Characteristics and predictors of patients receiving influenza immunization in physician offices versus pharmacies

Nancy M. Waite, PharmD[1] Suzanne M. Cadarette, PhD[2,3], Michael A. Campitelli, MPH[3], Giulia P. Consiglio, BSc[2,3], Sherilyn K.D. Houle, PhD[1], Jeffrey C. Kwong, MD MSc[3,4]

Corresponding author: Nancy M. Waite nmwaite@uwaterloo.ca

Affiliation: [1]School of Pharmacy, University of Waterloo, [2]Leslie Dan Faculty of Pharmacy, University of Toronto; [3]ICES; [4]Department of Family & Community Medicine, University of Toronto

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Abstract: 247

Background: Since 2012, community pharmacists have been allowed to administer influenza vaccines in Ontario, Canada. Little is known about the characteristics of patients immunized in community pharmacies versus physician offices.

Methods: We used Ontario healthcare linked administrative data to identify patients who received influenza vaccine in pharmacies or physician offices for the 2013-14 and 2015-16 influenza seasons. We identified predictors of influenza vaccination in pharmacies versus physician offices using modified Poisson regression, stratified by age group (≤65 years and ≥66 years).

Results: More vaccinations were administered in the 2013-14 (2,677,287) than 2015-16 (2,465,178) influenza season with a decline in percentage vaccinated in a physician office for both age groups. For those immunized, living in a non-urban area or higher income quintile neighbourhood; being vaccinated in November, December or January; not identifying as an immigrant; not having a diagnosis of diabetes or hypertension; and receiving a pharmacist service on the same day as the vaccination were all predictive of being immunized in a pharmacy, regardless of age group. The place of the previous year's vaccination predicted the current influenza season vaccine place of vaccination. Among those aged ≥66 years, individuals who had a hospitalization in the previous year were more likely to be vaccinated in a pharmacy, whereas those with higher annual medication costs were more likely to be vaccinated in a physician office.

Interpretation: Identifying characteristics associated with vaccination in a physician office versus community pharmacy can inform policy and health care practice efforts to target specific populations.

1. Introduction

Influenza vaccination is the most effective mechanism to prevent influenza and the resultant morbidity, mortality, work absenteeism, and lost productivity.[1-7] In 2000, Ontario introduced the Universal Influenza Immunization Program (UIIP) to provide influenza vaccine at no charge to the entire population aged ≥6 months through physician offices, public health clinics, and workplaces. While this strategy was effective in increasing overall influenza vaccine coverage, levels remained suboptimal.[9-11]

In an effort to further improve vaccine coverage, Ontario's UIIP was expanded in 2012 to allow injection-certified pharmacists in community pharmacies to administer influenza vaccines to Ontarians aged ≥5 years. Most Ontario residents live within close distance of a pharmacy (91% within 5 kilometres, and 65% within 800 metres),[12] and 51% visit a pharmacy at least once per month.[13] Additionally, pharmacies offer access to a pharmacist during extended evening and weekend hours, no appointments are necessary for many of their services, and they are available to individuals who do not have a primary care provider. It was anticipated that the high degree of public access to trained community pharmacists would positively impact vaccine coverage. Indeed, similar policies have resulted in long-term absolute increases of 2.2% to 7.6% in the number of adults aged 25-59 years receiving influenza vaccine (no significant change for those younger or older) in the United States,[14] and these effects have been confirmed in systematic reviews.[15,16] In Canada, people living in a province where pharmacist influenza vaccine administration is allowed are 5% more likely to be vaccinated than those residing in provinces without this option.[17]

While some data exist on the impact of pharmacists being permitted to immunize on influenza vaccine coverage, little research has been done to understand the types of patients who use this service – particularly in comparison to those who receive the vaccine in physician offices. The current study used Ontario healthcare administrative data to: 1) characterize patients being immunized in a community pharmacy or physician office; and 2) identify predictors of receiving their vaccine in a community pharmacy or physician office.

2. Methods

We identified all individuals who had a record in Ontario's population-based health administrative data of receipt of an influenza vaccine in community pharmacies or physician offices from October to March in the 2013-14 and 2015-16 influenza seasons. These two influenza seasons were two and four years post policy implementation, avoiding the initial year of implementation when the service was first being introduced across a limited number of pharmacies and to allow time for the service to become more established. Demographic and health services utilization data on these individuals were analyzed to compare the characteristics and predictors of patients receiving influenza vaccination in a community pharmacy versus a physician office. The health administrative databases were linked using encoded identifiers and analyzed at ICES (see Appendix A for a description of the databases). In the event that more than one vaccination was registered for the same patient within an influenza season, the earliest vaccination in the season was used as the patient's index date. Ethics approval was obtained from the Research Ethics Board of the University of Waterloo (Waterloo, Ontario, Canada).

2.1 Influenza vaccination data sources

The Ontario Health Insurance Plan (OHIP) billing claims database captures influenza vaccines administered in physician offices using service provision codes. Community pharmacies bill for an influenza immunization administration fee by processing a claim for that product to the government payer using its Drug Identification Number (DIN). This information is contained in the Ontario Drug Benefits (ODB) database. The claim is associated with a pharmacy rather than a specific pharmacist, hence in this study we refer to vaccine administration in a community pharmacy (understanding that these were community pharmacist-administered vaccines). Appendix B provides the OHIP service codes and ODB DINs used for data extraction.

