

The Impact of Influenza-associated Respiratory Illnesses on Hospitalizations, Physician Visits, Emergency Room Visits, and Mortality

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ABSTRACT

Objectives: Although the increased risk of hospitalization and mortality during influenza seasons has been documented extensively, there is a relative paucity of research on the impact of influenza-related illnesses on other health care use indicators, such as physician use. The purpose of this study was to examine the impact of influenza-associated respiratory illnesses on the Winnipeg health care system, including hospitalizations, physician visits and emergency room visits. Their impact on mortality was also examined.

Methods: Administrative data were used to track health care use and mortality over four influenza seasons (1995-96 to 1998-99). Excess health care use and deaths were calculated by subtracting rates during influenza seasons from those during weeks when influenza viruses were not circulating.

Results: Significant excess hospitalization, physician visit, and emergency room visit rates emerged for influenza and pneumonia, acute respiratory diseases, and chronic lung disease, especially among children and adults aged 65 and over. Considerable excess mortality due to influenza and pneumonia and chronic lung disease among individuals aged 65 and over also emerged, particularly among nursing home residents.

Discussion: Influenza-associated respiratory illnesses have a substantial impact on the health care system. Given the burden of illness among children during influenza seasons, the study further suggests that influenza vaccination might be considered for this age group.

La traduction du résumé se trouve à la fin de l'article.

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Influenza is a major cause of morbidity and death. 70,000 to 75,000 hospitalizations and approximately 6,700 deaths each year are attributed to influenza and pneumonia in Canada, with influenza and pneumonia together being the sixth leading cause of death.^{1,2} Although the increased risk of hospitalization and mortality during influenza seasons has been documented extensively,³⁻¹⁹ there is a relative paucity of research on the impact of influenza on other health care use indicators, such as physician use and emergency room use.^{17,20} The actual burden of illness attributable to influenza may therefore be underestimated given the extant literature. Thus, the purpose of the present study was to examine the impact of influenza-associated respiratory conditions not only on hospital use and mortality, but also on physician visits and emergency room visits.

The complications of influenza are primarily respiratory in nature and include exacerbation of pre-existing medical conditions, such as chronic lung disease. We focused in the present study on respiratory conditions that have been shown to be linked to influenza, including: pneumonia and influenza, acute respiratory diseases, and chronic lung diseases.⁸⁻²² Given that age is a major risk factor for complications of influenza, we examined the impact of respiratory conditions separately for three age groups – children, individuals between the ages of 15 and 64, and older adults aged 65 and over. Seniors aged 65 years and older are particularly susceptible to experiencing serious complications related to influenza, with 80% to 90% of influenza-attributable deaths occurring among this age group.⁸⁻¹⁰ Similarly, increased health care use attributable to influenza has been shown among young children.^{8,9,16,17}

METHODS

Study population and data source

Using anonymized administrative data, we examined the impact of influenza-associated respiratory illnesses for the Winnipeg population (approximately 650,000 individuals) over a 4-year period (1995-96 to 1998-99). Winnipeg residents were identified from the population registry maintained by Manitoba Health using postal codes and municipal codes. Health care use files (obtained from Manitoba Health) included: hospital discharge abstracts, physician claims and nursing home data.

