Vaccine Use and the Risk of Outbreaks in a Sample of Nursing Homes during an Influenza Epidemic

Nancy Arden, MN, Arnold S. Monto, MD, and Suzanne E. Ohmit, DrPH

Introduction

It has long been recognized that the impact of influenza is particularly severe among older individuals. In comparison with elderly persons living in the community, residents of nursing homes are at a higher risk of serious influenza-related complications. Nursing home residents are older and more debilitated than community-dwelling elderly people, and, because of the closed environment in which they live, are more likely to be exposed to influenza infection if the virus is introduced. They may also have a diminished immunologic response to influenza vaccine, which would result in lower protective efficacy for vaccination. To increase vaccine uptake to produce the desired herd immunity effect, the factors influencing influenza vaccine acceptance in nursing homes need to be identified. Funding of the Influenza Vaccine Demonstration Project by the Health Care Financing Administration provided an opportunity to conduct studies of influenza vaccine use and effectiveness among nursing home residents in seven counties in Michigan. During the 1989/90 influenza season, influenza A(H3N2) viruses caused widespread illness and were associated with excess mortality nationally. Influenza A(H3N2) viruses isolated in the study area were antigenically similar to A/Shanghai/11/87, the A(H3N2) component of the 1989/90 influenza vaccine. In this report, we describe the determinants of influenza vaccine use in study area nursing homes and the effect that vaccination levels had on the occurrence of outbreaks.

Methods

The demonstration was conducted in a seven-county area of lower Michigan, with community surveillance of the occurrence of influenza-like illness and circulation of influenza viruses. During December 1989, staff in all 83 licensed nursing homes in the study area were contacted by telephone and asked whether they were willing to submit weekly surveillance forms identifying influenza-like illness in residents and to collect specimens for virus isolation from ill individuals. Influenza-like illness was defined as an oral temperature (or rectal or axillary equivalent) of at least 37.8°C and one or more of the following signs or symptoms: cough, sore throat, or coryza. Nursing homes were considered to have experienced influenza outbreaks if they met the Centers for Disease Control and Prevention (CDC) criterion of 10% of residents in the facility or wing developing influenza-like illness during a 1-week period. Outbreak status was determined only in homes that provided 10 or more weekly illness reports during the influenza season. At the end of the season, the homes were asked to provide data on characteristics, including size, proportion of residents who received influenza vaccine, and other information about their influenza vaccination programs. Standard bivariate and multivariate analyses were generated with SAS-PC. Logistic regression models were generated with the EGRET statistical package.

Results

Fifty-eight of the 83 (69.9%) nursing homes in the study area were able to provide information on the proportion of

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TABLE 1—The Association of Consent Policy with Influenza Vaccination Rates in Large and Small Nursing Homes: Lower Michigan, 1989/90

<table>
<thead>
<tr>
<th>Consent Policy</th>
<th>No.</th>
<th>%</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homes with 100 or fewer beds (n = 34)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal</td>
<td>2</td>
<td>33.3</td>
<td>4</td>
<td>66.7</td>
</tr>
<tr>
<td>Written</td>
<td>10</td>
<td>35.7</td>
<td>18</td>
<td>64.3</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>35.3</td>
<td>22</td>
<td>64.7</td>
</tr>
<tr>
<td>Homes with more than 100 beds (n = 24)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal</td>
<td>0</td>
<td>0.0</td>
<td>3</td>
<td>100.0</td>
</tr>
<tr>
<td>Written</td>
<td>17</td>
<td>81.0</td>
<td>4</td>
<td>19.0</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>41.7</td>
<td>7</td>
<td>29.2</td>
</tr>
<tr>
<td>All homes (n = 58)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Verbal</td>
<td>2</td>
<td>22.2</td>
<td>7</td>
<td>77.8</td>
</tr>
<tr>
<td>Written</td>
<td>27</td>
<td>55.1</td>
<td>22</td>
<td>44.9</td>
</tr>
<tr>
<td>Total*</td>
<td>29</td>
<td>50.0</td>
<td>29</td>
<td>50.0</td>
</tr>
</tbody>
</table>

*P = .072.

