older (Figure 1). Substantial decreases in coverage were observed among those aged 65 years and older in all provinces and territories, except for Newfoundland and Labrador (Table 2). In those aged 12–64 years with a chronic medical condition, influenza vaccine coverage in most provinces remained relatively stable, but Ontario saw a significant decrease from 46% to 36% (Table 2). In the low-risk group, numerous provinces made significant gains in vaccination coverage over time, including Nova Scotia, New Brunswick, Manitoba, Saskatchewan and Alberta.

Progress toward targets

No group met the 80% target during the study period, including those at high risk (Figure 2). Those aged 85 years and older with a chronic condition were the closest to reaching this level (74%). Since this target was reconfirmed in 2005, coverage has declined and was even further from this level than in 2005.

Timing of influenza vaccination

The most common month to receive influenza vaccination was November (48%), followed by October (30%). Few people reported being vaccinated in December (7%), January (4%), February (1%), March–August (2%) or September (3%); 5% did not recall the month of vaccination. The percentage of people receiving influenza vaccines in October increased from 24% in 2006/07 to 34% in 2013/14, whereas those receiving influenza vaccines in November decreased 12% (from 55% to 43%). Those aged 65 years and older had higher vaccine uptake in October than those at low risk (35% v. 27%, $p < 0.001$).

Reasons for not receiving influenza vaccination

Across all groups, the most frequently reported reason for not receiving seasonal influenza vaccination was perceiving it to be unnecessary (Table 3). Eighty-three percent of people who had never received a flu shot thought it unnecessary, which is significantly higher than the 53% reported by those who had had a previous flu shot ($p < 0.001$). Residents of Quebec cited this reason most frequently, with 80% of those not having

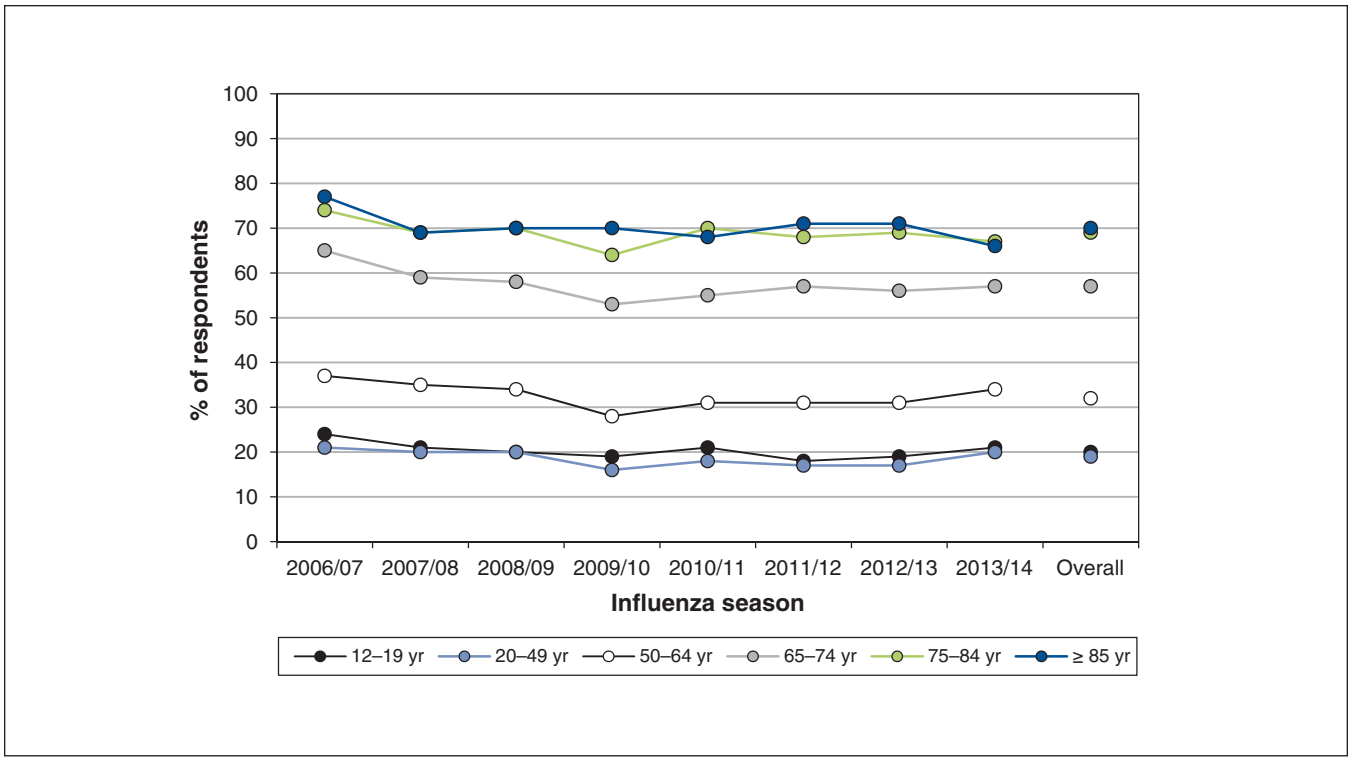

Figure 1: Percentage reporting influenza vaccination within the previous 12 months in the 2006/07 to 2013/14 influenza seasons, by age group. Note: For age groups 65–74, 75–84 and ≥ 85, values changed by ≥ 5 percentage points during the study period.

