Reducing Medical Service Utilization by Encouraging Vaccines
Randomized Controlled Trial

Gregory D. Berg, PhD, Eileen Thomas, RN, CCM, Steven Silverstein, MD, FACEP, Cheryl L. Neel, RN, MPH, Matthew Mireles, MBA

Background: Vaccination against influenza is associated with reductions in hospitalizations for heart disease, cerebrovascular disease, pneumonia, or influenza, and the risk of death from all causes during the influenza season.

Design: Randomized controlled trial.

Participants: All members enrolled in the Blue Cross Blue Shield Association’s Government Wide Service Benefit Program in the states of Oklahoma, Rhode Island, Kentucky, California, Arizona, Utah, and Colorado in October 2002. The sample size was 339,220 members.

Intervention: Two identical influenza/pneumonia direct mail marketing pieces that encouraged members to receive influenza and pneumococcal vaccinations. The study period was October 15, 2002 through March 15, 2003 when most influenza cases occur. Data were collected in July 2003 and analyzed during August 2003.

Main Outcome Measures: Administrative claims based on influenza/pneumonia inpatient admissions and emergency department (ED) visits.

Results: The intervention group experienced a 2.62% (p=0.010) higher rate of influenza vaccinations; 4.61% (p=0.080) higher rate of pneumonia vaccinations; 9.67% (p=0.136) lower rate of influenza/pneumonia inpatient admissions; and 22.64% (p=0.002) lower rate of influenza/pneumonia ED visits compared to the control group. The benefit-cost ratio (return on investment) from this intervention was estimated to be $2.21 per dollar spent.

Conclusions: Administrative claims data suggest that members respond to health plan mailings with an increase in influenza vaccination rates. Health plans can cost-effectively impact medical service utilization and vaccination rates by mailing information to their members.

Introduction

Influenza epidemics usually occur during the winter, and influenza was responsible for an average of 36,000 deaths per year in the United States from 1990 to 1999. Although rates of infection are highest among children, serious illness and death are most common in individuals aged >65 and those with medical conditions that place them at higher risk for complications. Influenza vaccination has been found to be associated with reductions in hospitalization for heart disease, cerebrovascular disease, pneumonia, or influenza, and the risk of death from all causes during the influenza season.

Even though vaccination rates increased during the 1990s, the Advisory Committee of Immunization Practices (ACIP), Centers for Disease Control and Prevention, recommends using strategies to increase vaccination levels including reminder systems and standard orders programs.

Economic studies of influenza vaccinations for people aged >65 have shown overall cost savings and reductions in hospitalization and death. Similarly, studies of adults aged <65 also show that influenza vaccinations can reduce direct medical costs as well as indirect costs from worker absenteeism. The cost per additional vaccine administered has been found by the Task Force on Community Preventive Services (Task Force) to range between $3 and $46. Client recall and reminder systems have been found to be effective in increasing community demand for vaccines.

This study implemented the ACIP recommendation of trying to increase vaccination levels in both at-risk and healthy members in a preferred provider organi-
zation (PPO) health plan (Blue Cross and Blue Shield Association Government Wide Service Benefit Program) and thereby reduce influenza and pneumonia hospitalization and emergency department (ED) visits. This study used a reminder system for a mass mailing strategy in a randomized controlled trial. The reminder system intervention encouraged members to receive an influenza vaccination.

Methods
Subjects
All subscribers and their dependents enrolled in Blue Cross Blue Shield Association Government Wide Service Benefit Program in the states of Oklahoma, Rhode Island, Kentucky, California, Arizona, Utah, and Colorado in October 2002 were eligible for the study. The 5-month study period was October 15, 2002 through March 15, 2003, when influenza was most likely to occur.

The sample size was determined by a budget of $40,000. Subscribers in all states had an equal probability of assignment into the intervention group. Once in a group, that subscriber and associated dependents remained in that group for the duration of the study. If a member died or changed health plan coverage, the person was still included in the study for the duration of health plan eligibility. The simple randomization code was developed using a computer random number generator between the values of zero and unity, whereby if the number was <0.25 then that subscriber and associated dependents were assigned to the intervention group. The total sample size was 339,220 individuals of which 82,364 were in the intervention group. Figure 1 shows the flow diagram for subscribers and individuals.

All study personnel and participants were blinded to treatment assignment for the duration of the study. Only the study statisticians saw unblended data, but none had any contact with study participants.

