

Influenza vaccination

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Abstract

Objectives

This article compares influenza vaccination rates in 1996/97 and 2000/01 and describes the characteristics of adults who were vaccinated.

Data sources

The data on influenza vaccination are from the 1996/97 National Population Health Survey and the 2000/01 Canadian Community Health Survey, both conducted by Statistics Canada. Data on hospitalizations and deaths are from the Hospital Mortality Data Base and the Canadian Mortality Data Base, respectively.

Analytical techniques

Cross-tabulations were used to estimate rates of vaccination among seniors, people with chronic conditions, and the total population aged 20 or older. Multiple logistic regression was used to assess relationships between being vaccinated and selected characteristics.

Main results

Between 1996/97 and 2000/01, the percentage of Canadians aged 20 or older who reported having had a flu shot the previous year rose from 16% to 28%. Rates were higher for seniors and people with chronic conditions. The odds of vaccination were high for residents of middle-to-high income households, people with at least some postsecondary education, former smokers, and people with a regular doctor. Smokers and people who reported their health as good to excellent had lower odds of being vaccinated.

Key words

immunization, preventive health services, community health services, population-based health planning

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Influenza or “the flu” is a viral infection that affects an estimated 10% to 25% of Canadians each year, usually between November and May.¹ The symptoms include a cough, fever, chills and muscle aches. While most people recover within a week or two, some may suffer serious complications, such as pneumonia or heart failure, that require hospitalization and that could even lead to death (see *Influenza immunization, hospitalizations and deaths*). The severity of the flu varies from year to year, as new viruses emerge.

A decade ago in Canada, a national consensus conference recommended that seniors and people of any age with medical conditions that place them at high risk for influenza-related complications receive an annual flu shot;² the target immunization rate was set at 70%. While the recent *Canadian Immunization Guide* suggests that priority be given to ensuring vaccination of these “high-risk groups,” it also states, “Healthy adults and their children who wish to protect themselves from influenza should be encouraged to receive the vaccine.”³ This recommendation is supported by the results of recent studies showing that immunization of healthy adults and children may be cost-effective under some circumstances.⁴⁻¹⁰ However, although some experts support

universal immunization,¹¹ others are critical, citing varying estimates of the efficacy of vaccination.¹²

This article, based on data from the 1996/97 National Population Health Survey (NPHS) and the 2000/01 Canadian Community Health Survey (CCHS), discusses the extent of influenza

vaccination among seniors, adults with certain chronic conditions, and the total population aged 20 or older (see *Definitions, Methods and Limitations*). Reasons for not being immunized are presented for seniors.

Influenza immunization, hospitalizations and deaths

Influenza vaccines are not a recent innovation; they have, in fact, been available since the 1940s,^{13,14} but their use has only recently become widespread. During the 2000/01 flu season, approximately 10 million doses of flu vaccine were distributed in Canada.¹⁵

The vaccine, made from fragments of inactivated influenza viruses, offers protection by building immunity or antibodies, so that when a "live" virus does show up, the body's defences are ready.¹⁶ There are three types of influenza viruses: Types A, B and C. Types A and B cause epidemics almost every winter; Type C causes a mild respiratory illness and is not thought to cause epidemics. A flu shot can prevent illness from types A and B, but does not protect against Type C.¹⁷

The viruses that cause influenza mutate rapidly,¹⁷ so vaccines are updated annually to include viruses similar to the strains circulating throughout the world at the time. Because the viruses change so often, people at high risk are advised to receive a shot every year,^{13,14} ideally between mid-October and mid-November.¹⁸ The vaccine

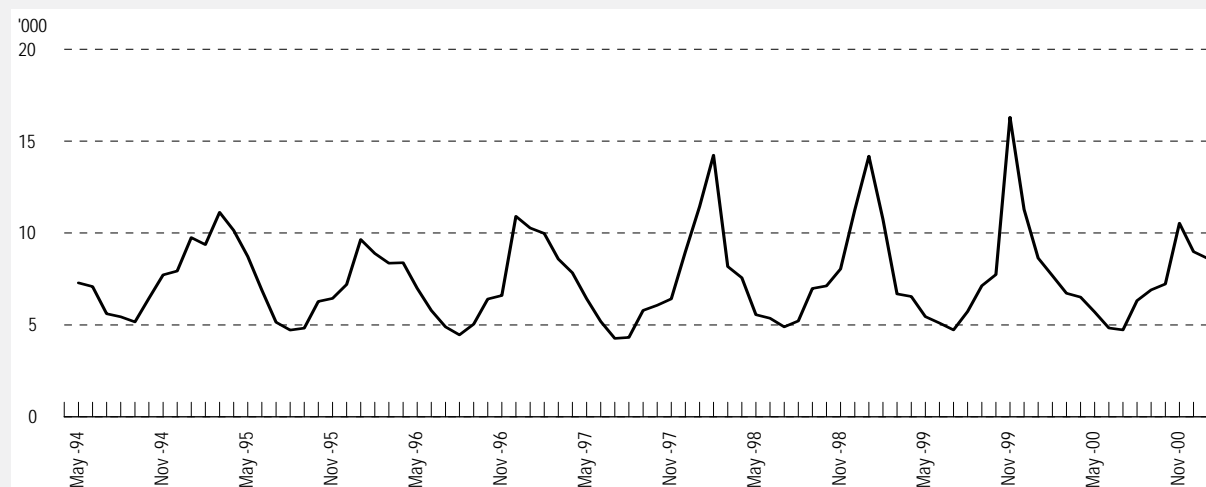
becomes effective about two weeks after the injection and lasts about six months.