Table 2: Respondents reporting influenza vaccination in the 2006/07 to 2013/14 influenza seasons, by risk group

	% of respondents									
Variable	Total	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	Overall
High-risk group: aged ≥ 65 yr										
Canada* (*n* = 74 491†)	100.0	69	63	63	58	61	61	61	60	62
Newfoundland and Labrador	1.6	52	51	51	55	51	53	50	56	52
Prince Edward Island*	0.5	67	49	57	59	63	60	55	58	58
Nova Scotia*	3.2	76	72	72	71	73	75	74	70	73
New Brunswick*	2.4	64	59	57	62	65	66	61	59	62
Quebec*	25.1	63	59	58	37	52	53	55	54	54
Ontario*	38.4	76	67	67	68	65	67	67	66	67
Manitoba*	3.5	66	64	60	68	59	56	61	56	61
Saskatchewan*	3.1	61	62	61	58	61	59	53	50	58
Alberta*	8.3	70	60	59	58	65	56	60	58	60
British Columbia*	13.9	67	60	61	62	59	63	60	60	61
Territories*‡	0.1	76	74	66	69	68	57	56	63	65
High-risk group: aged 12–64 yr with at ≥ 1 chronic condition										
Canada (*n* = 71 366†)	100.0	39	36	35	32	34	33	32	36	34
Newfoundland and Labrador	1.7	34	28	34	30	33	28	29	34	31
Prince Edward Island	0.5	37	39	32	32	36§	36§	29§	38	35
Nova Scotia	3.4	48	55	49	58	56	47	57	52	53
New Brunswick	2.5	40	39	32	43	47	35	42	44	40
Quebec	23.5	31	31	31	23	25	30	26	30	28
Ontario*	39.1	46	39	39	31	36	33	35	36	36
Manitoba	3.5	34	32	36	42	35	29	30	30	33
Saskatchewan	2.8	32	37	32	36	27	37	27	36	33
Alberta	10.8	35	33	32	33	36	33	30	37	34
British Columbia	11.9	39	36	33	36	35	35	30	39	35
Territories‡	0.3	38	36	32§	47	40	37	30	37	37
Low-risk group: aged 12–64 yr with no chronic conditions										
Canada (*n* = 335 699†)	100.0	23	21	22	17	20	19	19	22	20
Newfoundland and Labrador	1.5	14	16	17	14	16	16	16	17	16
Prince Edward Island	0.4	24	20	19	16	20	24	20	28	21
Nova Scotia*	2.6	29	28	25	32	38	32	26	35	31
New Brunswick*	2.1	17	21	20	22	26	25	25	29	23
Quebec	23.0	16	17	16	10	13	12	13	14	14
Ontario	39.3	28	26	26	17	22	20	20	24	23
Manitoba*	3.4	18	15	18	19	17	18	18	23	18
Saskatchewan*	2.8	18	18	20	16	23	22	18	24	20
Alberta*	11.3	20	19	23	23	22	21	21	25	22
British Columbia	13.4	23	21	21	21	19	21	21	23	21
Territories‡	0.3	29	26	28	36	34	27	24	29	29

*Changed by ≥ 5 percentage points during the study period.
†Representing 4 221 945, 4 044 776 and 19 024 659 Canadians, respectively.
‡Includes the Northwest Territories, Yukon and Nunavut combined.
§Owing to high sampling variability, these estimates should be interpreted with caution because the respective coefficient of variation is between 16.6% and 33.3%.

received influenza vaccination in the past 12 months deeming it unnecessary. The reported reasons were consistent over the study period. The only change in reasons was for those who had previously received their influenza vaccination but had not done so in the past 12 months, with 49% in this group thinking it unnecessary in 2006/07 and 54% in 2013/14.