2.2 Patient characteristics at time of immunization

Individual baseline characteristics were determined relative to their index date (i.e., vaccination date). The Ontario Registered Persons Database was used to determine age, sex, Rurality Index of Ontario (RIO) score, and neighborhood income quintile of residence. The RIO score is a continuous measure of remoteness specific to Ontario that accounts for community size and travel time to basic and advanced medical centres.[18] Patients were grouped into Urban (RIO score 0-9); Non-major urban (RIO score 10-39); and Rural (RIO score ≥40). Neighborhood income quintile, which has been shown to be a reasonable proxy for socioeconomic-status,[19] was obtained by linking patient postal codes to census data. The Ontario portion of the Immigration, Refugees, and Citizenship Canada database was used to determine the landing date for immigrants to Ontario since 1985. Patients were classified as landing <5 years, 5-9 years ago, or ≥10 years ago, or being a long-term resident.

Validated algorithms were applied to the health care utilization databases to determine certain diagnoses as of the time of immunization: diabetes,[20] hypertension,[21] chronic obstructive pulmonary disease,[22] asthma,[23] congestive heart failure,[24] and acute myocardial infarction.[25] The incidence of cancer, except non-melanoma skin cancers, was determined using the Ontario Cancer Registry.[26]

Patients requiring a hospital admission, emergency department visit, or home care visit in the past year were identified using the Discharge Abstract Database, National Ambulatory Care Reporting System, and Home Care Database, respectively. The number of physician office visits in the past year, and whether a patient received a periodic health examination, was obtained from the OHIP database. For patients aged ≥66 years, the ODB database was used to capture the number of unique prescription medications prescribed in the past year, to categorize their total cost (<$500, $500-$999, $1000-$1999, $2000-$2999, $3000-$3999, ≥$4000), and to flag whether the recipient was a low-income senior. Because drug coverage in Ontario is only universal for adults aged ≥65 years, we measured prescription medications restricted to those aged ≥66 years so that one year of data is available to calculate drug costs. However, since individuals of all ages qualify for pharmacist services (MedsCheck Annual, MedsCheck Diabetes, MedsCheck at Home, Pharmaceutical Opinion Program, and Smoking Cessation Program),[27] the ODB database was used to assess the receipt of these services in the entire study population in the year prior to (including up to the day of) immunization.

2.3 Statistical analysis

All analyses were stratified by age group (≤65 years or ≥66 years). Descriptive characteristics of patients were summarized as means or proportions.

Modified Poisson regression models were used to estimate the unadjusted and adjusted associations between all of the measured baseline characteristics and the receipt of influenza vaccination in a pharmacy.[28] Modified Poisson regression was used to calculate relative risk ratios because the outcome of receiving influenza vaccination from a pharmacist was relatively common; using standard logistic regression models to estimate odds ratios would have overestimated the measure of effect for each predictor.[29]

Analyses were performed using SAS Enterprise Guide, version 9.3 (SAS Institute Inc.) and STATA, version 13.1 (StataCorp LP).

3. Results

Characteristics by Age Group and Influenza Season

The total number of individuals recorded in the administrative data as vaccinated decreased by 7.9% between the 2013-14 (n=2,677,287) and 2015-16 (n=2,465,178) influenza seasons, with a 14.2% decrease among individuals aged ≤65 years and 2.9% increase in those aged ≥66 years. Appendix C summarizes the characteristics of individuals vaccinated in the two influenza seasons by age group. Few differences were seen between influenza seasons. Between age groups, a higher proportion of older patients lived in rural areas, were not recent immigrants, had been diagnosed with a number of chronic diseases, had been vaccinated in the previous year in physician offices, used healthcare services in the previous year (including remunerated pharmacist services), and were vaccinated in October.

Characteristics by Age Group, Influenza Season, and Immunization Provider

Table 1 presents information about those vaccinated by age group, influenza season, and provider location. The percentage of patients immunized in physician offices was higher in both age groups and influenza seasons, but decreased between the 2013/14 and 2015/16 influenza seasons from 67.1% to 60.9% for those aged ≤65 years, and from 79.5% to 71.2% for older patients. In the 2013-14 influenza season, 47.3% of individuals aged ≤65 years vaccinated in a physician office had been vaccinated in a physician office the previous year, compared to 75.6% of individuals aged ≥66 years; little change was seen for 2015-16. In contrast, in 2013-14, 16.9% and 16.5% of individuals aged ≤65 and ≥66 years, respectively, were vaccinated in a pharmacy the previous year, increasing markedly in 2015-16 to 49.5% and 53.5% of individuals aged ≤65 and ≥66 years, respectively.

Predictors of Immunization Setting

Figures 1 and 2 illustrate the Incidence Rate Ratios (IRRs) for being immunized in physician offices compared to community pharmacies for those aged ≤65 years and ≥66 years for the 2015-16 influenza season. Living in smaller communities, living in highest income quintile neighbourhoods, and receiving a pharmacist service on the same day as the vaccination were all predictive of being immunized in a pharmacy, whereas immigrant status, prior vaccination in a physician office, and the presence of certain chronic health conditions (diabetes, hypertension and COPD) were associated with immunization in a physician office, regardless of age group. The location of the previous year's vaccination (whether physician office or pharmacy) was a strong predictor for the current influenza season vaccine provider. Among individuals aged ≥66 years, those who were hospitalized in the previous year were more likely to be vaccinated in a pharmacy, whereas low-income seniors and seniors with higher annual medication

costs were more likely to be vaccinated in a physician office. Among individuals aged ≤65 years, hospitalization in the previous year predicted vaccination in a physician office, and home care use or provision of a pharmaceutical service in the past year predicted vaccination in a pharmacy. Adjusting for other factors, immunization in pharmacies was more common in November, December, and January. Immunization in pharmacies was least common in March among patients aged ≥66 years.