Intervention and Hypothesis
The current study tested the hypothesis that encouraging members to receive an influenza vaccine would result in fewer influenza or pneumonia inpatient admissions and ED visits.

Each subscriber in the intervention group received two identical mailings that were mailed on October 1, 2002 and November 1, 2002. The objective of the mailings was to promote receiving influenza vaccination in order to reduce influenza and pneumonia inpatient hospitalizations and ED visits. The 8-½"×11" mailer with a single fold was designed in color with a physician sitting at a desk on the front cover. The mailer contained a description of the influenza season and things that can be done for protection of self and family under the following headings: where to go and what to do, know the facts, understanding your risks, and a description of what an influenza shot will do. The mailings were sent at the beginning of the study period to increase the likelihood that a person would read at least one of the two identical mailings and subsequently receive an influenza vaccination. Because the mailings were sent out in bulk, no information is available on undeliverable pieces. Subscribers, not individual members, were randomized and received the two mailings to reduce cross-contamination among household members, avoiding the possibility of a husband and wife pair being randomized into two different groups. The control group did not receive the mailings.

Influenza vaccination is typically given from the middle of October until late December, with most people receiving them in November and early December. Since the intervention was a mailing from the health plan encouraging vaccinations, no institutional review board approval was needed.

Disease and Outcome Definitions
The primary outcome measure was influenza/pneumonia inpatient admissions and ED visits with secondary outcome measures of influenza and pneumonia vaccinations. Administrative medical claims for 5 months, from October 15, 2002...
through March 15, 2003, provided information on inpatient admissions and emergency department visits for pneumonia and influenza and evidence of influenza and pneumococcal vaccinations. To account for the time lag from the date of service when a claim was incurred to the time that a claim was paid, claims data were provided through June 15, 2003, resulting in a 3-month claims lag in administrative claims. Pneumonia and influenza were determined by ICD-9 codes 480 to 487. Influenza vaccinations were determined by CPT4 codes 90657, 90658, 90659, 90660, and 90724, or HCPCS code G0008, and pneumonia vaccinations were determined by CPT codes 90669 and 90732, or HCPCS code G0009.

Statistical Analysis

A randomized controlled trial was used to assign member intervention exposure. The intervention group received two influenza/pneumonia marketing pieces, which encouraged members to receive influenza and pneumococcal (if appropriate) vaccination. The second group served as a control group and received no marketing pieces beyond that which was received by the general population in the health plan, which did not encourage influenza or pneumococcal vaccination. To check randomization, demographic variables were compared to ensure that there were no statistically significant differences between the groups.

The rates of inpatient admissions as well as ED visits were compared between the intervention group and the control group. Since randomization was based on clusters (subscribers were randomized rather than individuals) p values were calculated with a chi-square statistic using the clustering option in SAS, version 8 (SAS Institute Inc., Cary NC, 1999). Statistical significance in differences in utilization and vaccinations between each group was calculated using the chi-square statistic generated by “proc genmod” using the “repeated” option in SAS to account for the clustering effect on the variance.22

A cost–benefit analysis (CBA) as well as a cost-effectiveness analysis (CEA) are reported. In a CBA, both program costs and incremental savings are expressed in monetary terms. In a CEA, the added costs of a program are expressed in terms of a ratio relative to a nondollar comparator such as inpatient admissions, quality adjusted life years, lives saved, and so on.23–25 Incremental savings (cost) from changes in utilization and vaccination rates are calculated as the difference in utilization rates between the exposed and the control group over the study period multiplied by the number of members in the exposed group multiplied by the average cost of an influenza/pneumonia utilization visit or vaccination.

