Successful implementation of a combined pneumococcal and influenza vaccination program in a Canadian emergency department

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ABSTRACT
Objectives: To determine the proportion of patients vaccinated with pneumococcal (PVAX) and influenza (IVAX) vaccines under an emergency department (ED) vaccination program, that would not otherwise have been vaccinated by other primary care resources.

Methods: This prospective cohort study was performed in a tertiary care academic centre. A questionnaire was administered to all consenting ED patients who met screening eligibility criteria to receive either IVAX or PVAX. Eligible unvaccinated patients who did not plan on receiving vaccination elsewhere were offered one or both of the vaccines and, if agreeable, were immunized in the ED.

Results: During the 4-week study period, 754 patients (36% of all presenting ED patients) were eligible for vaccination with one or both vaccines. Of these 525 (70%) consented to participate in the study and completed a questionnaire. Of the 525 participants, 289 (55%) of IVAX eligible patients; 95% confidence interval [CI], 51%–59%) were unvaccinated against influenza that year and did not plan on being vaccinated elsewhere and 277 (60% of PVAX eligible patients; 95% CI, 56%–64%) were unvaccinated against pneumococcus and did not plan on being vaccinated elsewhere. IVAX was administered to 187 patients (65% penetration; 95% CI, 59%–70%), and PVAX was administered to 165 patients (60% penetration; 95% CI, 54%–65%). Overall vaccine penetration was 45% (95% CI, 42%–50%) in the study participants and 32% (95% CI, 29%–35%) for the entire ED screened and eligible group. Reasons for vaccination refusal included concerns about benefit, side effects, and the desire to discuss vaccination with their primary care physician.

Conclusions: An ED-based program can result in the vaccination of a significant proportion of patients eligible for IVAX and/or PVAX who would otherwise likely go unprotected.

Key words: emergency department; vaccination, pneumococcal; vaccination, influenza

RÉSUMÉ
Objectifs : Déterminer la proportion de patients ayant reçu le vaccin contre l’infection à pneumocoques (PVAX) et celui contre la grippe (IVAX) dans le cadre d’un programme de vaccination au département d’urgence (DU) qui, autrement, n’auraient pas été vaccinés par d’autres ressources de soins primaires.

Méthodes : Cette étude des cohortes prospective fut menée dans un centre universitaire de soins...
tertiaires. On demanda à tous les patients consentants du DU qui répondaient aux critères d’admissibilité au IVAX ou au PVAX de remplir un questionnaire. Aux patients admissibles non vaccinés qui n’avaient pas planifié de recevoir cette vaccination ailleurs, on offrit un vaccin ou les deux et, s’ils acceptaient, ils étaient immunisés au DU.

Résultats : Au cours de la période d’étude de quatre semaines, 754 patients (36 % de tous les patients reçus au DU) furent admissibles à l’un des vaccins ou aux deux. Parmi ceux-ci, 525 patients (70 %) consentirent à participer à l’étude et remplirent un questionnaire. De ces 525 participants, 289 (55 % des patients admissibles au IVAX; intervalle de confiance [IC] 95 %, 51 %–9 %) n’avaient pas reçu le vaccin contre la grippe cette année-là et ne planifiaient pas de se faire vacciner ailleurs et 277 (60 % des patients admissibles au PVAX; IC 95 %, 56 %–64 %) n’avaient pas été vaccinés contre l’infection à pneumocoques et n’avaient pas planifié de se faire vacciner ailleurs. IVAX fut administré à 187 patients (pénétration à 65 %; IC 95 %, 59 %–70 %), et PVAX fut administré à 165 patients (pénétration à 60 %; IC 95 %, 54 %–65 %). La pénétration globale de la vaccination était de 46 % (IC 95 %, 42 %–50 %) chez les participants à l’étude et de 32 % (IC 95 %, 29 %–35 %) pour tout le groupe de patients du DU admissibles et ayant subi des tests de dépistage. Les raisons de refus de la vaccination étaient les inquiétudes quant à ses mérites et à ses effets indésirables et le désir de discuter de la vaccination avec le médecin de soins primaires.