Similar results were observed for the 2013-14 influenza season (data not shown).

4. Interpretation

For the 2013-14 and 2015-16 influenza seasons, Ontarians were more likely to have the influenza vaccine administered in a physician office than a community pharmacy, but over time pharmacy-based vaccination increased, likely reflecting an increased awareness of the availability of this pharmacist service. Over the past 20 years, pharmacists have been increasingly involved as partners with other health care professionals and public health departments in vaccination campaigns and as immunizers themselves.[30-33] Pharmacists can administer one, several, or all vaccines across all US states and in 9 of 10 Canadian provinces, with influenza vaccination permitted in all jurisdictions where pharmacists can vaccinate.[34,35] Patient response to pharmacists as immunizers has been positive.[36,37] For example, Papastergiou et al. found that 92% of patients who had been vaccinated by a pharmacist were "very satisfied" with the service, with 28% of respondents overall and 21% of patients at high risk for influenza complications indicating that they would not have been vaccinated at all if the service was not available at the pharmacy.[36]

Demographic predictors of influenza vaccination in a physician office included living in an urban area or lower income quintile neighbourhood, identifying as an immigrant, having a chronic disease such as diabetes or hypertension, and being a senior with a low income or a higher drug cost burden. We hypothesize that many of these patients would see a physician on a regular basis due to their medical complexity, or may be more familiar with physician-delivered care versus pharmacist-delivered care. In contrast, vaccinated individuals who lived in non-urban communities and those without a chronic disease may be more inclined to take advantage of the accessibility and convenience of community pharmacies. The higher likelihood of being vaccinated in a physician office in October is likely due to prioritization of physician offices for delivery of influenza vaccines in order to vaccinate high-risk individuals as early as possible.

Loyalty and familiarity appeared to play an important role in determining influenza vaccine administration location, as demonstrated by the strong association between current year and previous year's vaccine location. Patient surveys following vaccination by a pharmacist found that 92% of respondents would receive their next influenza vaccine at a pharmacy.[35] Interestingly, physician office visits and periodic physician health exams within the past year were not predictive of vaccination in a physician office, and receipt of pharmacist services in the past year was a weak predictor of pharmacy-administered influenza vaccine. While infrequent (less than 2% of patients), receiving another pharmacist service on the day of vaccination was highly associated with influenza vaccination at a pharmacy. This may occur as a result of pharmacists recommending the influenza vaccine during an activity such as a medication review, or using the influenza vaccine opportunity to inquire about medication use, leading to provision of another pharmacist service.

As the health care community continues to try to increase influenza vaccination coverage, there is further opportunity to increase the number of individuals receiving influenza vaccine. Understanding which patients are more likely to be vaccinated in a physician office or pharmacy presents several opportunities for more targeted influenza vaccine advocacy. Pharmacies can consider using public and individually-tailored approaches to better reach individuals within certain demographics, either focussing on attracting individuals who are less likely to be vaccinated by a pharmacist (for example, by using pharmacy dispensing records to identify high-risk individuals), or maximizing uptake among those who appear to prefer pharmacy-based immunizations. Further opportunity also exists for physician, pharmacist, and public health collaboration to better co-ordinate influenza vaccination initiatives within a community and capitalize on patient preferences for vaccine administration.

Study limitations include that Ontario influenza vaccine data for public health influenza vaccination clinics, long-term care facilities, workplaces, Community Health Centres, and nurses in community pharmacies and some Family Health Teams are not collected at the individual patient level (not linkable to ICES demographic or health data) and, therefore, are not included in this study. Errors in the billing data are also a possibility. The covariates related to prescription drug claims are limited to individuals aged ≥65 years and thus predictive status is unknown for those aged <65 years.

This paper addresses a gap in the literature related to characterizing patients who have the influenza vaccine administered in a physician office or a community pharmacy. To further increase influenza vaccination coverage, both health care provider groups and policy-makers can use this information to target patients they are more likely to vaccinate and identify mechanisms to promote vaccination to those they are less likely to vaccinate. It is also an opportunity for physicians and pharmacists to encourage patients to take advantage of the availability of immunizations across various settings, to best align with their preferences and encourage uptake.

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Table 1. Baseline characteristics by age group and immunization provider location for those vaccinated in 2013-14 and 2015-16 influenza seasons

