Influenza Vaccination: Reduction in Hospitalizations and Death Rates among Members of "Maccabi Healthcare Services" during the 2000–2001 Influenza Season

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Abstract

Background: Upper respiratory tract illnesses have been associated with an increased risk of morbidity and mortality.

Objective: To assess the influence of vaccination against influenza on the risk of hospitalization in internal medicine and geriatric wards, and the risk of death from all causes during the 2000–2001 influenza season.

Methods: A historical cohort study was conducted using computerized general practitioner records on patients aged 65 years and above, members of "Maccabi Healthcare Services" – the second largest health maintenance organization in Israel with 1.6 million members. The patients were divided into high and low risk groups corresponding to coexisting conditions, and were studied. Administrative and clinical data were used to evaluate outcomes.

Results: Of the 84,613 subjects in the cohort 42.8% were immunized. At baseline, vaccinated subjects were sicker and had higher rates of coexisting conditions than unvaccinated subjects. Vaccination against influenza was associated with a 30% reduction in hospitalization rates and 70% in mortality rates in the high risk group. The NNT (number needed to treat) measured to prevent one hospitalization was 53.2 (28.2 in the high risk group and 100.4 in the low risk group). When referring to length of hospitalization, one vaccine was needed to prevent 1 day of hospitalization among the high risk group. Analyses according to age and the presence or absence of major medical conditions at baseline revealed similar findings across all subgroups.

Conclusions: In the elderly, vaccination against influenza is associated with a reduction in both the total risk of hospitalization and in the risk of death from all causes during the influenza season. These findings compel the rationale to increase compliance with recommendations for annual influenza vaccination among the elderly.

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Serious complications of influenza among the elderly include pneumonia and exacerbations of coexisting conditions that can result in hospitalization or death [1]. Vaccination against influenza in the elderly has consistently been associated with reductions in hospitalizations for pneumonia and in death from all causes [2,3].

Nichol et al. [4] conducted and recently published one of the largest studies of its kind, measuring the influence of influenza vaccination on rates of hospitalizations for cardiac disease and stroke among the elderly. We adopted Nichol's methods and performed a similar analysis based on the computerized database of "Maccabi Healthcare Services." We studied a cohort during the 2000–2001 influenza season to assess whether influenza vaccination of community-dwelling elderly persons is associated with reduced rates of hospitalization for any reason and of death for any cause.

Methods

Maccabi Healthcare Services (Maccabi) is the second largest health maintenance organization in Israel, ensuring coverage for 1.6 million members nationwide. Maccabi has developed and implemented a computerized information system fully employed at all levels of the organization. Demographic and clinical data are collected in real time from all levels of care and stored in a central database. This is one of several studies involving the pooling of computerized data from Maccabi. This study was approved by the research review board of the health plan.

Subjects

Maccabi members who were at least 65 years of age on 1 October 2000 were included in the study if they were not institutionalized and had been continuously enrolled during the preceding 12 months and throughout the outcome period.

Data collection and outcomes

Demographic data (e.g., age and gender) and baseline coexisting conditions were obtained from the Maccabi administrative and clinical databases. Baseline coexisting conditions were defined by inpatient or outpatient diagnoses in an identical manner to that suggested by Nichol et al. [4]. That is, International Classification of Diseases, 9th Revision, Clinical Modification Codes 093, 112.81, 130.3, 391, 393 through 398, 402, 404, 410 through 429, 745, 746, 747.1, 747.49, 759.82, 785.2, and 785.3; lung disease (codes 011, 460, 462, 465, 466, 480 through 511, 512.8, 513 through 517, 518.3, 518.8, 519.9, and 714.81), diabetes (codes 250 and 251), renal disease (codes 274.1, 408, 580 through 591, 593.71 through 593.73, and 593.9), cancer (codes 200 through 208, 140 through 198, and 199.1), vasculitis and rheumatologic disease (codes 446, 710, 714.0 through 714.4, 714.8, 714.89, and 714.9), dementia and stroke (codes 290 through 294, 331, 340, 341, 348, and 438), hypertension (code 401), atrial fibrillation (code 427.3), and lipid disorders (code 272).

The study outcomes included hospitalization in internal medicine and geriatric wards for any reason, and death from any cause. Influenza vaccination status was also ascertained from the database.

Statistical analysis

Analyses were conducted in subgroups according to age (65–74, 75–84, and 85 years or older) and risk. High risk was defined by one of the following coexisting conditions: heart disease, lung disease, diabetes or endocrine disorders, renal disease, stroke or dementia, vasculitis or rheumatologic disease, or cancer. Low risk was defined by the absence of any of these conditions.