No vaccine gives complete protection. If the influenza strains have been accurately predicted, the vaccine is 70% to 90% effective for healthy people younger than 65, but less so for seniors.¹⁶ Even so, people who develop the flu after being vaccinated generally experience milder symptoms than they would have without the shot, and complications are less likely.

Each year a substantial number of people are hospitalized for influenza and influenza-related complications (notably, pneumonia). These hospitalizations follow a yearly cycle, peaking in the winter months and bottoming out during the summer. The number varies, depending on the severity of the flu strain that year (chart).

Similarly, the annual number of deaths caused by flu varies, again reflecting the strain. From 1990 to 2000, the figure ranged from just 122 (in 1992) to 762 (in 1998).¹⁹

Hospital stays with diagnosis of influenza/pneumonia,[†] by month, Canada, April 1994 to December 2000



Data source: Statistics Canada, Hospital Morbidity Database, 1994/95 to 2000/01
[†] International Classification of Diseases (ICD-9) codes 481 to 487 (Reference 20)

Definitions

Respondents to the 1996/97 National Population Health Survey (NPHS) and the 2000/01 Canadian Community Health Survey (CCHS) were asked: "Have you ever had a flu shot?" Those who had were asked when they had had their last shot: less than one year ago; one year to less than two years ago; and two years ago or more. Respondents aged 65 or older who indicated that they had not been vaccinated within the past year were asked why not. Proxy responses were not accepted for either of these questions.

The presence of a *chronic condition* was determined by asking respondents if they had any "long-term conditions that had lasted or were expected to last six months or more and that had been diagnosed by a health professional." A list of conditions was read to respondents. Those who reported asthma, chronic bronchitis/emphysema, diabetes, heart disease, cancer, or effects of a stroke were considered to have a condition for which influenza vaccination was recommended (see *Limitations*).

Two *age groups* were considered: 20 to 64, and 65 or older.

Household income was based on the number of people in the household and total household income from all sources in the 12 months before the 2000/01 CCHS interview. For this analysis, two income groups were defined:

Household income group	People in household	Total household income
Lower	1 or 2	Less than \$29,999
	3 or 4	Less than \$39,999
	5 or more	Less than \$59,999
Higher	1 or 2	\$30,000 or more
	3 or 4	\$40,000 or more
	5 or more	\$60,000 or more

Three *education* categories were considered: less than secondary graduation, secondary graduation, and at least some postsecondary.

Smoking status was defined as never, former, or daily/occasional.

Respondents were asked if they had a *regular medical doctor*.

Two categories of *self-reported health* were considered: poor/fair and good/very good/excellent.

In accordance with the *International Classification of Diseases, Ninth Revision (ICD-9)*²⁰ codes, a hospitalization for influenza pneumonia was defined as the presence of any code in the 481 to 487 range among the top three diagnostic codes on the patient's record. For the mortality data, influenza was identified by code 487.

Sharp rise

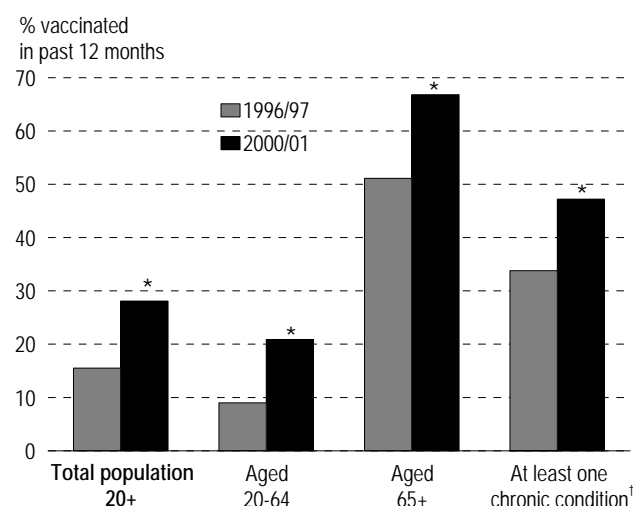
In 2000/01, 28% of Canadians aged 20 or older reported that they had been vaccinated against influenza sometime in the previous year. This was up substantially from 1996/97, when fewer than 16% reported having had a flu shot. Rates, however, differed substantially, depending on whether respondents were members of groups that had been targeted for coverage (Chart 1).