Characteristic	2013/14 Influenza Season				2015/16 Influenza Season			
	Aged 65 years and under		Aged 66 years and older		Aged 65 years and under		Aged 66 years and older	
	Vaccinated in a pharmacy (N=555,913)	Vaccinated in a physician office (N=1,135,212)	Vaccinated in a pharmacy (N=201,816)	Vaccinated in a physician office (N=784,346)	Vaccinated in a pharmacy (N=567,539)	Vaccinated in a physician office (N=883,055)	Vaccinated in a pharmacy (N=292,255)	Vaccinated in a physician office (N=722,329)
Demographics								
Age at immunization, Mean ± SD	42.35 ± 17.79	40.02 ± 20.46	74.58 ± 6.95	75.99 ± 7.20	43.35 ± 17.75	40.73 ± 20.41	74.89 ± 7.03	76.09 ± 7.27
Sex (female)	303,116 (54.5%)	627,361 (55.3%)	110,136 (54.6%)	428,674 (54.7%)	311,438 (54.9%)	491,171 (55.6%)	159,545 (54.6%)	392,979 (54.4%)
Rurality index of Ontario score								
Urban	400,929 (72.1%)	900,265 (79.3%)	128,967 (63.9%)	554,548 (70.7%)	407,899 (71.9%)	704,958 (79.8%)	182,367 (62.4%)	516,802 (71.5%)
Non-major Urban	128,929 (23.2%)	199,741 (17.6%)	58,752 (29.1%)	190,992 (24.4%)	132,262 (23.3%)	151,809 (17.2%)	88,473 (30.3%)	171,354 (23.7%)
Rural	26,055 (4.7%)	35,206 (3.1%)	14,097 (7.0%)	38,806 (4.9%)	27,378 (4.8%)	26,288 (3.0%)	21,415 (7.3%)	34,173 (4.7%)
Neighbourhood income quintile								
1 (lowest)	81,645 (14.7%)	215,212 (19.0%)	31,307 (15.5%)	135,463 (17.3%)	84,275 (14.8%)	163,833 (18.6%)	44,625 (15.3%)	122,375 (16.9%)
2	94,213 (16.9%)	221,639 (19.5%)	37,899 (18.8%)	160,329 (20.4%)	96,782 (17.1%)	172,238 (19.5%)	53,953 (18.5%)	146,153 (20.2%)
3	106,402 (19.1%)	227,810 (20.1%)	38,281 (19.0%)	156,294 (19.9%)	109,083 (19.2%)	177,109 (20.1%)	56,336 (19.3%)	144,092 (19.9%)
4	125,795 (22.6%)	239,132 (21.1%)	43,712 (21.7%)	163,581 (20.9%)	130,181 (22.9%)	191,164 (21.6%)	63,825 (21.8%)	154,003 (21.3%)
5 (highest)	147,858 (26.6%)	231,419 (20.4%)	50,617 (25.1%)	168,679 (21.5%)	147,218 (25.9%)	178,711 (20.2%)	73,516 (25.2%)	155,706 (21.6%)
Low income senior	N/A	N/A	19,746 (9.8%)	124,216 (15.8%)	N/A	N/A	26,320 (9.0%)	103,719 (14.4%)
Month of vaccination								
October	139,731 (25.1%)	440,771 (38.8%)	85,260 (42.2%)	450,054 (57.4%)	99,753 (17.6%)	245,473 (27.8%)	82,537 (28.2%)	309,345 (42.8%)
November	237,952 (42.8%)	418,580 (36.9%)	87,501 (43.4%)	262,335 (33.4%)	343,003 (60.4%)	421,753 (47.8%)	172,606 (59.1%)	324,576 (44.9%)
December	59,119 (10.6%)	124,597 (11.0%)	13,857 (6.9%)	45,878 (5.8%)	95,324 (16.8%)	150,302 (17.0%)	29,988 (10.3%)	67,038 (9.3%)
January	113,432 (20.4%)	129,580 (11.4%)	14,556 (7.2%)	22,433 (2.9%)	23,256 (4.1%)	47,380 (5.4%)	5,913 (2.0%)	16,638 (2.3%)
February	4,823 (0.9%)	17,492 (1.5%)	569 (0.3%)	2,998 (0.4%)	4,808 (0.8%)	13,865 (1.6%)	1,029 (0.4%)	3,732 (0.5%)
March	856 (0.2%)	4,192 (0.4%)	73 (0.0%)	648 (0.1%)	1,395 (0.2%)	4,282 (0.5%)	182 (0.1%)	1,000 (0.1%)
Immigration								
None	494,681 (89.0%)	920,309 (81.1%)	194,136 (96.2%)	716,582 (91.4%)	503,451 (88.7%)	719,352 (81.5%)	279,858 (95.8%)	656,326 (90.9%)
<5 years	11,552 (2.1%)	40,211 (3.5%)	813 (0.4%)	5,469 (0.7%)	6,013 (1.1%)	14,291 (1.6%)	600 (0.2%)	2,886 (0.4%)
5-9 years	13,002 (2.3%)	44,758 (3.9%)	1,009 (0.5%)	7,729 (1.0%)	13,808 (2.4%)	33,501 (3.8%)	1,609 (0.6%)	7,656 (1.1%)
≥10 years	36,678 (6.6%)	129,934 (11.4%)	5,858 (2.9%)	54,566 (7.0%)	44,267 (7.8%)	115,911 (13.1%)	10,188 (3.5%)	55,461 (7.7%)
Comorbidity								
Diabetes	54,584 (9.8%)	168,581 (14.9%)	53,936 (26.7%)	264,997 (33.8%)	62,665 (11.0%)	144,678 (16.4%)	81,964 (28.0%)	256,396 (35.5%)