Interpretation

Seasonal influenza vaccine coverage in Canada was essentially stable between the 2006/07 and 2013/14 influenza seasons, except for a dip during the 2009 A/H1N1 pandemic that required a few influenza seasons to recover from. Although seasonal influenza vaccine coverage dipped slightly in the pandemic year, overall coverage for any influenza vaccine (i.e., either the seasonal trivalent vaccine or the pandemic monovalent vaccine) was highest for that year, likely due to the pandemic situation and messaging about the additional need for vaccination. Surprisingly, we observed a substantial drop in coverage over time among those aged 65 and older, with an even larger drop among those aged 85 and older. Coverage also declined among individuals younger than 65 years with chronic conditions, another high-risk group, although this trend was observed only in a few provinces. Consequently, the level of vaccine coverage in Canada is even further from the target of 80% for high-risk groups set in 2005. Individuals with asthma comprised a substantial proportion of those with chronic conditions, and they had the lowest coverage; further efforts to target this group could result in overall gains among high-risk groups. Whereas coverage dropped for high-risk age groups, gains were seen in the low-risk population in some provinces. We also observed variations in coverage by sex, age group, risk group and province. Variations across provinces may be partially due to differences in vaccination policies, such as universal funding for influenza vaccines or the ability of pharmacists to administer vaccines.[8,15]

The most frequently cited reason for not receiving seasonal influenza vaccination was perceiving it to be unnecessary, and this was consistent across risk groups and provinces. However, the proportion citing this reason was lower in those classified as having a chronic condition.

Coverage estimates in selected countries were higher than in Canada for the 2013/14 season (Table 4). In the United States, for example, vaccination coverage was higher among those aged 65 years and older, with 65% coverage obtained; this estimate, however, still falls below the US national target of 70%.[17] Few countries have met their targets for this group. Countries such as the Netherlands, which has attained the highest coverage in Europe in past seasons, might be able to offer strategies to increase uptake in Canada.[21] Other trends noted in Canada were also observed in the US, such as relatively stable coverage across time and the greatest proportion of vaccinations being provided in October and November.[17] Large variability in coverage between states has been reported in the US and in Australia. The Australian Adult Vaccination Survey also reported similar results regarding reasons for not being vaccinated, with