Conclusions : Un programme basé au DU peut permettre de vacciner une proportion importante de patients admissibles à IVAX ou à PVAX qui, autrement, ne se feraient probablement pas vacciner.

Introduction

Every year, vaccine-preventable influenza and pneumococcal disease cause thousands of hospitalizations and deaths among Canadian adults. The US Centers for Disease Control and Prevention (CDC) estimate that 20 000 Americans die from influenza or its complications annually, with 90% of these fatalities in the elderly.7 According to Health Canada, 10%–25% of Canadians contract influenza each year. Up to 1500 Canadians, mostly seniors, die from pneumonia related to influenza disease each year, and many others die from other serious complications. The case-fatality rate from invasive pneumococcal disease, in particular pneumococcal bacteremia, is 15%–20% among adults and 30%–40% among the elderly even when appropriate antibiotics are administered.

Numerous studies have shown influenza (IVAX) and pneumococcal (PVAX) vaccines are the most effective means of preventing the serious respiratory and invasive complications and minimizing health care costs that result from influenza and pneumococcal disease.7–9 Despite proven efficacy, Canadian data from 2000/2001 showed that approximately 70% of adults 65 years of age received IVAX, but that only 40% of those 18–64 years with high-risk medical conditions were vaccinated.9 The province of Newfoundland had the lowest influenza vaccination rates. Ontario, with its easy access to universal vaccination, had the highest rate, and the Quebec rate was just below the Canadian average.9 In 2001 only 42% of Canadians 65 reported ever having been vaccinated against pneumococcus and only 15% of those <65 with high-risk medical conditions had been vaccinated.9

Since emergency department (ED) utilization correlates with both the absence of a primary care physician and the presence of chronic medical conditions, the ED represents a location where many high-risk unvaccinated patients can be identified. Results from previous US and Canadian studies suggest that a large proportion of ED patients are IVAX-eligible — approximately 30% in the US and over 60% in Canada. A significant percentage of these patients, irrespective of whether they have a family physician, report a willingness to receive vaccination in the ED.8,11–13 The primary objective of this study was to determine the proportion of patients vaccinated with PVAX and IVAX under an ED vaccination program who would not have been otherwise vaccinated by other primary care resources. Our secondary objectives were to estimate the proportion of IVAX- and PVAX-eligible ED patients who did not expect to receive vaccination elsewhere, to determine reasons for patient refusal of ED vaccination and to assess the opinions and attitudes of patients toward the ED vaccination program.

Methods

Study design, setting and population

This prospective cohort study was carried out in the ED of the Sir Mortimer B. Davis Jewish General Hospital (JGH), Montréal, a tertiary care adult university hospital. The 2000 JGH ED census was approximately 58 000 patients, 17 000 (29%) of whom were 65 years of age. Data were collected between 8 am and 4 pm during weekdays from Nov. 1–30, 2001. All patients presenting to the ED were
screened for influenza and pneumococcal vaccination eligibility (based on age or chronic disease). Patients eligible to receive the vaccines were then further screened for study eligibility (Table 1). The study was approved by the institution's Research and Ethics Board.

**Study protocol**
A research assistant approached all patients determined to be vaccine eligible to request written consent for the study. Consenting patients had demographic information collected and completed a questionnaire that asked about primary care providers, current and previous years' vaccination history and plans for vaccination. Unvaccinated patients who did not have a clear plan for vaccination elsewhere were offered vaccination in the ED and were given an explanation of all the potential benefits and side effects. If the patient agreed, a vaccination order sheet was presented to the attending emergency physician to sign. Once ordered, the study nurse administered the appropriate vaccine to the patient. Patients who received a vaccination in the ED were additionally questioned about their satisfaction with the ED vaccination program.