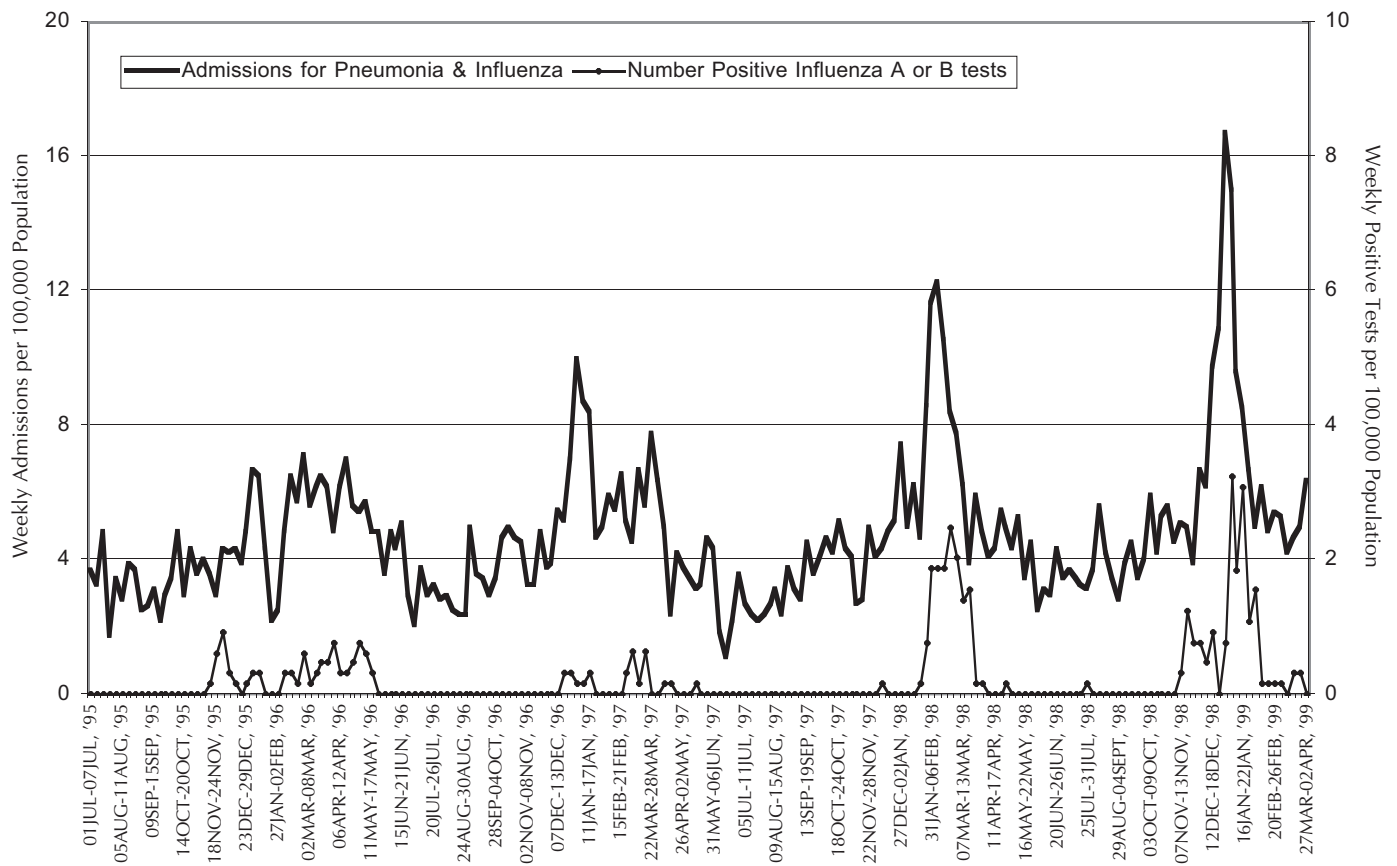


Figure 1. Average Weekly Hospital Admissions Rates for Pneumonia and Influenza versus Weekly Positive Viral Tests Rates for Influenza A or B, 1995-96 to 1998-99, Winnipeg

Note: Data are shown for each of the 52 weeks in each year; only select dates are printed because of space constraints.

Vital statistics were obtained from the Office of Vital Statistics. We used viral testing data from the provincial laboratory, where all viral testing in the province is conducted, to identify influenza seasons.

Definitions and measures

Study years were defined from July to June, as influenza seasons tend to bridge calendar and fiscal years (except for 1998-99, which ended on March 31, the last date for which we had data at the time analyses were conducted). Weeks were defined from Saturday to Friday.

Influenza seasons were defined as the weeks during each study year during which at least two positive tests for influenza A or B were obtained for Winnipeg residents at the provincial laboratory. Given this definition, influenza seasons lasted on average 15 weeks (range = 8 to 26 weeks). Influenza A viruses predominated in all four study years.

Interim periods were defined for each study year as the weeks prior to and following the influenza seasons.

Influenza-associated respiratory illnesses were defined in terms of respiratory illnesses

that have been linked to influenza:⁸⁻²² pneumonia and influenza (ICD-9-CM codes 480 - 487), chronic lung diseases (e.g., chronic bronchitis, asthma; codes 490 - 496), and acute respiratory diseases (e.g., acute bronchitis; codes 460 - 466).