Seniors were most likely to have been vaccinated. In 2000/01, two-thirds of people aged 65 or older reported that they had had a flu shot the previous year, up from just over half in 1996/97.

The vaccination rate was also relatively high for adults (aged 20 or older) with at least one chronic condition that made them especially vulnerable to complications of flu—asthma, chronic bronchitis/emphysema, diabetes, heart disease, cancer and effects of stroke. In 2000/01, 47% of people with at least one of these conditions had had a flu shot, a significant increase from 34% in 1996/97.

There was, however, considerable provincial variation in flu shot rates: overall and for these two

Chart 1
Influenza vaccination rates, by age and presence of chronic conditions, household population aged 20 or older, Canada excluding territories, 1996/97 and 2000/01



Data sources: 1996/97 National Population Health Survey, cross-sectional sample, Health file; 2000/01 Canadian Community Health Survey, fourth quarter

Note: Groups for whom vaccination rates are calculated are not mutually exclusive.

† Asthma, chronic bronchitis/emphysema, diabetes, heart disease, cancer, effects of stroke

* Significantly higher than 1996/97 ($p \leq 0.05$)

target groups. To some extent, this may be related to efforts that different provinces have made to reach susceptible populations and to promote the benefits of being immunized.

Widely available

Most provinces have offered publicly funded influenza immunization to seniors and people with chronic conditions since at least the mid-1990s (Table 1). In 2000, all provinces except Prince Edward Island and New Brunswick provided vaccine to seniors (New Brunswick extended coverage to seniors in 2003), and only Prince Edward Island did not cover people with chronic conditions. Ontario, however, was the only province that provided flu shots to all residents. Perhaps for this reason, 37% of Ontario adults reported in 2000/01 that they had been immunized the previous year, the highest rate in the country (Table 2).

Ontario also had the highest immunization rate for seniors. In 2000/01, close to three-quarters of Ontario's population aged 65 or older reported that they had had a flu shot. By contrast, the percentages of seniors who had been immunized were significantly below the national figure in Newfoundland, New Brunswick and Québec.

As well, Ontario was the only province where the vaccination rate (58%) for people with chronic conditions (asthma, bronchitis/emphysema,

diabetes, heart disease, cancer, effects of stroke) significantly exceeded the percentage for Canada. On the other hand, rates for people with these conditions were significantly below the national level in Newfoundland, Québec, Saskatchewan and Alberta.

Provincial rates rising

In every province except Newfoundland, flu vaccination rates rose between 1996/97 and 2000/01. The largest increase was in Ontario, possibly owing to the provincial initiative that made flu vaccine available at no charge to every resident.

The reasons for the increases in overall vaccination rates in other provinces are less obvious. In Québec, the *projets spéciaux* were started in 1999 to promote and improve accessibility to influenza vaccination,^{21,22} and in 2000, the age threshold for funding coverage was lowered from 65 to 60. During the same period, some provinces began providing flu shots to groups besides seniors and people with chronic conditions. For instance, Alberta's program was expanded to include employees in health care facilities and in other settings that provide health services to people at risk; in 2000/01, British Columbia began providing the vaccine to emergency responders (police, fire, ambulance personnel) and independent health care practitioners and their staff.

Table 1
Publicly funded vaccination programs and increase in vaccination rates, by province, 1996 and 2000

	Age 65 or older			At least one chronic condition [†]			All adults		
	Covered by program		Increase in vaccination rate, 1996/97 to 2000/01	Covered by program		Increase in vaccination rate, 1996/97 to 2000/01	Covered by program		Increase in vaccination rate, 1996/97 to 2000/01
	1996	2000		1996	2000		1996	2000	
Newfoundland	yes	yes		yes	yes		no	no	
Prince Edward Island	no	no		no	no		no	no	*
Nova Scotia	yes	yes	*	yes	yes		no	no	*
New Brunswick	no	no [‡]	*	yes	yes		no	no	*
Québec	yes	yes [§]	*	yes	yes	*	no	no	*
Ontario	yes	yes	*	yes	yes	*	no	yes	*
Manitoba	yes	yes	*	yes	yes	*	no	no	*
Saskatchewan	yes	yes	*	yes	yes	*	no	no	*
Alberta	yes	yes	*	yes	yes	*	no	no	*
British Columbia	yes	yes	*	yes	yes	*	no	no	*

[†] Asthma, chronic bronchitis/emphysema, diabetes, heart disease, cancer, effects of stroke

[‡] In 2003, the program was expanded to include the population aged 65 or older.

[§] Program covered those aged 60 or older since 2000.