Hypertension	121,978 (21.9%)	308,227 (27.2%)	140,459 (69.6%)	611,099 (77.9%)	130,272 (23.0%)	245,319 (27.8%)	204,878 (70.1%)	562,473 (77.9%)
Chronic obstructive pulmonary disease	9,398 (1.7%)	26,884 (2.4%)	17,440 (8.6%)	80,492 (10.3%)	10,869 (1.9%)	22,807 (2.6%)	25,416 (8.7%)	74,029 (10.2%)
Asthma	95,131 (17.1%)	205,529 (18.1%)	25,396 (12.6%)	115,787 (14.8%)	99,150 (17.5%)	162,238 (18.4%)	38,815 (13.3%)	110,502 (15.3%)
Congestive heart failure	4,817 (0.9%)	14,809 (1.3%)	15,172 (7.5%)	81,333 (10.4%)	5,630 (1.0%)	12,601 (1.4%)	22,626 (7.7%)	75,666 (10.5%)
Acute myocardial infarction	5,906 (1.1%)	15,179 (1.3%)	10,648 (5.3%)	45,921 (5.9%)	6,190 (1.1%)	12,374 (1.4%)	15,243 (5.2%)	42,086 (5.8%)
Cancer	18,570 (3.3%)	40,066 (3.5%)	30,555 (15.1%)	121,804 (15.5%)	23,249 (4.1%)	37,210 (4.2%)	49,457 (16.9%)	125,255 (17.3%)
Healthcare use in previous year								
Influenza vaccination in a physician office	132,308 (23.8%)	537,155 (47.3%)	92,143 (45.7%)	593,096 (75.6%)	91,801 (16.2%)	406,390 (46.0%)	87,363 (29.9%)	515,454 (71.4%)
Influenza vaccination in a community pharmacy	93,868 (16.9%)	27,364 (2.4%)	33,207 (16.5%)	15,944 (2.0%)	281,121 (49.5%)	82,324 (9.3%)	156,379 (53.5%)	74,034 (10.2%)
Inpatient hospitalization	23,828 (4.3%)	80,604 (7.1%)	19,907 (9.9%)	93,660 (11.9%)	24,557 (4.3%)	66,061 (7.5%)	28,519 (9.8%)	86,168 (11.9%)
Emergency Department visit	121,020 (21.8%)	268,251 (23.6%)	55,602 (27.6%)	227,776 (29.0%)	124,111 (21.9%)	213,063 (24.1%)	81,315 (27.8%)	214,099 (29.6%)
Home care use	14,442 (2.6%)	37,564 (3.3%)	23,233 (11.5%)	113,629 (14.5%)	15,529 (2.7%)	30,896 (3.5%)	33,233 (11.4%)	104,690 (14.5%)
Number of physician office visits, Mean ± SD	8.43 ± 12.25	11.25 ± 14.15	14.30 ± 15.83	18.02 ± 18.59	8.83 ± 12.86	11.72 ± 14.91	14.17 ± 15.67	17.92 ± 18.70
Periodic health examination	36,291 (6.5%)	79,012 (7.0%)	16,748 (8.3%)	66,430 (8.5%)	30,867 (5.4%)	45,541 (5.2%)	18,865 (6.5%)	43,415 (6.0%)
Previous pharmacy use								
Number of unique prescription medications in past year, Mean ± SD	N/A	N/A	9.59 ± 6.31	10.27 ± 6.94	N/A	N/A	9.65 ± 6.25	10.18 ± 6.90
Total cost of prescription medications in past year			1,373.28 ± 3,764.67	1,596.94 ± 3,343.26			1,446.58 ± 4,113.70	1,655.59 ± 3,731.92
<$500	N/A	N/A	83,738 (41.5%)	260,435 (33.2%)	N/A	N/A	125,613 (43.0%)	253,066 (35.0%)
$500-$999	N/A	N/A	42,057 (20.8%)	168,536 (21.5%)	N/A	N/A	60,133 (20.6%)	152,874 (21.2%)
$1000-$1999	N/A	N/A	39,853 (19.7%)	177,024 (22.6%)	N/A	N/A	53,761 (18.4%)	153,428 (21.2%)
$2000-$2999	N/A	N/A	17,184 (8.5%)	82,927 (10.6%)	N/A	N/A	24,409 (8.4%)	74,183 (10.3%)
$3000-$3999	N/A	N/A	7,943 (3.9%)	39,555 (5.0%)	N/A	N/A	10,827 (3.7%)	34,964 (4.8%)
>$4000	N/A	N/A	11,041 (5.5%)	55,869 (7.1%)	N/A	N/A	17,512 (6.0%)	53,814 (7.5%)
Pharmacist service in past year	59,275 (10.7%)	122,507 (10.8%)	75,413 (37.4%)	285,434 (36.4%)	63,983 (11.3%)	102,774 (11.6%)	103,553 (35.4%)	260,805 (36.1%)
Pharmacist service on day of vaccination	4,238 (0.8%)	3,387 (0.3%)	4,848 (2.4%)	6,835 (0.9%)	4,760 (0.8%)	2,913 (0.3%)	7,117 (2.4%)	6,074 (0.8%)

Figure 1. Adjusted IRRs for being immunized in a physician office vs a community pharmacy for individuals aged ≤65 years