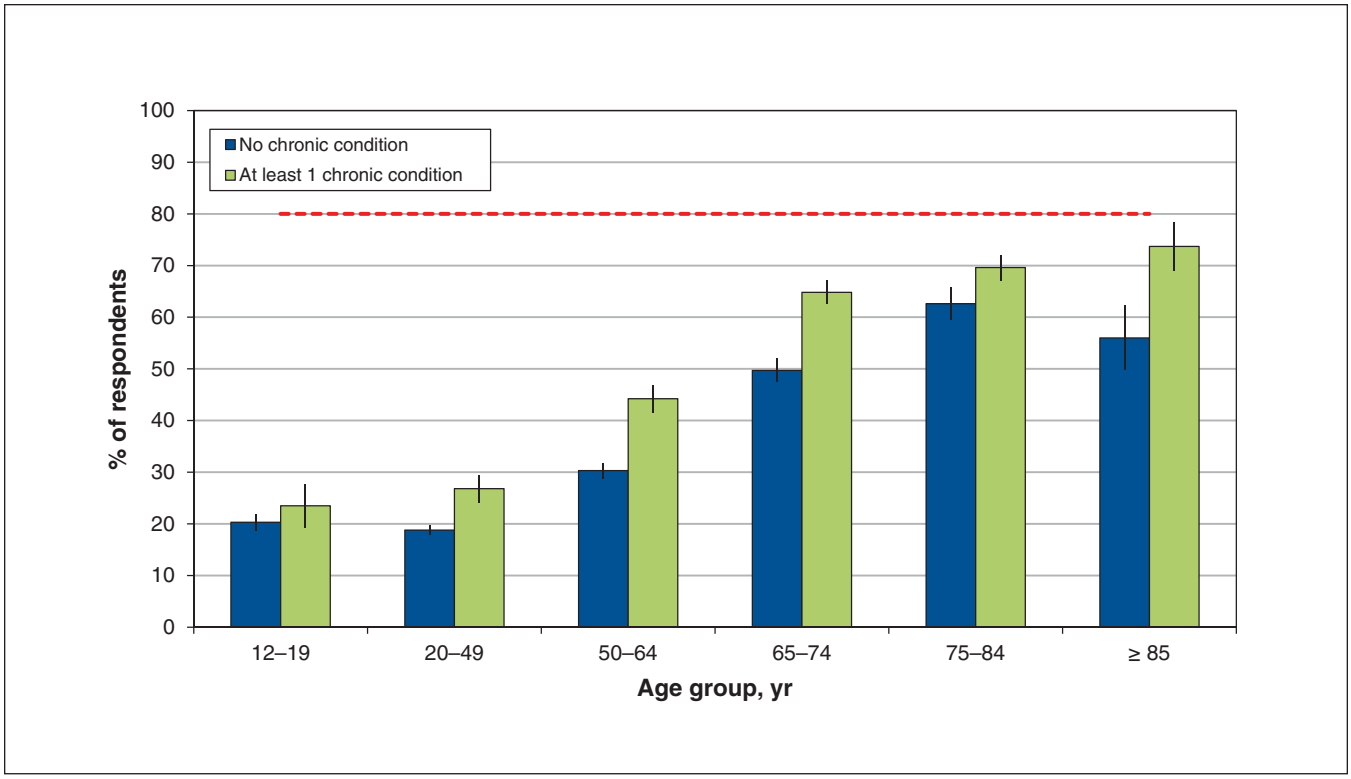

Figure 2: Percentage reporting influenza vaccination during the 2013/14 influenza season, by age group and presence of chronic conditions. Red dashed line represents target set in 2010 for adults aged ≥ 65 years and those with chronic conditions.

the first 2 reasons being that the respondent does not get the flu or is not at risk, followed by not getting around to it; these responses echo those reported in Canada.[22] In this study, perceiving influenza vaccines to be unnecessary was the main reason reported for not receiving seasonal influenza vaccination across all characteristics examined, including risk group; this was true for both those who have never received a flu shot and for those who have had one in the past but not in the last 12 months. Further work is needed to explore why individuals believe the influenza vaccination is unnecessary, so that efforts to tackle this barrier to vaccination can be made. This may include enhanced education and discussion by health care providers.[23] Additional efforts to enhance vaccination access, increase community demand, and improve provision by providers or the health care system may also improve coverage.[24,25]

The conclusions from our study are similar to those of a recently published report,[26] although our study differed slightly by reporting coverage by influenza season (as opposed to survey cycle) and using a stricter definition for influenza vaccination. This study updates previous work on trends in influenza vaccination, using data after the survey was conducted annually, as opposed to every 2 years.

Limitations

This study has some limitations. The Canadian Community Health Survey does not include children younger than 12 years or older adults in institutions, both important risk groups who should be vaccinated. Additionally, we relied on self-reports to assess vaccine coverage. However, this outcome has been frequently used in influenza vaccination reporting and has been shown to be valid.[27–36] There may be some recall bias regarding the receipt of seasonal influenza vaccination in the last 12 months, but this was partially mitigated by incorporating the follow-up questions regarding timing of vaccination into our outcome definition. The cross-sectional nature of the data also limits our ability to make conclusions about temporal associations between predictors and vaccination status.

Table 3: Reasons reported for not receiving influenza vaccination during the 2006/07 to 2013/14 influenza seasons, by selected characteristics*

Variable	% of respondents					
	Total	Unnecessary	Did not get around to it	Previous bad reaction	Fear	Doctor said unnecessary
Overall, *n* = 336 109†	100.0	72	15	6	4	2
Never vaccinated	62.4	83	9	2	5	2
Ever vaccinated but not in last 12 months	37.6	53	27	12	3	2
High risk (aged ≥ 65 yr)	7.8	69	11	11	5	4
With a chronic condition	3.2	63	12	14	5	4
Without a chronic condition	4.6	73	10	9	5	3
High risk (aged 12–64 yr with a chronic condition)	13.6	64	18	8	5	3
Low risk	78.6	73	15	4	4	2
Province or territory	100.0					
Newfoundland and Labrador	1.6	75	13	5	4	2
Prince Edward Island	0.4	67	18	6	5	2
Nova Scotia	2.3	65	20	7	5	2
New Brunswick	2.1	71	15	6	5	2
Quebec	25.6	80	9	4	3	1
Ontario	37.4	68	18	7	5	2
Manitoba	3.5	71	15	5	4	2
Saskatchewan	2.9	68	19	5	4	1
Alberta	10.9	69	18	6	4	2
British Columbia	13.1	71	16	5	4	2
Territories‡	0.1	63	21	8	5	1

*Those who reported not receiving influenza vaccination in the last 12 months were asked why. Respondents could pick more than 1 reason.
†Representing 19 049 608 Canadians.
‡Includes the Northwest Territories, Yukon and Nunavut combined.

Table 4: Comparison of influenza vaccination coverage in 2013/14 in all respondents and those aged 65 and older, by country

	% of respondents	
Country	Overall*	Age ≥ 65 yr
Canada	31	60
United States[17]	42	65
England[18]	NR	73
Scotland[18]	NR	77
Australia[19]	39	73
New Zealand[20]	NR	68

Note: NR = not reported.
*Age ≥ 12 yr in Canada; age ≥ 18 yr in the United States and Australia.

Conclusion

Seasonal influenza vaccine coverage remains below national targets and is lower than in 2005. Of particular concern is the drop in coverage observed in those aged 65 and older and the perception that influenza vaccination is unnecessary. Targeted efforts are needed to restore high coverage in high-risk groups.

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