**Data analysis**
Data were analyzed using Statview (version 5.0, SAS Institute Inc.). Descriptive statistics were expressed as proportions or means with standard deviations and 95% confidence intervals (CIs). There was no prior sample size calculation, and the sample size simply reflects the number of patients who were enrolled during the study period.

**Results**
During the study period, 2092 patients presented to the ED and, of these, 754 (36%) were eligible for vaccination with IVAX, PVAX or both, based on age (87%) or chronic disease (13%) criteria (Fig. 1). Of these potentially eligible patients, 172 (23%) were excluded due to predefined exclusion criteria (Table 1), 20 (3%) were missed and 562 (74%) were approached for consent. The most common

<table>
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<th>Variable</th>
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<th>Pneumococcal</th>
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</tr>
<tr>
<td>≥65</td>
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<tr>
<td>(including hypertension)</td>
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</tr>
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<tr>
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<tr>
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<td>Yes</td>
</tr>
<tr>
<td>Liver disease / Chronic alcoholism</td>
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**Exclusion**
Contraindication to vaccination
Unstable vital signs
Allergy to egg (IVAX) or thiomersal (IVAX and PVAX)
Contraindication to IM injection (IVAX only)
Chemotherapy induced neutropenia
Expecting an operative intervention within 72 hours
Significant febrile illness >38.5°C

Other exclusions
Unable to communicate in English or French
Significant dementia or delirium (not oriented to person, time or place, or confused/agitated)
Non-resident of Canada
Interviewed in the ED during a previous visit
Unable to sign consent form

IVAX = influenza vaccine; PVAX = pneumococcal vaccine; IM = intramuscular; ED = emergency department; *Quebec immunization protocol.**Unless for asthma.**†Except for sickle-cell anemia.

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**Fig. 1. Study population.**
*87% met the age criteria and 13% met the chronic disease criteria. †See Table 1 for exclusion criteria.
reasons for exclusion were contraindications to vaccination (10%), enrolment during a previous ED visit (5%) and dementia or delirium (5%). Ninety-three percent (n = 525) of the patients approached agreed to participate and were administered a verbal questionnaire (Fig. 1). Of these, 88% stated they had a family physician and 56% had seen their physician in the previous month.

**Influenza vaccination**

All 525 interviewed patients met eligibility criteria for influenza vaccination. Of the 525 patients, 183 (35%) had already been vaccinated with IVAX for the upcoming influenza season, most of them by their family physician (Fig. 2) and 70% had received IVAX in previous years. Of 342 patients who had not been vaccinated or were unsure of their vaccination status, 289 (85%) did not have clear plans for vaccination elsewhere and thus were offered vaccination in the ED (Fig. 3). The majority of these patients (n = 204, 71%) accepted ED vaccination, but the others refused for various reasons (Fig. 3). Eight percent did not receive IVAX, primarily because the attending emergency physician had concerns about possible contraindications or side effects and refused to sign the order sheet. Figure 3 shows that, overall, 187 (65%) of 289 IVAX-eligible patients who did not intend to get vaccinated elsewhere received IVAX in the ED (95% CI, 59%–70%).

**Pneumococcal vaccination**

Of the 525 interviewed patients, 460 (88%) were eligible for pneumococcal vaccination. Fig. 4 shows that 174 (38%) of these patients had already been vaccinated with PVAX in the past, most of them by their family physician. Fig. 5 shows that, of 286 patients who had never received PVAX or were unsure of their vaccination status, 97% had no plan to be vaccinated elsewhere, thus were offered ED vaccination. One hundred and eighty-five (67%) of these patients (95% CI, 61%–72%) accepted pneumococcal vaccination (Fig. 5). Eleven percent of the patients who agreed to be vaccinated were not vaccinated because the attending emergency physician had concerns about possible contraindications or side effects and refused to sign the order sheet. Overall, 165 (60%) of 277 PVAX-eligible patients who did not intend to get vaccinated elsewhere received PVAX in the ED (95% CI, 54%–65%).