The factors that were shown, in bivariate analyses, to affect vaccination levels were also examined simultaneously by means of multivariate techniques. A general linear model was used to evaluate the main effects of consent policy and nursing home size on the proportion of vaccinated residents. In this model, only size (number of beds) was significantly related to proportion vaccinated (P = .017). Consent policy was not statistically significant, but there was a trend toward written consent leading to lower vaccination levels (P = .087). Logistic regression analysis was used to evaluate the main effects of the previously described variables on the dichotomous outcome for proportion vaccinated (.<.80 vs ≥.80). Again, only size was significantly related to proportion vaccinated.

During the 1989/90 winter season, circulation of influenza A(H3N2) was detected locally at a time of nationwide increased mortality resulting from pneumonia and influenza. The period of virus isolation lasted from December to March, with outbreaks of influenzalike illness occurring in nursing homes. Influenza A(H3N2) was identified in specimens submitted by 21 of 33 homes that provided specimens for virus isolation. Among the 45 nursing homes that both responded to the retrospective survey and participated in influenzalike illness surveillance, 17 (38%) were identified as having had an influenza outbreak. The occurrence of outbreaks in nursing homes of different sizes and with different vaccination rates is shown in Table 2. Homes where outbreaks were reported were significantly less likely to report vaccination rates of 80% or higher (P = .023, chisquare test). Homes where outbreaks occurred were also significantly larger than homes without outbreaks (P = .023, chi-square test).

Logistic regression was used to evaluate simultaneously the main effects of

residents who received influenza vaccine. The mean proportion vaccinated among the responding homes was 75.8%. The mean size of the 58 responding nursing homes was 99 beds. Homes with more than 100 beds were classified as large and those with 100 or fewer beds as small. The mean proportion vaccinated in small nursing homes (80.8%) was statistically greater (P = .009, t test) than the mean proportion vaccinated in large homes (68.7%). Smaller homes were also more likely than larger ones to report vaccination levels of 80% or more (P = .008, chi-square test).

Consent policies were also found to be significantly associated with the proportion vaccinated in responding nursing homes; lower rates of vaccination were reported in homes requiring written consent from mentally competent residents and/or from the relatives or guardians of competent or incompetent residents. Among the 58 nursing homes, 49 (84.5%) required written consent for vaccination. Large and small homes were equally likely to require written consent (P = .594, chi-square test). The mean proportion vaccinated among the homes requiring written consent was 73.9%, which was significantly lower (P = .002, t test) than the mean proportion vaccinated in those requiring only verbal or no consent (86.1%). However, the consequence of the consent policy appeared different in small and large homes. As shown in Table 1, in the smaller nursing homes, the effect of requiring written consent on vaccination frequency was minimal, suggesting that smaller homes were better able to compensate for such a requirement.

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Discussion

Even with increasing use of influenza vaccine, outbreaks of influenza continue to be reported in nursing homes.15-18 This is especially true when the circulating virus is different from the vaccine strain.19,20 In 1989/90, the circulating virus was quite similar to that included in the vaccine; in spite of this, influenza outbreaks were reported in nursing homes throughout the United States.11 The situation in lower Michigan, with outbreaks in approximately 38% of nursing homes, reflected influenza activity nationwide. In years with widespread outbreaks, questions are raised about the level of effectiveness of influenza vaccination.

While studies generally have been limited to nursing homes in which outbreaks have occurred, the current study was intended to examine a large sample of nursing homes, recruited in advance of the influenza season in a defined region, to determine vaccine effectiveness on an institutional level. It was found that homes that were highly vaccinated were less likely to have experienced an influenza outbreak. Smaller homes were also less likely to have outbreaks. This indicates that the vaccine is effective in preventing influenza-like illness and, based on theories of herd immunity, that the larger the number of susceptible residents in a home, the higher the probability that an outbreak will occur. The fact that outbreaks still do occur in these circumstances suggests the need for additional approaches to influenza control, such as use of the antivirals amantadine and rimantadine. A number of determinants of vaccine use were studied, as has been done previously.22,23 Only two of them—whether written permission for vaccination was required and size of the home—were significantly and independently associated with vaccination levels. That is not to say that other factors do not play a role, especially in larger nursing homes. Since size of home cannot be changed, the issue of obtaining permission for vaccination must be addressed. One reason that permission has traditionally been requested is the cost of the vaccine to the resident or family. Because vaccine is now a Medicare part B covered benefit, the perceived need for written consent for vaccination may gradually decrease.

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References