* Rate in 2000 significantly higher than rate in 1996 ($p < 0.05$)

Table 2
Influenza vaccination rates, by age, presence of chronic conditions and province, household population aged 20 or older, Canada excluding territories, 1996/97 and 2000/01

	Age 65 or older		At least one chronic condition [†]		Total population aged 20 or older	
	1996/97	2000/01	1996/97	2000/01	1996/97	2000/01
	%		%		%	
Canada	51.1	66.8 [‡]	33.8	47.2 [‡]	15.5	28.1 [‡]
Newfoundland	47.5	48.9*	35.2	28.9*	12.8*	12.1*
Prince Edward Island	55.9	65.2	38.1	47.2	18.1	22.2 ^{†*}
Nova Scotia	60.1*	71.0 [‡]	43.6*	48.1	20.2*	25.0 ^{†*}
New Brunswick	48.3	61.5 ^{†*}	34.8	42.8	16.6	20.5 ^{†*}
Québec	33.9*	59.2 ^{†*}	18.7*	35.6 ^{†*}	8.7*	20.0 ^{†*}
Ontario	59.5*	72.5 ^{†*}	39.1*	58.2 ^{†*}	18.4*	37.0 ^{†*}
Manitoba	51.9	62.2 [‡]	35.6	45.7 [‡]	15.9	23.4 ^{†*}
Saskatchewan	53.3	63.5 [‡]	30.2	39.7 ^{†*}	14.8	20.7 ^{†*}
Alberta	59.2*	68.7 [‡]	36.7*	38.5*	16.7*	24.0 ^{†*}
British Columbia	52.5	68.1 [‡]	39.7*	47.3 [‡]	18.5*	27.5 [‡]

Data sources: 1996/97 National Population Health Survey, cross-sectional sample, Health file; 2000/01 Canadian Community Health Survey, fourth quarter

Note: Groups for whom vaccination rates are calculated are not mutually exclusive.

[†] Asthma, chronic bronchitis/emphysema, diabetes, heart disease, cancer, effects of stroke

[‡] Significantly different from 1996/97 ($p < 0.05$)

* Significantly different from national rate ($p < 0.05$)

Nonetheless, the focus of all provincial programs remains the two target groups: seniors and people with chronic conditions. For seniors, increases in immunization rates between 1996/97 and 2000/01 were significant in eight provinces: Nova Scotia, New Brunswick, Québec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia. The largest increase was in Québec, where the rate among elderly people rose by 75%, consistent with the results of Québec surveys.^{21,23} Increases in the immunization rates of people with chronic conditions were statistically significant in Québec, Ontario, Manitoba, Saskatchewan and British Columbia. Again, the largest percentage change was in Québec, where the rate almost doubled.

Likelihood varies

The sharp differences in immunization rates between seniors, people with chronic conditions and the adult population overall indicate that everyone is not equally likely to have a flu shot. Moreover, being a member of one of the groups recommended for vaccination was not the only factor involved.

In 2000/01, 32% of women, compared with 24% of men, reported that they had been immunized (Table 3). Former smokers were more likely than people who had never smoked to have been

vaccinated (33% versus 29%), while daily or occasional smokers were considerably less likely (20%). Having a regular doctor also seemed to make a difference, as 31% of such people had had a flu shot, compared with just 10% who did not have a regular doctor. In addition, an individual's opinion of his or her health was important: 46% who considered themselves to be in fair or poor health had been vaccinated against flu, compared with 26% who assessed their health as good, very good or excellent.

Of course, these factors do not exist in isolation. For instance, seniors with a chronic condition may not consider themselves to be in good health, and they might be more likely than someone in better health to have a regular doctor. However, when such potentially confounding effects were taken into consideration, most of these relationships persisted.

Compared with women, men had significantly low odds of having had a flu shot. Odds were also low for people who considered themselves in good to excellent health, and for those who smoked. Having a regular doctor increased the odds of being immunized, as did being a former smoker. In addition, people in middle- to high-income households had elevated odds of vaccination. And

Methods

Data sources

Most of the analysis in this article is based on data from the 1996/97 National Population Health Survey and the 2000/01 Canadian Community Health Survey, both conducted by Statistics Canada.

National Population Health Survey

The biennial National Population Health Survey (NPHS), which began in 1994/95, covers household and institutional residents in all provinces and territories, except residents of Indian reserves, Canadian Forces bases, and some remote areas. The NPHS has both cross-sectional and longitudinal components.

Individual data are organized into the General file and the Health file. The General file contains socio-demographic and some health information for each member of participating households. Additional, in-depth health information collected for one randomly selected household member, as well as the information in the General file pertaining to that individual, is in the Health file. This analysis uses cross-sectional data from the 1996/97 NPHS (cycle 2) and pertains to the household population in the 10 provinces.