Results

Table 1 shows that the randomization appeared to be appropriate for the available demographic variables. Table 2 shows the utilization and vaccination rates per 10,000 for each group over the 5-month study period of October 15, 2002 through March 15, 2003. Compared with the control group, the intervention group had a higher influenza vaccination rate, as well as a lower inpatient admission and ED visit rates for pneumonia and influenza. The intervention group had a higher rate of receiving an influenza vaccination compared to the control group with a rate difference of 41.3 per 10,000 people (p <0.010), along with a higher rate difference of receiving a pneumonia vaccination at a rate of 11.0 (p =0.080). The increase in influenza vaccinations was measured only through administrative medical claims. People do receive influenza vaccinations in places that do not generate administrative claims. The intervention group experienced a lower rate of influenza/pneumonia inpatient admissions compared to the control group at a rate difference of 3.41 (p =0.136) and a lower rate difference of influenza/pneumonia ED visits at a rate of 5.72 (p =0.002).
Influenza vaccination has been shown to decrease influenza morbidity and mortality.6,9–18 This study was designed to evaluate the efficacy of targeted communications as a tool to increase the influenza and pneumococcal vaccination rates among both healthy and at-risk members of a large commercial health plan. The hypothesis was that this communication would lead to an increase in vaccination rates and a corresponding decrease in ED visits and inpatient admissions for influenza and pneumonia. The results indicate that this hypothesis appears to be correct. In individuals receiving two targeted mailings emphasizing the importance of influenza vaccination and of pneumococcal vaccination (where appropriate), there was a statistically significant increase in claims for those procedures and a corresponding decrease in ED visits for influenza and pneumonia compared to a control group that did not receive the mailings. While there was a decrease in inpatient admissions of 9.67%, it did not reach statistical significance.

There are a number of possible weaknesses in the study. The health plan involved in the study is somewhat atypical. The average age of >50 years is higher than would be normally expected in commercial health plans. Each subscriber is a federal employee and the benefit plan tends to be richer than other plans; the plan thus tends to retain subscribers with less member turnover than other plans. These differences are not believed to have affected the results. Also, there might have been differences between the control and intervention groups that could account for the observed results. At least for the available demographic and comorbidity variables, this does not appear to have been the case. Another potential weakness is the use of administrative claims data for analysis. Influenza vaccinations are often given in settings that do not generate claims. However, it is believed that this would most likely lead to an underestimation of the benefit of the intervention, as members urged to receive influenza vaccination would be more likely (or at least not less likely) to do so whatever the setting. Finally, there may have been other unknown interventions that could account for the results. Health plan members from the same communities were randomized into one of two groups, so any community-level program or other in-

### Table 2. Utilization rates by intervention group

<table>
<thead>
<tr>
<th>Utilization/vaccination type</th>
<th>Rate exposed*</th>
<th>Rate control*</th>
<th>Rate difference</th>
<th>Percent difference</th>
<th>Absolute difference*</th>
<th>p value</th>
<th>Average cost of visit</th>
<th>Estimated savings*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influenza/pneumonia inpatient admissions</td>
<td>31.93</td>
<td>35.35</td>
<td>−3.42</td>
<td>−9.67</td>
<td>−28.2</td>
<td>0.136</td>
<td>$3056</td>
<td>$86,055</td>
</tr>
<tr>
<td>Influenza/pneumonia emergency department visits</td>
<td>19.55</td>
<td>25.27</td>
<td>−5.72</td>
<td>−22.64</td>
<td>−47.1</td>
<td>0.002</td>
<td>$169</td>
<td>$7,981</td>
</tr>
<tr>
<td>Influenza vaccinations</td>
<td>1620.85</td>
<td>1579.52</td>
<td>41.33</td>
<td>2.62</td>
<td>340.4</td>
<td>0.010</td>
<td>$4.78</td>
<td>$1,627</td>
</tr>
<tr>
<td>Pneumonia vaccinations</td>
<td>250.47</td>
<td>239.43</td>
<td>11.04</td>
<td>4.61</td>
<td>90.9</td>
<td>0.080</td>
<td>$42.06</td>
<td>$3,824</td>
</tr>
</tbody>
</table>

*Utilization rate per 10,000 people.
*Calculated as rate difference multiplied by number of people in intervention group (n = 82,364).
*Calculated as the absolute difference multiplied by the average cost per visit/vaccination.
This study shows in a randomized controlled trial that a mass mailing reminder system encourages health-insurance members to receive an influenza vaccination to be cost saving in a population of both healthy and at risk members.

Vaccination against influenza is associated with reductions in hospitalizations for heart disease, cerebrovascular disease, pneumonia, or influenza, and the risk of death from all causes during the influenza season.

What This Study Adds...

This study shows in a randomized controlled trial that a mass mailing reminder system encourages health-insurance members to receive an influenza vaccination to be cost saving in a population of both healthy and at risk members.

The health plan was interested in whether mailings to both healthy and at risk members result in behavior change or if mailings can influence behavior. Indications from administrative claims suggest that members respond to health plan mailings as shown by the increase in influenza vaccination rates. These results show that a commercial health plan can have positive and cost-saving impacts on medical service utilization and vaccination rates as a result of mailing information to their members. Additional studies to investigate the utility of this type of intervention in noncommercial health plan populations would be of interest.

References