Hospital admissions were examined for all Winnipeg acute care hospitals. We focused on emergent/urgent medical patients, with medical cases identified using the DRG (Diagnostic Related Group) classification system and emergent/urgent cases classified based on the admission status reported on the hospital discharge abstract. Among these emergent/urgent medical cases, patients were then identified whose most responsible diagnosis included one of the respiratory illness diagnostic codes (see above).

Ambulatory visits to all Winnipeg physicians were examined using physician claims data. Visits to hospital in-patients were excluded from the definition of ambulatory visits.

Emergency room visits, identified from the physician claims database, were examined for two hospitals (the two Winnipeg teaching hospitals), which treat close to 50% of

the emergency cases in Winnipeg.²³ Emergency room visits to the remaining hospitals could not be examined, as physicians at community hospitals do not routinely file claims. Although we capture the only paediatric emergency room in Winnipeg and, therefore, most emergency room visits by children, the impact of influenza-associated illnesses for adults is consequently underestimated.

Deaths and cause of death were derived from Vital Statistics data. Death rates are presented both for residents of Winnipeg nursing homes, as well as for the entire Winnipeg population (including nursing home residents). Death rates were determined on a monthly basis for the months that span the influenza seasons, as weekly rates were very low and, therefore, unstable. Death rates for the general population are presented for individuals aged < 65 and those 65+ as very few people under 65 years of age died of respiratory illnesses. Rates for nursing home residents were not broken down by age, as most are 65+ years old.

TABLE I
Annualized Excess Hospital Admission Rates per 100,000 Age-specific Population

Year	Age	Influenza & Pneumonia		Acute Respiratory Disease		Chronic Lung Disease	
		Excess Rate	95% CL	Excess Rate	95% CL	Excess Rate	95% CL
1995-96	0-14	164	(107 - 221)	255	(206 - 304)	0	-
	15-64	28	(11 - 45)	0	-	0	-
	65+	241	(115 - 367)	30	(2 - 58)	351	(216 - 486)
1996-97	0-14	252	(180 - 324)	357	(286 - 428)	0	-
	15-64	38	(17 - 59)	0	-	24	(3 - 46)
	65+	458	(295 - 620)	42	(1 - 84)	440	(272 - 608)
1997-98	0-14	220	(127 - 313)	145	(70 - 221)	0	-
	15-64	64	(35 - 94)	0	-	45	(16 - 75)
	65+	1135	(886 - 1384)	167	(89 - 245)	815	(571 - 1058)
1998-99	0-14	250	(165 - 334)	425	(339 - 511)	0	-
	15-64	35	(11 - 59)	0	-	28	(5 - 51)
	65+	956	(752 - 1160)	149	(81 - 217)	979	(774 - 1184)
All Years	0-14	214	(179 - 249)	293	(260 - 326)	0	-
	15-64	34	(24 - 45)	0	-	17	(6 - 27)
	65+	537	(455 - 619)	75	(52 - 98)	516	(431 - 601)

CL=Confidence limits.
Excess rates that do not represent statistically significant differences ($p < 0.05$) between the influenza season and interim period are set to 0.

TABLE II
Annualized Excess Physician Visit Rates per 100,000 Age-specific Population

Year	Age	Influenza & Pneumonia		Acute Respiratory Disease		Chronic Lung Disease	
		Excess Rate	95% CL	Excess Rate	95% CL	Excess Rate	95% CL
1995-96	0-14	4200	(3928 - 4473)	28,457	(27,425 - 29,488)	989	(458 - 1520)
	15-64	1632	(1524 - 1740)	10,615	(10,273 - 10,957)	1148	(921 - 1375)
	65+	1850	(1542 - 2158)	3847	(3277 - 4416)	0	-
1996-97	0-14	4110	(3751 - 4469)	22,338	(21,093 - 23,582)	3201	(2579 - 3823)
	15-64	1792	(1650 - 1933)	8089	(7672 - 8506)	877	(615 - 1138)
	65+	2660	(2262 - 3059)	5871	(5150 - 6592)	0	-
1997-98	0-14	10,709	(10,149 - 11,269)	31,319	(29,809 - 32,830)	3225	(2478 - 3972)
	15-64	4523	(4315 - 4732)	9812	(9296 - 10,327)	2704	(2375 - 3033)
	65+	9548	(8900 - 10,195)	11,777	(10,813 - 12,742)	7212	(6131 - 8294)
1998-99	0-14	5238	(4839 - 5636)	28,237	(26,968 - 29,506)	8295	(7596 - 8993)
	15-64	2796	(2633 - 2960)	12,027	(11,571 - 12,484)	3907	(3610 - 4204)
	65+	5337	(4861 - 5813)	11,232	(10,406 - 12,059)	6286	(5333 - 7239)
All Years	0-14	5180	(5003 - 5356)	27,937	(27,342 - 28,532)	3790	(3495 - 4102)
	15-64	2270	(2200 - 2339)	9472	(9269 - 9674)	1939	(1809 - 2068)
	65+	3760	(3560 - 3960)	6524	(6174 - 6873)	1194	(785 - 1602)