Data on flu shots come from the Health file. The 1996/97 cross-sectional response rate for the Health file was 79.0%. The sample for this analysis consisted of 66,435 respondents who were aged 20 or older in 1996/97 (weighted to represent approximately 21.3 million individuals), and who replied to questions about flu shots. More detailed descriptions of the NPHS design, sample and interview procedures can be found in published reports.^{24,25}

Canadian Community Health Survey

The Canadian Community Health Survey (CCHS) collects cross-sectional information every two years. Data collection for the first cycle began in September 2000 and continued over 14 months. The survey covers the household population aged 12 or older in the provinces and territories, except residents of Indian reserves, Canadian Forces bases, and some remote areas. The responding sample for the first cycle was 131,535, yielding a response rate of 84.7%. More detailed descriptions of the CCHS design, sample and interview procedures are available in a published report.²⁶

This analysis uses data for the 10 provinces from the fourth quarter of the first cycle (June to August 2001), in which respondents were

asked about influenza vaccination. The sample consists of 30,735 respondents who were aged 20 or older (weighted to represent approximately 22.6 million individuals) and who replied to questions about flu shots.

Supplementary data

The data on influenza hospitalizations are from the Hospital Morbidity Data Base, maintained by Statistics Canada until 1994/95, and by the Canadian Institute for Health Information since 1995/96. The information in this database comes from the admission/separation form completed by general and allied special care hospitals at the end of each stay when a patient is "separated" as a discharge or death. The file contains data on all inpatient cases separated during the fiscal year. Because a patient may be admitted and discharged several times during one year, the statistics are a count of separations, not individual patients.

Mortality data are from the Canadian Vital Statistics Data Base, maintained by Statistics Canada, which compiles information provided by the vital statistics registrars in each province and territory.

Analytical techniques

Cross-tabulations based on data from the 1996/97 NPHS and 2000/01 CCHS were used to estimate national and provincial proportions of people who received an influenza vaccination in the previous year, overall for the population aged 20 or older, and for seniors and for individuals with chronic conditions. Multiple logistic regression was used to examine reports of immunization in 2000/01 in relation to selected characteristics: age, sex, presence of chronic conditions, household income, education, smoking status, having a regular doctor, and self-reported health. Cross-tabulations of 2000/01 CCHS data were used to determine reasons why seniors were not vaccinated.

The data were weighted to represent the demographic makeup of the Canadian population in 1996/97 and 2000/01. To account for survey design effects, standard errors and coefficients of variation were estimated with the bootstrap technique.²⁷⁻²⁹ The significance level was set at $p < 0.05$.

Table 3
Rates of and adjusted odds ratios for influenza vaccination, by selected characteristics, household population aged 20 or older, Canada excluding territories, 2000/01

	Rate	Adjusted odds ratio	95% confidence interval
	%		
Total	28.1
Sex			
Men	24.4*	0.78*	0.73, 0.83
Women†	31.6	1.00	...
Age group			
20-64†	20.9	1.00	...
65+	66.8*	6.05*	5.63, 6.49
At least one chronic condition†			
Yes	47.2*	1.98*	1.83, 2.14
No†	23.6	1.00	...
Household income			
Lower†	27.2	1.00	...
Higher	28.1	1.47*	1.31, 1.64
Education			
Less than high school graduation†	35.9	1.00	...
High school graduation	25.3*	1.00	0.91, 1.10
At least some postsecondary	26.2*	1.13*	1.03, 1.24
Smoking status			
Never†	29.2	1.00	...
Former	32.6*	1.12*	1.04, 1.21
Daily/Occasional	20.1*	0.79*	0.72, 0.86
Has regular doctor			
Yes	31.4*	2.90*	2.56, 3.28
No†	10.7	1.00	...
Self-reported health			
Poor/Fair†	45.8	1.00	...
Good/Very good/Excellent	25.7*	0.66*	0.59, 0.73

Data source: 2000/01 Canadian Community Health Survey, fourth quarter

† Reference category

‡ Asthma, chronic bronchitis/emphysema, diabetes, heart disease, cancer, effects of stroke

* Significantly different from reference group ($p < 0.05$)

... Not applicable

although a relatively large proportion of people with less than high school graduation had been immunized, when the effects of the other variables were controlled, the odds of having had a flu shot were actually higher for those who had at least some postsecondary education. This paradoxical finding probably reflects the adjustment for age.

Why not?

Experts have identified several factors that may contribute to underutilization of influenza vaccination among high-risk groups: scepticism about the vaccine's effectiveness and uncertainty

Limitations

Data from the National Population Health Survey (NPHS) and the Canadian Community Health Survey (CCHS) are subject to the problems inherent in self-reported information. No independent source was available to verify if people who reported that they had received a flu shot had actually had one, although a Québec study showed self-reports of influenza vaccination to be valid when they were compared with medical chart data.²⁹ As well, it is not known if people who reported having received a professional diagnosis of a chronic condition actually did have the condition.

The current *Canadian Immunization Guide* recommends annual vaccination of the elderly and people with medical conditions that place them at high risk of influenza-related complications.³ These conditions are chronic cardiac and pulmonary disorders (including bronchopulmonary dysplasia, cystic fibrosis and asthma), diabetes mellitus, cancer, immunodeficiency, immunosuppression, renal disease, anemia and hemoglobinopathy. Because the NPHS and CCHS did not collect information on all of these conditions, the group identified in this article as having a chronic condition that heightened their susceptibility to complications of influenza (asthma, heart disease, effects of a stroke, chronic bronchitis/emphysema, diabetes, or cancer) is a subset of the actual target population.