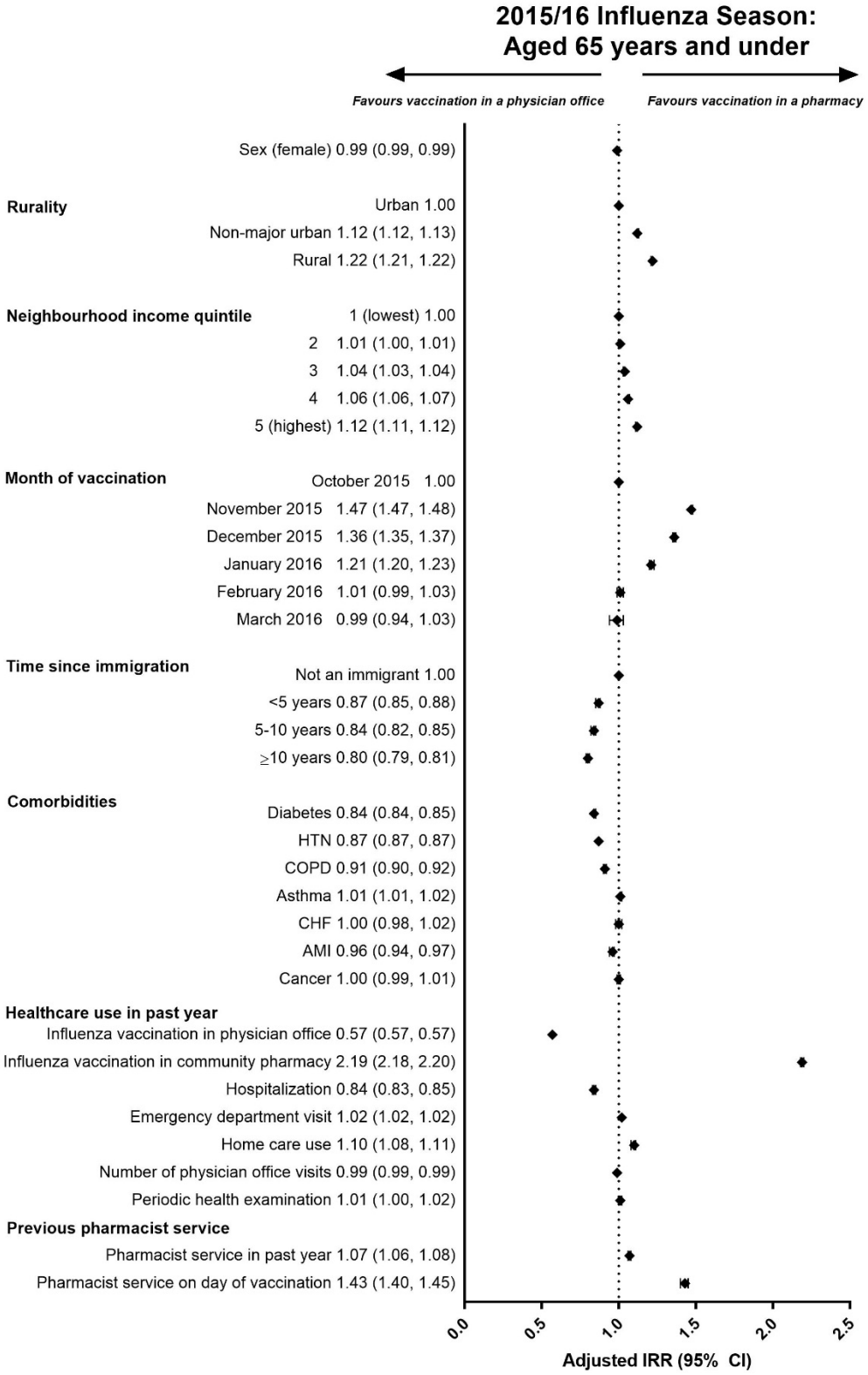
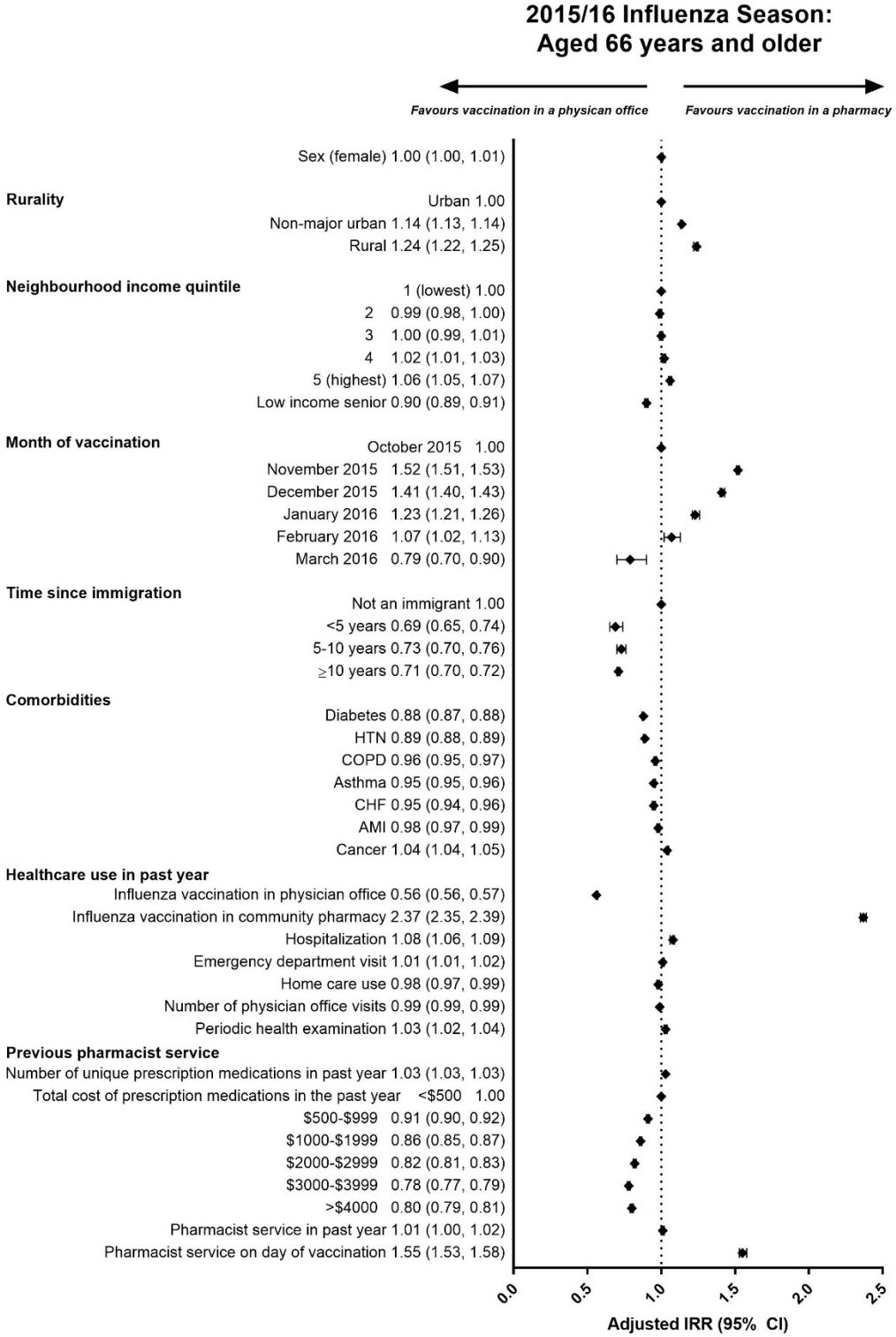