CL=Confidence limits.
Excess rates that do not represent statistically significant differences ($p < 0.05$) between the influenza season and interim period are set to 0.

Analytic approach

Annualized crude rates per 100,000 age-specific population were calculated for the influenza seasons versus interim periods. Generally, denominators for each study year included all Winnipeg residents as of December 31st of a given study year. Denominators for mortality rates among nursing home residents included only individuals residing in nursing homes on December 31st of a given study year. To determine the impact of influenza-associated respiratory illnesses, we calculated excess rates by subtracting age-specific, annualized crude rates during the interim periods from

those during the influenza seasons. 95% confidence intervals were then calculated for these excess rates, assuming a Poisson distribution. Excess rates are reported only if they represent statistically significant ($p < 0.05$) differences between influenza seasons and interim periods.

FINDINGS

Hospital admissions

For illustrative purposes, Figure 1 shows weekly hospital admission rates for pneumonia and influenza (for all ages combined) in comparison to the four influenza seasons.

Seasonal variation is evident during all four study-years, with an especially high peak in 1997-98, when there was a poor match between influenza vaccine and strain, and an even higher peak in 1998-99 when the match was good. Similar patterns emerged for acute respiratory diseases and chronic lung disease.

Annualized excess rates (per 100,000 population) are presented in Table I. Significant excess admission rates emerged for pneumonia and influenza across all age groups, and particularly among children and adults aged 65 and over. Marked excess admission rates for acute respiratory diseases were evident among children. For chronic lung disease, substantial excess admission rates emerged for seniors aged 65+ across all influenza seasons.

To examine the relative impact of respiratory illnesses, we compared weekly hospital admissions for all respiratory illnesses (influenza and pneumonia, acute respiratory disease and chronic lung disease combined) to the *total* weekly emergent/urgent admissions. Admissions for respiratory illnesses constituted, on average, 11.2% of total emergent/urgent medical admissions during the interim periods (range = 10.4% to 12.2% across the four study years); the percentage increased to 15.9% during the influenza seasons (range = 13.1% to 20.1%). During peak weeks, admissions for respiratory illnesses constituted, on average, 23.9% of total emergent/urgent medical admissions (range = 18.3% to 30.9%).

Physician visits

Significant excess physician visits rates emerged for influenza and pneumonia, acute respiratory disease and chronic lung disease for most age groups. Noteworthy are the large excess visits (particularly for acute respiratory diseases) among children (27,937 on average per 100,000 population across the study years).

Of the *total* number of ambulatory visits, 12.1% on average were for respiratory illnesses (all categories combined) during the interim periods (range = 11.9% to 13.4%), compared to 16.3% during the influenza seasons (range = 15.4% to 17.4%) and 19.4% during peak weeks (range = 17.3% to 20.9%).

Emergency room visits

Marked excess emergency room visit rates for influenza and pneumonia and acute res-

piratory disease were evident among children (see Table III). Visit rates for chronic lung disease increased primarily among individuals aged 65 and over.

In comparing emergency room visits for respiratory conditions to the *total* number of visits, 8.7% were for respiratory illnesses during interim periods (range = 8.1% to 9.3%); the percentage increased to 12.4% during influenza seasons (range = 11.3% to 14.6%) and 17.7% during peak weeks (range = 15.1% to 21.7%).