The NPHS and CCHS data used in this analysis pertain to the household population. This may bias the results, especially for seniors, because it excludes residents of long-term health care facilities, whose characteristics and experiences may differ from those of household residents. And even for the household population, those who participated in the surveys may have been healthier and more likely than non-respondents to engage in health-promoting behaviour.

The CCHS results apply only to the fourth quarter of data collection, so the sample size (30,735) is less than half that of the 1996/97 NPHS (about 66,435), and the variance on the results is greater. As well, the fourth quarter of the CCHS occurred during the summer, which may have affected perceptions of health, compared with responses that might have been obtained in the winter.

about side effects; cavalier attitudes toward health; lack of physician contact; low physician reimbursement for vaccination; perception of influenza as a minor illness; and inconvenience.³⁰⁻³³

Results from the 2000/01 CCHS confirm that some of these factors are deterrents, at least among

Table 4
Seniors' reasons for not having influenza vaccination, unvaccinated household population aged 65 or older, Canada excluding territories, 1996/97 and 2000/01

	1996/97	2000/01
Total not vaccinated ('000)	1,567	1,146
Reason (%)		
Unnecessary	71	63*
Did not get around to it	12	13
Previous bad reaction	9	9
Doctor said unnecessary	6	5
Fear	3	3 ^{E1}
Not available	2 ^{E2}	F
Other	2 ^{E1}	7*

Data sources: 1996/97 National Population Health Survey, cross-sectional sample, Health file; 2000/01 Canadian Community Health Survey, fourth quarter
Note: Because more than one answer was accepted, total sums to more than 100%.

E1 Coefficient of variation 16.6% to 25.0%

E2 Coefficient of variation 25.0% to 33.3%

F Coefficient of variation greater than 33.3%

* Significantly different from 1996/97 ($p < 0.05$)

the elderly. Although a two-thirds majority of seniors reported having had a flu shot in 2000/01, this left a substantial number who had not. The primary reason for not being vaccinated—mentioned by 63% who had not had a flu shot—was that they did not think it was necessary (Table 4). This was down from 1996/97, when 71% who had not been vaccinated felt that it was unnecessary. In both periods, the second-ranking reason was not getting around to it, and about 10% reported a bad reaction to a previous flu shot. Almost no seniors attributed their failure to be immunized to unavailability of the vaccine.

Concluding remarks

A growing number of Canadians are attempting to ward off the annual threat of influenza by getting a flu shot. In 2000/01, 28% of people aged 20 or older reported that they had been vaccinated against

flu in the previous year, up from 16% in 1996/97. Most likely to have been immunized were seniors and people with chronic conditions, two of the groups targeted for flu shots by health care authorities since the early 1990s. Nonetheless, among seniors, who tend to be particularly susceptible to the flu and its complications, the overwhelming reason for not being immunized was a belief that it was unnecessary.

In the near future, as the number of Canadians aged 65 or older increases, not being immunized may have consequences for the health care system. The question of how to raise immunization levels has been addressed extensively.³⁴ Previous studies found that vaccination was more likely on a physician's recommendation,^{33,35} and was aided by general practitioners' mailing out a reminder.³² The results of the analysis of CCHS data show a significantly high rate of immunization for people who have a regular doctor. One approach that has been suggested is to offer influenza immunization as part of any contact with health care providers. ●

Acknowledgements

The authors thank Theresa Tam for commenting on an earlier version of the manuscript. The authors also thank the following people for providing information on publicly funded influenza immunization programs in their provinces: Elaine Sartison, Alberta; Jane Crickmore, British Columbia; Michelle Long, Manitoba; Lynn Cochrane, New Brunswick; Cathy O'Keefe, Newfoundland; Mahnaz Farhang Mehr, Nova Scotia; Erika Bontovics and Joyce Nsubuga, Ontario; Lamont Sweet and Anne Neatby, Prince Edward Island; Lucie St-Onge and Maryse Guay, Québec; and Rosalie Tuchscherer, Saskatchewan.