Overall, of the 525 eligible patients, 239 or 46% (95% CI,
42%–50%) of all those enrolled and 32% (95% CI, 28%–36%) of all those screened eligible were vaccinated in the ED with one or both vaccines (Fig. 6). Of 187 patients vaccinated in the ED with IVAX, 98% (95% CI, 96%–100%) reported being satisfied or extremely satisfied with the ED-based vaccination program. Of 165 patients vaccinated with PVAX, 97% (95% CI, 94%–100%) were satisfied or extremely satisfied with the ED vaccination process.

**Discussion**

Influenza and pneumococcal vaccination has been shown to reduce morbidity and mortality caused by influenza and pneumococcal disease. Unfortunately, despite the vaccines’ proven efficacy, many patients are missed by primary care practitioners and do not receive vaccination while in hospital. In a 2002 US survey, few primary care physicians had the capacity to use their practice database to contact elderly patients for influenza vaccination, and only half of these physicians were able to target individuals with chronic illness who would benefit from vaccination. In the US, the opportunity to provide PVAX to hospitalized elderly patients was missed in up to 80% of cases, suggesting that current hospital-based systems are not highly effective in providing vaccination. A survey of American College of Emergency Physicians members from 35 different US ED settings found that 80% and 71% reported never giving IVAX and PVAX, respectively. Additionally, a study by Kapur and Tenenbein found most Canadian emergency physicians rarely (30%) or never (57%) offer IVAX, yet 76% report they would be willing to prescribe it.

There is both a need and a desire for preventive health care measures in the ED, especially among patients who do not have primary care physicians. In 2000, the CDC recommended the implementation of ED immunization programs. Recent Canadian data on influenza and pneumococcal disease prevention in 2001 suggest that while national vaccination rates are improving, a large segment of the population remains unprotected. In a study by Rodríguez and Baruff, 63% of elderly ED patients had not received that year’s IVAX and 82% had not received received PVAX. Wrenn and colleagues reported that 57% of all

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Fig. 4. Pneumococcal vaccination status among participants. CI = confidence interval. PVAX = pneumococcal vaccine.

Fig. 5. Pneumococcal vaccination rate among study participants. CI = confidence interval. PVAX = pneumococcal vaccine. *See Results section for explanation.
high-risk ED patients had not received IVAX within the preceding 6 months, and 75% had never received PVAX. In high-risk patients <65 years, 60% had not received IVAX and 80% had not been vaccinated with PVAX. Our findings of IVAX and PVAX coverage rates of only 35% and 38%, respectively, are similar to the results of previous US studies.

Influenza and pneumococcal immunization in the ED is both accepted and desired by ED patients, who often have little or no access to other immunization services.\textsuperscript{11,22} Wrenn and colleagues reported that 46% of patients who had not received IVAX were willing to be vaccinated in the ED; the proportion increased to 53% for PVAX. This is in keeping with Kapur and Tenenbein's findings in 2000 that 59% of ED patients at risk from influenza were willing to be vaccinated in the ED.\textsuperscript{8} In a vaccination program at Cook County Hospital, Chicago, 61% of screened high-risk patients were immunized against influenza and 35% against pneumococcus.\textsuperscript{13} Other investigators found that 54% of unvaccinated patients would accept IVAX in the ED and 62% PVAX.\textsuperscript{15} We found an even higher proportion of patients who were eligible and agreeable to vaccination with IVAX and PVAX. Influenza vaccination was accepted by 71% of eligible unvaccinated patients without an alternative plan, 92% of whom were vaccinated in the ED. Similarly, 67% of patients accepted vaccination with PVAX, 89% of whom were vaccinated in the ED.