Figure 2. Adjusted IRRs for being immunized in a physician office vs a community pharmacy for individuals aged ≥66 years



Appendix A. Description of Ontario health administrative data sources included in this study

Database	Description
Immigration, Refugees, and Citizenship Canada's (CIC) Permanent Resident Database	The Ontario portion of the IRCC Permanent Resident Database includes immigration application records for people who initially applied to land in Ontario since 1985. The dataset contains permanent residents' demographic information such as country of citizenship, level of education, mother tongue, and landing date. New immigrants who are currently residing in Ontario but originally landed in another province are not captured in this dataset.
Discharge Abstract Database (DAD)	The DAD is compiled by the Canadian Institute for Health Information and contains administrative, clinical (diagnoses and procedures), and demographic information for all admissions to acute care hospitals in Ontario. DAD records have been demonstrated to have excellent agreement (over 99%) for demographic and administrative data. Regarding diagnoses, median agreement between original DAD records and re-abstracted records for the 50 most common most responsible diagnoses was noted to be 81% (Sensitivity 82%; Specificity 82%).[1] The corresponding median agreement for the 50 most frequently performed surgical procedures was 92% (sensitivity 95%, positive predictive value 91%).
Home Care database (HCD)	The HCD database contains information regarding the referral, authorization, and provision of community-based home health care services that are coordinated within Ontario's Local Health Integration Networks. The database is administered by Health Shared Services Ontario (formerly known as the Ontario Association of Community Care Access Centres).
National Ambulatory Care Reporting System (NACRS)	The NACRS is compiled by the Canadian Institute for Health Information and contains administrative, clinical (diagnoses and procedures), and demographic information for all patient visits made to hospital- and community-based ambulatory care centres (emergency departments, day surgery units, dialysis and cancer care clinics) in Ontario.
Ontario Drug Benefit (ODB) program database	The ODB database contains prescription medication claims for those covered under the provincial drug program, mainly those aged 65 years and older, nursing home residents, and those receiving social assistance. Each medication claim has an associated prescriber identifier which indicates the health practitioner who wrote the prescription. A special flag in the ODB database indicates whether the prescription was dispensed in the community or nursing home setting.

	An audit of 5,155 randomly selected prescriptions dispensed from 50 Ontario pharmacies determined that the ODB had an error rate of 0.7% and none of the pharmacy characteristics examined (locations, owner affiliation, productivity) were associated with coding errors.[2]
Ontario Health Insurance Plan (OHIP) physician billing claims database	The OHIP physician billing claims database contains information on all outpatient services provided by fee-for-service physicians in Ontario and "shadow billings" for physicians paid under alternate payment plans. Billing codes are specific in identifying services provided in the nursing home setting. Billing codes on the claims (OHIP fee codes) identify the care provider, their area of specialization and the type and location of service.
Registered Persons Database (RPDB)	The RPDB provides basic demographic information (age, sex, area of residence, date of birth, and date of death for deceased individuals) about anyone who has ever received an Ontario health card number (e.g., been enrolled in the province's publicly funded health insurance system). The RPDB also indicates the time periods for which an individual was eligible to receive publicly funded health insurance benefits and the best known postal code for each registrant on July 1st of each year.

References

1. Juurlink, D, Preyra, C, Croxford, R, Chong, A, Austin, P, Tu, J, and Laupacis, A. Canadian Institute for Health Information Discharge Abstract Database: A Validation Study. 2006. Toronto, Institute for Clinical Evaluative Sciences.
Ref Type: Report

2. Levy AR, O'Brien BJ, Sellors C, Grootendorst P, Willison D: Coding accuracy of administrative drug claims in the Ontario Drug Benefit database. Can J Clin Pharmacol 2003; 10: 67-71

Appendix B. Influenza vaccine codes

OHIP fee codes for influenza vaccines

Fee code	Description
G590	INFLUENZA AGENT +VISIT
G591	INJECTION OF INFLUENZA AGENT - SOLE REASON
Q590	BASIC FLU SHOT FEE-PER-VISIT PREMIUM FHN/FHO

ODB Drug Identification Numbers for influenza vaccines

DIN	Product Name
02015986	FLUVIRAL S/F
02223929	VAXIGRIP
02269562	INFLUVAC
02346850	AGRIFLU
02362384	FLUAD
02365936	FLUZONE
02420643	FLUZONE QUADRIVALENT
02420686	FLUVIRAL
02420783	FLULAVAL TETRA
02426544	FLUMIST QUADRIVALENT
02428881	AGRIFLU
02432730	FLUZONE QUADRIVALENT
09857501	FLUZONE

Appendix C. Characteristics by age group for those vaccinated in 2013-14 and 2015-16 influenza seasons