References

- 1 Macey JF, Zabchuk P, Winchester B, et al. Influenza in Canada, 2000-2001 season. *Canadian Communicable Disease Report* 2002; 28(3): 17-28.
- 2 Health Canada. Canadian consensus conference on influenza. *Canadian Communicable Disease Report* 1993; 19: 136-46.
- 3 National Advisory Committee on Immunization. Influenza vaccine. In: *Canadian Immunization Guide*, sixth edition (Health Canada, Catalogue H49-8/2002E) Ottawa: Minister of Public Works and Government Services Canada, 2002.
- 4 Nichol KL, Lind A, Margolis KL, et al. The effectiveness of vaccination against influenza in healthy, working adults. *New England Journal of Medicine* 1995; 333(14): 889-93.
- 5 Grotto I, Mandel Y, Green MS, et al. Influenza vaccine efficacy in young, healthy adults. *Clinical Infectious Diseases* 1998; 26: 913-7.
- 6 Saxen H, Virtanen M. Randomized, placebo-controlled double blind study on the efficacy of influenza immunization on absenteeism of health care workers. *Pediatric Infectious Disease Journal* 1999; 18: 779-83.
- 7 White T, Lavoie S, Nettleman MD. Potential cost saving attributable to influenza vaccination of school-aged children. *Pediatrics* 1999; 103: 73.
- 8 Bridges CB, Thompson WW, Meltzer MI, et al. Effectiveness and cost-benefit of influenza vaccination of healthy working adults: A randomized controlled trial. *Journal of the American Medical Association* 2000; 284(13): 1655-63.
- 9 Nichol KL. Cost-benefit analysis of a strategy to vaccinate healthy working adults against influenza. *Archives of Internal Medicine* 2001; 12; 161(5): 749-59.
- 10 Lee PY, Matchar DB, Clements DA, et al. Economic analysis of influenza vaccination and antiviral treatment for healthy working adults. *Annals of Internal Medicine* 2002; 137(4): 225-31.
- 11 Schabas RE. Mass influenza vaccination in Ontario: A sensible move. *Canadian Medical Association Journal* 2000; 164(1): 36-7.
- 12 Demicheli V. Mass influenza vaccination in Ontario. Is it worthwhile? *Canadian Medical Association Journal* 2001; 164(1): 38-9.
- 13 Health Canada. *Flu shots*. Available at: http://www.hc-sc.gc.ca/english/iyh/medical/flu_shots.html. Accessed March 25, 2003.
- 14 Health Canada. *Information Sheets, Influenza*, Population and Public Health Branch. Available at: http://www.hc-sc.gc.ca/pphb-dgspsp/publicat/info/infflu_e.html. Accessed March 25, 2003.
- 15 Macey JF, Li Y, Winchester B, et al. Influenza in Canada, 2001-2002 season. *Canadian Communicable Disease Report* 2003; 29(6): 45-59.
- 16 American Academy of Family Physicians. Information from your family doctor—influenza vaccine. *American Family Physician*. Available at: <http://www.aafp.org/afp/20030215/797ph.html>. Accessed August 8, 2003.
- 17 National Center for Infectious Diseases, Centers for Disease Control. *The Influenza (flu) Viruses*. Available at: <http://www.cdc.gov/ncidod/diseases/flu/viruses.htm>. Updated May 20, 2003. Accessed March 20, 2003.
- 18 Brock University. *Health Education: Flu*. Available at: <http://www.brocku.ca/healthservices/pages/flu.html>. Accessed August 8, 2003.
- 19 Statistics Canada. *Canadian Vital Statistics Database*.
- 20 World Health Organization. *Manual of the International Statistical Classification of Diseases, Injuries and Causes of Death*. Based on the recommendations of the Ninth Revision Conference, 1975. Geneva: World Health Organization, 1977.
- 21 Guay M, Clément P, Lemaire J. *Projets spéciaux de vaccination contre l'influenza et le pneumocoque 2000-2001*. Québec, Québec: Institut national de santé publique du Québec, 2002.
- 22 Guay M. *Projets spéciaux de vaccination influenza-pneumocoque 1999-2000*. Québec, Québec: Institut national de santé publique du Québec, 2000.
- 23 Guay M, DeWals P. Vaccination contre la grippe. In: *Enquête sociale et de santé*, second edition. Québec, Québec: Institut de la statistique du Québec, 2001. Available at: http://www.stat.gouv.qc.ca/publications/sante/e_soc-sante98_pdf.htm.
- 24 Tambay JL, Catlin G. Sample design of the National Population Health Survey. *Health Reports* (Catalogue 82-003) 1995; 7(1); 29-38.
- 25 Swain L, Catlin G, Beaudet MP. The National Population Health Survey—Its longitudinal nature. *Health Reports* (Statistics Canada, Catalogue 82-003) 1999; 10(4): 69-82.
- 26 Béland Y. Canadian Community Health Survey—Methodological overview. *Health Reports* (Statistics Canada, Catalogue 82-003) 2002; 13(3): 9-19.
- 27 Rao JNK, Wu CFJ, Yue K. Some recent work on resampling methods for complex surveys. *Survey Methodology* (Statistics Canada, Catalogue 12-001) 1992; 18(2): 209-17.
- 28 Rust KF, Rao JNK. Variance estimation for complex surveys using replication techniques. *Statistical Methods in Medical Research* 1996; 281-310.
- 29 Yeo D, Mantel H, Liu TP. Bootstrap variance estimation for the National Population Health Survey. *American Statistical Association: Proceedings of the Survey Research Methods Section*. Baltimore: August 1999.
- 30 Carbonneau M, DeWals P, Payette H. *Évaluation des avantages d'un programme de vaccination contre l'influenza chez les personnes âgées vivant en milieu ouvert*. Rapport technique de l'étude pilote. Sherbrooke, Québec: Département de santé communautaire, 1992.
- 31 National Coalition for Adult Immunization. *A Call to Action: Improving Influenza and Pneumococcal Vaccination Rates among High-risk Adults, 1998*. Summary of a roundtable hosted by the National Coalition for Adult Immunization. Available at: <http://www.nfid.org/ncai/publications/roundtable/>. Accessed September 7, 2000.
- 32 van Essen GA, Kuyvenhoven MM, de Melker RA. Why do healthy elderly people fail to comply with influenza vaccination? *Age and Ageing* 1997; 26(4): 275-9.