Deaths

Excess death rates for the entire population are shown in Table IV. Very few individuals had as their reported cause of death an acute respiratory disease. These data are therefore not shown. Excess death rates for influenza and pneumonia and chronic lung disease emerged for individuals aged 65+ but not for younger persons. Consistent with this, excess death rates for influenza and pneumonia and chronic lung disease were evident for nursing home residents in all study years (see Table V).

In the general population, deaths due to all respiratory illnesses combined constituted on average 6.4% of *all* deaths during the interim periods (range = 5.3% to 7.5%), with the proportion increasing to 9.1% during the influenza seasons (range = 7.8% to 10.9%) and 12.0% during peak weeks (range = 10.7% to 14.6%). Proportions were slightly higher for nursing home residents: On average, 11.8% of *all* deaths during interim periods were due to respiratory illnesses (range = 9.8% to 13.7%), and 16.6% versus 21.6% during influenza seasons and peak weeks, respectively (range = 14.5% to 18.2% and 19.1% to 25.5%, respectively).

DISCUSSION

The present findings show that influenza-associated respiratory illnesses have a substantial impact on the health care system. Consistent with previous research,^{8,9,13,16} hospitalizations for respiratory illness increased during influenza seasons, with excess hospitalizations for influenza and pneumonia and chronic lung disease being particularly pronounced among adults aged 65 and over. Substantial excess hospitalizations for acute respiratory diseases were evident among children. Noteworthy are also the marked excess physician visit

TABLE III
Annualized Excess Emergency Room Visit Rates per 100,000 Age-specific Population

Year	Age	Influenza & Pneumonia		Acute Respiratory Disease		Chronic Lung Disease	
		Excess Rate	95% CL	Excess Rate	95% CL	Excess Rate	95% CL
1995-96	0-14	385	(304 - 466)	1694	(1527 - 1862)	0	-
	15-64	25	(5 - 44)	38	(12 - 64)	0	-
	65+	0	-	46	(7 - 85)	0	-
1996-97	0-14	540	(440 - 640)	2168	(1951 - 2385)	0	-
	15-64	38	(16 - 60)	57	(27 - 87)	42	(4 - 80)
	65+	103	(3 - 203)	97	(40 - 154)	210	(69 - 351)
1997-98	0-14	0	-	0	-	0	-
	15-64	0	-	0	-	0	-
	65+	0	-	142	(59 - 226)	463	(270 - 656)
1998-99	0-14	484	(372 - 596)	2574	(2307 - 2841)	0	-
	15-64	77	(49 - 105)	0	-	0	-
	65+	479	(346 - 612)	104	(40 - 168)	398	(235 - 560)
All Years	0-14	389	(341 - 437)	1626	(1521 - 1731)	0	-
	15-64	42	(31 - 53)	35	(20 - 49)	0	-
	65+	190	(138 - 242)	77	(51 - 104)	251	(180 - 322)

CL=Confidence limits.
Excess rates that do not represent statistically significant differences (p<0.05) between the influenza season and interim period are set to 0.

TABLE IV
Annualized Excess Death Rates per 100,000 Age-specific General Population

Year	Age	Influenza & Pneumonia		Chronic Lung Disease	
		Excess Rate	95% CL	Excess Rate	95% CL
1995-96	<65	0	-	0	-
	65+	92	(37 - 148)	87	(32 - 143)
1996-97	<65	0	-	0	-
	65+	102	(33 - 172)	111	(42 - 180)
1997-98	<65	0	-	0	-
	65+	234	(154 - 316)	162	(81 - 243)
1998-99	<65	0	-	0	-
	65+	203	(114 - 173)	89	(4 - 174)
All Years	<65	0	-	0	-
	65+	139	(105 - 173)	82	(50 - 115)

CL=Confidence limits.
Excess rates that do not represent statistically significant differences (p<0.05) between the influenza season and interim period are set to 0.