Characteristic	2013/14 Influenza Season		2015/16 Influenza Season	
	Aged 65 years and under (n=1,691,125)	Aged 66 years and older (n=986,162)	Aged 65 years and under (n= 1,450,594)	Aged 66 years and older (n= 1,014,584)
Demographics				
Age at immunization, Mean ± SD	40.79 ± 19.66	75.70 ± 7.18	41.75 ± 19.45	75.75 ± 7.22
Sex (female)	930,477 (55.0%)	538,810 (54.6%)	802,609 (55.3%)	552,524 (54.5%)
Rurality index of Ontario score				
Urban	1,301,194 (76.9%)	683,515 (69.3%)	1,112,857 (76.7%)	699,169 (68.9%)
Non-major Urban	328,670 (19.4%)	249,744 (25.3%)	284,071 (19.6%)	259,827 (25.6%)
Rural	61,261 (3.6%)	52,903 (5.4%)	53,666 (3.7%)	55,588 (5.5%)
Neighbourhood income quintile				
1 (lowest)	296,857 (17.6%)	166,770 (16.9%)	248,108 (17.1%)	167,000 (16.5%)
2	315,852 (18.7%)	198,228 (20.1%)	269,020 (18.5%)	200,106 (19.7%)
3	334,212 (19.8%)	194,575 (19.7%)	286,192 (19.7%)	200,428 (19.8%)
4	364,927 (21.6%)	207,293 (21.0%)	321,345 (22.2%)	217,828 (21.5%)
5 (highest)	379,277 (22.4%)	219,296 (22.2%)	325,929 (22.5%)	229,222 (22.6%)
Low income senior	*	143,962 (14.6%)	*	130,039 (12.8%)
Month of vaccination				
October	580,502 (34.3%)	535,314 (54.3%)	345,226 (23.8%)	391,882 (38.6%)
November	656,532 (38.8%)	349,836 (35.5%)	764,756 (52.7%)	497,182 (49.0%)
December	183,716 (10.9%)	59,735 (6.1%)	245,626 (16.9%)	97,026 (9.6%)
January	243,012 (14.4%)	36,989 (3.8%)	70,636 (4.9%)	22,551 (2.2%)
February	22,315 (1.3%)	3,567 (0.4%)	18,673 (1.3%)	4,761 (0.5%)
March	5,048 (0.3%)	721 (0.1%)	5,677 (0.4%)	1,182 (0.1%)
Immigration				
None	1,414,990 (83.7%)	910,718 (92.3%)	1,222,803 (84.3%)	936,184 (92.3%)
<5 years	51,763 (3.1%)	6,282 (0.6%)	20,304 (1.4%)	3,486 (0.3%)

5-9 years	57,760 (3.4%)	8,738 (0.9%)	47,309 (3.3%)	9,265 (0.9%)
≥10 years	166,612 (9.9%)	60,424 (6.1%)	160,178 (11.0%)	65,649 (6.5%)
Comorbidity				
Diabetes	223,165 (13.2%)	318,933 (32.3%)	207,343 (14.3%)	338,360 (33.3%)
Hypertension	430,205 (25.4%)	751,558 (76.2%)	375,591 (25.9%)	767,351 (75.6%)
Chronic obstructive pulmonary disease	36,282 (2.1%)	97,932 (9.9%)	33,676 (2.3%)	99,445 (9.8%)
Asthma	300,660 (17.8%)	141,183 (14.3%)	261,388 (18.0%)	149,317 (14.7%)
Congestive heart failure	19,626 (1.2%)	96,505 (9.8%)	18,231 (1.3%)	98,292 (9.7%)
Acute myocardial infarction	21,085 (1.2%)	56,569 (5.7%)	18,564 (1.3%)	57,329 (5.7%)
Cancer	58,636 (3.5%)	152,359 (15.4%)	60,459 (4.2%)	174,712 (17.2%)
Healthcare use in previous year				
Influenza vaccination in a physician office	669,463 (39.6%)	685,239 (69.5%)	498,191 (34.3%)	602,817 (59.4%)
Influenza vaccination in a community pharmacy	121,232 (7.2%)	49,151 (5.0%)	363,445 (25.1%)	230,413 (22.7%)
Inpatient hospitalization	104,432 (6.2%)	113,567 (11.5%)	90,618 (6.2%)	114,687 (11.3%)
Emergency Department visit	389,271 (23.0%)	283,378 (28.7%)	337,174 (23.2%)	295,414 (29.1%)
Home care use	52,006 (3.1%)	136,862 (13.9%)	46,425 (3.2%)	137,923 (13.6%)
Number of physician office visits, Mean ± SD	10.32 ± 13.62	17.26 ± 18.13	10.59 ± 14.21	16.84 ± 17.96
Periodic health examination	115,303 (6.8%)	83,178 (8.4%)	76,408 (5.3%)	62,280 (6.1%)
Previous pharmacy use				
Number of unique prescription medications in past year, Mean ± SD	*	10.13 ± 6.82	*	10.03 ± 6.72
Total cost of prescription medications in past year	*	1,551.17 ± 3,434.90	*	1,595.38 ± 3,846.95
<$500	*	344,173 (34.9%)	*	378,679 (37.3%)
$500-$999	*	210,593 (21.4%)	*	213,007 (21.0%)
$1000-$1999	*	216,877 (22.0%)	*	207,189 (20.4%)
$2000-$2999	*	100,111 (10.2%)	*	98,592 (9.7%)
$3000-$3999	*	47,498 (4.8%)	*	45,791 (4.5%)
>$4000	*	66,910 (6.8%)	*	71,326 (7.0%)
Pharmacist service in past year	181,782 (10.7%)	360,847 (36.6%)	166,757 (11.5%)	364,358 (35.9%)
Pharmacist service on day of vaccination	7,625 (0.5%)	11,683 (1.2%)	7,673 (0.5%)	13,191 (1.3%)