Emergency department overcrowding is a serious public health problem that often peaks over the winter months when the level of influenza virus activity is high in the community. Schull and coworkers found that influenza virus was a significant predictor of increased ED utilization for respiratory illness in patients age 65 years.\textsuperscript{23} Grafstein and associates found that a population-based influenza and pneumococcal vaccination campaign decreased ED visits for influenza and pneumococcal disease by 25%.\textsuperscript{24} In 1999, Stack and colleagues reported that an ED-based pneumococcal vaccination program would result in considerable cost savings and decreased mortality.\textsuperscript{25} As well, a more recent cost-effectiveness study on a potential ED-based pneumococcal vaccination program suggested significant cost savings would be realized for patients aged 65.\textsuperscript{26} Of note, however, Groll and colleagues did not find a reduction in ED visits in 5 EDs after a universal influenza vaccination program was introduced in Ontario.\textsuperscript{27} It is likely that an ED vaccination program would increase vaccine coverage rates, decrease morbidity and mortality and, perhaps, reduce overall ED visits and hospitalizations.

Based on previous experience at our institution, an ED vaccination program is most feasible when a dedicated nurse is involved. This removes any additional burden of vaccination from the busy ED nurses, but generates additional expense for the program. As vaccines are provided free of charge by the government, the nurse's salary comprises the sole cost to such programs. Future research could investigate the feasibility of using existing ED staff to vaccinate patients, or at least to educate patients on the need for IVAX and PVAX. Another strategy would be to create a tracking system, connected to family practice offices or local community health clinics, of eligible unvaccinated patients presenting to the ED.

Despite public awareness of vaccination and our approach of restricting the eligible ED population to those who would not have been vaccinated elsewhere, the proportion of patients we found who accepted and received IVAX and PVAX in the ED was high. This suggests that annual implementation of similar programs would have a significant public health impact, particularly in EDs that serve a large proportion of elderly and high-risk patients. Future studies are needed to determine the true impact and cost-effectiveness of such programs on the number of ED visits and hospital admissions due to influenza and pneumococcal disease during the winter months, as well as the cost-effectiveness of ED vaccination programs versus community-based initiatives.

**Limitations**

Our study has several limitations. We screened patients early (first 4 weeks) in the vaccination season, which might have skewed vaccination status toward a tendency to be unprotected, thus increasing the number of patients vaccinated in the ED. We attempted to correct for this by vaccinating only patients who denied a plan for vaccination elsewhere; however, some patients may have misrepresented their plans in order to take advantage of more convenient ED vaccination. It is thus conceivable that, through our program, we might have vaccinated some patients who would otherwise have been vaccinated elsewhere. Finally, we hired a dedicated study nurse for vaccination purposes, which undoubtedly

![Fig. 6. Summary of vaccination program. CI = confidence interval; IVAX = influenza vaccine; PVAX = pneumococcal vaccine.](image-url)
contributed to our high vaccination rates. It may not be possible to hire a dedicated vaccination nurse in centres with limited budgets. Unfortunately not all patients who agreed to ED vaccination were vaccinated, predominantly due to the emergency physician's discomfort and concerns about the possibility of side effects. If ED vaccination programs become more established, it is our hope that emergency physicians will increasingly accept IVAX and PVAX, just as they accept ED tetanus prophylaxis.

Conclusions

This study demonstrates that an ED-based vaccination program can immunize a significant proportion of at-risk patients who would otherwise not consider or have access to influenza or pneumococcal vaccination.

Acknowledgements: We thank Manon Goulet, Shiva Rahmani, Mady Virgona and Nathalie Trudel for their work on this project. In addition we thank the emergency physicians, nurses, unit coordinators and registration staff of the Sir Mortimer B. Davis Jewish General Hospital, without whom we would not have been able to conduct this study.

This project was supported by contributions from Programme MESSS (le Ministère de la Santé et des Services sociaux), Règles régionales and FRSQ (Fonds de recherche en santé du Québec) de soutien à la recherche sur la problématique des urgences, SANTÉ publique de Montréal-Centre, the Brownstein Emergency Department Research Endowment Fund, and the Armand Aflalo and Family Emergency Department Research Fund.

Competing interests: None declared.

References


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