- 33 Bovier PA, Chamot E, Bouvier Gallacchi M, et al. Importance of patients' perceptions and general practitioners' recommendations in understanding missed opportunities for immunizations in Swiss adults. *Vaccine* 2001; 19(32): 4760-7.
- 34 Gyorkos TW, Tannenbaum TN, Abrahamowicz M, et al. Evaluation of the effectiveness of vaccination delivery methods. *Canadian Journal of Public Health* 1994; Supplement: S14-30.
- 35 Nichol KL, MacDonald R, Hauge M. Factors associated with influenza and pneumococcal vaccination behavior among high-risk adults. *Journal of General Internal Medicine* 1996; 11(11): 673-7.

Appendix

Table A
Distribution of selected characteristics, household population aged 20 or older, Canada excluding territories, 2000/01

	Sample size	Estimated population	
		'000	%
Total	30,735	22,623	100.0
Men	14,010	11,075	49.0
Women	16,725	11,548	51.0
Age group			
20-64	24,042	18,958	83.8
65+	6,693	3,665	16.2
Flu shot in last year			
Yes	9,097	6,147	27.2
No	20,806	15,706	69.4
Missing	832	770	3.4
Household income			
Lower	4,057	2,302	10.2
Higher	23,385	18,075	79.9
Missing	3,293	2,245	9.9
Has regular doctor			
Yes	26,357	19,004	84.0
No	4,364	3,610	16.0
Missing	14	F	F
At least one chronic condition[†]			
Yes	6,852	4,394	19.4
No	23,875	18,222	80.6
Missing	8	F	F
Education			
Less than secondary graduation	8,035	5,009	22.1
Secondary graduation	5,819	4,432	19.6
At least some postsecondary	16,507	12,945	57.2
Missing	374	236	1.0
Smoking			
Never	9,107	7,616	33.7
Former	13,117	8,948	39.6
Daily/Occasional	8,455	6,017	26.6
Missing	56	42	0.2
Self-reported health			
Poor/Fair	4,648	2,791	12.3
Good/Very good/Excellent	26,066	19,823	87.6
Missing	21	F	F
Province			
Newfoundland	818	399	1.8
Prince Edward Island	1,893	100	0.4
Nova Scotia	1,287	689	3.0
New Brunswick	1,089	556	2.5
Québec	4,985	5,531	24.5
Ontario	9,165	8,701	38.5
Manitoba	2,006	787	3.5
Saskatchewan	1,871	688	3.0
Alberta	3,335	2,152	9.5
British Columbia	4,286	3,018	13.3

Data source: 2000/01 Canadian Community Health Survey, fourth quarter

Note: Because of rounding, detail may not add to totals.

[†] Asthma, chronic bronchitis/emphysema, diabetes, heart disease, cancer, effects of stroke

F Coefficient of variation greater than 33.3%

Table B
Provincial distribution of seniors, population with at least one chronic condition, and household population aged 20 or older, Canada excluding territories, 2000/01

	Age 65 or older		At least one chronic condition		Total population aged 20 or older	
	Sample size	Estimated population	Sample size	Estimated population	Sample size	Estimated population
		'000 %		'000 %		'000 %
Canada	6,693	3,665 100.0	6,852	4,394 100.0	30,735	22,623 100.0
Newfoundland	126	60 1.6	170	87 2.0	818	399 1.8
Prince Edward Island	453	17 0.5	449	21 0.5	1,893	100 0.4
Nova Scotia	303	118 3.2	334	150 3.4	1,287	689 3.0
New Brunswick	221	92 2.5	258	122 2.8	1,089	556 2.5
Québec	937	894 24.4	1,062	1,050 23.9	4,985	5,532 24.5
Ontario	2,067	1,413 38.6	2,162	1,716 39.1	9,165	8,701 38.5
Manitoba	521	143 3.9	411	144 3.3	2,006	787 3.5
Saskatchewan	514	136 3.7	426	131 3.0	1,871	688 3.0
Alberta	631	288 7.9	670	411 9.4	3,335	2,152 9.5
British Columbia	920	504 13.8	910	561 12.8	4,286	3,018 13.3

Data source: 2000/01 Canadian Community Health Survey, fourth quarter

Note: Because of rounding, detail may not add to totals.

† Asthma, chronic bronchitis/emphysema, diabetes, heart disease, cancer, effects of stroke