Gender proportions and prevalence rates were compared using the chi-square test corrected for continuity, while mean ages were compared using the standard Student t-test. Significance values and 95% confidence intervals were calculated using Compare2 version 1.11 (copyright J.H Abramson 2000–2002).

The summer months (June through September) after the influenza season were selected as a control period. We assessed the effect of vaccination on the risk of hospitalization during these months, a period during which influenza was not circulating and at a time when the vaccination was expected to provide minimal benefit.

Table 1. Baseline characteristics of subjects in the cohort

Characteristic	Vaccinated subjects	Unvaccinated subjects
No. of subjects	36,569	48,044
Age group (yrs) (%)		
65–74	60.8	60.1
75–84	32.2	29.2
⩾85	7.0	10.7
Mean age ± SD	74.3 ± 7.2	74 ± 6.4
Coexisting conditions (%)	78.9	63.3

Table 2. Outcome during the influenza season among vaccinated and unvaccinated subjects in high and low risk groups

Outcome	High risk group		Low risk group	
	Vaccinated	Unvaccinated	Vaccinated	Unvaccinated
Hospitalization rate	8.25% (n=2,380)	11.8% (n=3,585)	3.6% (n=276)	4.6% (n=807)
Death rate	0.82% (n=238)	2.7% (n=872)	0.4% (n=31)	1% (n=180)

Table 3. Relative risk (and 95%CI) in outcome measures during the influenza season among vaccinated and unvaccinated subjects in high and low risk groups corresponding to age subgroups

Outcome	High risk age subgroups			Low risk age subgroups		
	6—74	75–84	⩾ 85	65–74	75–84	⩾ 85
Reduction in hospitalization rates (%)	0.71 (0.64–0.79)	0.76 (0.70–0.82)	0.70 (0.65–0.76)	0.81 (0.59–1.11)	0.82 (0.67-1.00)	0.91 (0.73–1.13)
Reduction in death rates (%)	68.7	71.2	64.8	65.4	40.9	50.9

Results

There were 84,613 subjects in the cohort. The crude compliance rate with influenza vaccination was 42.8%. At baseline, vaccinated subjects presented a significantly ($P < 0.001$) higher prevalence rate of coexisting conditions [Table 1].

During the influenza season, there were 2,380 and 3,585 hospitalizations and 238 and 872 deaths among high risk vaccinated and unvaccinated subjects respectively, presenting a reduction of 30% in hospitalization rates (relative risk 0.70, 95% confidence interval 0.67–0.73) and 71.2% in death rates (RR 0.29, 95%CI 0.25–0.33). There were 276 and 807 hospitalizations and 31 and 180 deaths among low risk vaccinated and unvaccinated subjects respectively, yielding a reduction of 22% in hospitalization rates (RR 0.78, 95%CI 0.68–0.89) and 60.6% in death rates (RR 0.39, 95%CI 0.27–0.58). [Table 2]

Estimates of vaccine effectiveness were similar among the age subgroups [Table 3]. The number needed to treat (i.e., vaccinate) to prevent one hospitalization was 53.2 (28.2 in the high risk group and 100.4 in the low risk group). When referring to length of hospitalization, one vaccine is needed to prevent 1 day of hospitalization among the high risk group.

During the summer following the influenza season, which was chosen as a control period, high risk vaccinated subjects had

RR = relative risk
CI = confidence interval

similar hospitalization rates compared to controls (6.7% vs. 7.1%) (RR 0.94, 95%CI 0.89–1.00), while among the low risk group there were substantial differences (2.84 vs. 3.42%) (RR 0.83, 95%CI 0.71–0.97).

Discussion

Several previous observational studies suggested vaccination-associated reductions of 20–40% in the risk of hospitalization for pneumonia or influenza [5–14]. Nichol and co-workers [4] reported a 29–32% reduction in the risk of hospitalization for pneumonia or influenza, basing the results on one of the largest cohorts ever used to evaluate the effectiveness of the vaccine. Some observational studies reported vaccination-associated reductions of 30–50% in the risk of death from any cause [15–18]. Nichol et al. [4] reported a 48–50% reduction in the risk of death from all causes.

In our study, influenza vaccination in high risk elderly persons was associated with substantial reductions in the risk of hospitalization for any reason in internal medicine and geriatric wards, and death from all causes during the 2000–2001 influenza season, at rates similar to those reported previously. However, we were not able to estimate the effectiveness of the vaccine among members of the low risk group due to a selection bias. Moreover, some of the benefits attributed to influenza vaccination may be due to pneumococcal vaccination. Pneumococcal vaccinations are usually given only once and may be effective for 6 to 10 years. However, pneumococcal vaccination has not been shown consistently to reduce the risk of hospitalization for pneumonia [19].

The findings of our study support the aim of increasing compliance with recommendations for annual influenza vaccination among the elderly.

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