TABLE V
Annualized Excess Death Rates per 100,000 Population: Nursing Home Residents (All Ages)

Year	Influenza & Pneumonia		Chronic Lung Disease	
	Excess Rate	95% CL	Excess Rate	95% CL
1995-96	1463	(864 - 2061)	855	(439 - 1272)
1996-97	1969	(1229 - 2710)	1034	(491 - 1576)
1997-98	3188	(2733 - 3643)	1652	(1302 - 2003)
1998-99	2449	(1895 - 3003)	682	(205 - 1158)
All Years	1421	(861 - 1980)	602	(190 - 1015)

CL=Confidence limits.

and emergency room visit rates for influenza and pneumonia and acute respiratory diseases among children.

Deaths due to influenza and pneumonia and chronic lung disease also increased during influenza seasons for individuals aged 65 and over, corroborating previous research that shows that older adults are particularly susceptible to serious complications of influenza.¹⁰ Large excess death

rates for influenza and pneumonia and chronic lung disease emerged among nursing home residents, most likely because of the presence of pre-existing disease that increases the risk of serious influenza-related complications.

The contribution of respiratory illnesses to total health care use and mortality was considerable. During peak weeks – weeks during which rates were highest – respira-

tory illnesses constituted 24% of all emergent/urgent medical admissions, 19% of all physician visits, 18% of all emergency room visits and, among nursing home residents, 22% of all deaths. These percentages are approximately double those during periods when influenza viruses were not circulating.

Several limitations of this study should be highlighted at this point. First, some of the morbidity and mortality attributed here to influenza may have been due to other viruses, such as respiratory syncytial virus and parainfluenza virus. As the time periods during which these viruses are active typically overlap with influenza seasons, it is difficult to disentangle the relative impact of each virus. Second, given the number of statistical tests conducted, some findings may represent Type I errors. It is therefore important to interpret general patterns only. Third, it was not possible to determine people's influenza vaccination status. Thus we were not able to determine the relative impact of influenza-associated illnesses for people who were vaccinated versus those who were not.

In sum, we found substantial excess health care use and deaths during influenza seasons. Influenza vaccination is currently the best method to attenuate the adverse effects of influenza.^{21,22,24} Even though Canadian immunization guidelines specifically identify seniors aged 65 and over as targets for influenza vaccination,²⁵ vaccination coverage has been found to be low among non-institutionalized seniors in Manitoba (53% in 2000).²⁶ Increasing vaccination coverage could substantially reduce influenza-related morbidity among older adults. The excess burden of illness among children during influenza seasons found in the present study further suggests that recommendations for influenza vaccination might be extended to include children.

Finally, the study suggests that health care providers should anticipate and plan for a substantial increase in activity during the winter months. Strategies such as temporarily increasing staffing levels during influenza seasons, enhancing hospital discharge services or increasing home care services so that patients who no longer need acute care can be discharged home, could help minimize the impact of influenza-associated respiratory illnesses on the health care system and potential hospital and emergency room overcrowding.

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RÉSUMÉ

Objectifs : Les risques accrus d'hospitalisation et de mortalité durant la saison grippale sont bien documentés, mais les études sur les incidences des maladies liées à la grippe sur d'autres indicateurs de l'utilisation des soins de santé, comme le recours aux médecins, sont encore relativement rares. On examine ici les incidences des maladies respiratoires associées à la grippe sur le système de soins de santé de Winnipeg (hospitalisations, visites chez le médecin et visites aux salles d'urgence). On examine aussi leurs incidences sur la mortalité.

Méthode : À l'aide de données administratives, on a suivi l'utilisation des soins de santé et la mortalité sur quatre saisons grippales (1995-1996 à 1998-1999). La surutilisation des soins de santé et la surmortalité ont été calculées en soustrayant les taux durant les saisons grippales des taux durant les semaines où les virus de la grippe ne circulaient pas.

Résultats : La grippe, la pneumonie, les maladies respiratoires aiguës et les pneumopathies chroniques ont causé d'importants excédents dans les taux d'hospitalisation et les visites chez le médecin et dans les salles d'urgence, surtout pour les enfants et les adultes de 65 ans et plus. Une importante surmortalité due à la grippe, à la pneumonie et aux pneumopathies a aussi été enregistrée chez les 65 ans et plus, tout particulièrement parmi les pensionnaires de maisons de soins infirmiers.

Débat : Les maladies respiratoires associées à la grippe ont de graves répercussions sur le système de soins de santé. Comme les enfants tombent souvent malades durant la saison grippale, on recommande aussi d'envisager de les vacciner contre la grippe.