Impact of Institution Size, Staffing Patterns, and Infection Control Practices on Communicable Disease Outbreaks in New York State Nursing Homes

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Institutional risk factors associated with the occurrence of nosocomial respiratory or gastrointestinal disease outbreaks in 1992 were examined in a case-cohort study of New York State nursing homes conducted in 1993. Facility size, staffing patterns, and employee sick leave policies were the principal effects found in an unconditional logistic regression model. The risk of having respiratory or gastrointestinal disease outbreaks was greater in larger nursing homes (adjusted risk ratio (RR) = 1.71 for each 100-bed increase in size, 95% confidence interval (CI) 1.20–2.42), for nursing homes with a single nursing unit (adjusted RR = 3.93, 95% CI 0.98–15.71), or those with multiple nursing units with shared staff (adjusted RR = 2.51, 95% CI 1.07–5.89). The risk was less for nursing homes with paid employee sick leave policies (adjusted RR = 0.38, 95% CI 0.15–0.99). Other potential risk factors examined in this study, such as the ratio of beds per unit, type of sponsorship, daily review of laboratory test results, and the proportion of private beds and patient-to-staff ratio, were not significantly associated with the risk of disease outbreaks. The results of this study have direct implications for control of nosocomial disease outbreaks in nursing homes. Am J Epidemiol 1996;143:1042–9.

Nosocomial infections are an important cause of preventable morbidity and mortality among residents of nursing homes. The prevalence of nosocomial infections varied from 3 to 16.2 percent in several one-day surveys (1–3) and reached 18.2 percent in a 2-month period survey (4). The incidence of nosocomial infections varied from 3.9 to 13.5 per 1,000 patient care days in two other studies (5, 6). Outbreaks of infectious disease in nursing homes have also been repeatedly reported, and most of these outbreaks involved respiratory or gastrointestinal infections (7–14). In 1991, the Centers for Disease Control described 115 outbreaks of foodborne diseases in nursing homes reported by 26 states during 1975–1987 (7). These outbreaks caused 4,944 episodes of illness, 213 hospitalizations, and 51 deaths. Outbreaks of respiratory infections due to influenza A (8–10), respiratory syncytial virus (11, 12), and Group A Streptococcus (13, 14) have been recently described among nursing home residents. One report of an influenza outbreak in a well immunized nursing home population (8) reported an attack rate of 30 percent among residents, of whom 13 percent were hospitalized and 8 percent died. In another study in which nine outbreaks of Group A streptococcal disease were reported (13), 20 percent of residents were infected and 26 percent of case-residents died. Clearly, prevention of outbreaks of communicable diseases in nursing homes is important, because infections, and especially respiratory or gastrointestinal infections, may spread rapidly in these settings and may involve many residents.

The characteristics of nursing home residents, such as old age, underlying illness, diminished functional status, and mobility, may make them more vulnerable to nosocomial infections (5, 15, 16). Infection control practices have been developed to protect residents from nosocomial infections or outbreaks. In the past decade, a number of studies have described the existing infection control programs in nursing homes and their relation to nosocomial infections (2, 17–19). The impact of different infection control practices varied in these studies (17, 19). A lack of appropriate education and knowledge of infection control practices among nursing home personnel (19), allowing employees with diarrheal illness to work with residents (18), and high patient-to-staff ratio and lack of financial com-
Compensation for employee sick leave (2) have been suggested as potential problems in the prevention and control of nosocomial infections. However, these studies did not directly evaluate the impact of infection control practices on nosocomial infections.

In 1993, a case-cohort study was carried out among New York State nursing homes in order to explore the institutional risk factors that might reduce or increase the risk of having nosocomial outbreaks of respiratory or gastrointestinal infections.

**MATERIALS AND METHODS**

**Case definition and cohort sample selection**

This study was restricted to licensed nursing homes in New York State which cared primarily for adults and operated during all of 1992, the time period for this study. A total of 629 nursing homes met these criteria.

To identify nursing homes in New York State with infectious disease outbreaks in 1992, all infectious disease outbreaks reported to the New York State Department of Health were reviewed. These outbreak reports were obtained from the Bureau of Health Facility Coordination. This Bureau receives legally mandated reports of all infectious disease outbreaks in health care facilities, which submit these reports via one of five administrative area offices in New York State. An outbreak is defined by the Bureau of Health Facility Coordination as any increase in disease incidence over the baseline rate of nosocomial infections in the facility.

In 1992, the New York State Department of Health received a total of 424 infectious disease outbreak reports. Eighty-two (19.3 percent) were reports of a single case of disease with outbreak potential (e.g., tuberculosis), while 342 (80.7 percent) were reports of outbreaks with multiple cases. Of the multiple-case outbreaks, respiratory infections accounted for 48 percent (164/342), gastrointestinal infections for 34.5 percent (118/342), and other infections for 18 percent (60/342). A total of 5,372 nursing home residents were affected among the multiple-case outbreaks and 92 percent of these (4,948/5,372) had respiratory or gastrointestinal infections.

Based on the above review, the case-cohort study (20) was designed to focus on nursing homes with multiple outbreaks of either respiratory or gastrointestinal infection. A case was defined as a nursing home which reported two or more outbreaks of respiratory or gastrointestinal infections in 1992. The cohort sample homes were randomly selected from the entire population of 629 nursing homes licensed in New York State and eligible for the study. Two cohort sample homes were selected for each case home by frequency matching for administrative area of the state as defined by the New York State Department of Health, Office of Health System Management.

**Data collection**

A questionnaire with a cover letter was mailed to the administrator of each selected nursing home on February 26, 1993. The questionnaire was composed of three sections: 1) residents’ status including age distribution, functional capacity, and vaccination levels for influenza; 2) facility characteristics, including bed capacity, type of sponsorship (public, voluntary or proprietary), and proportion of private patient rooms; and 3) infection control program components and practices, including preadmission screening policies, number of staff, hours per week with infection control practitioner on duty, continuing education of staff on infection control principles and procedures, and level of surveillance for nosocomial infections.

Follow-up by mail was conducted with all facilities that did not return their questionnaires. Facilities that did not respond to the second inquiry were contacted again by phone.

**Data analysis**

Case and cohort sample homes were compared in a univariate analysis with regard to facility characteristics, infection control practices, and residents’ status. Statistical significance was assessed by the chi-square test and continuous variables were evaluated with Student’s t-test. Risk ratios and 95 percent confidence intervals were used to estimate the strength of the association between case status and possible risk factors. Those potential risk factors associated with respiratory or gastrointestinal infection outbreaks in the univariate analysis were further analyzed in an unconditional logistic regression model (21). The adjusted risk ratios and the corresponding 95 percent confidence intervals for the potential risk factors were estimated in the model. Administrative area in New York State, the basis of frequency matching in the cohort sample selection, was included in the model.

The microcomputer version of the Series/1 Data Entry System (SIDES/PC) (Software Consulting Service, Inc., San Antonio, Texas) was used for data entry and data verification by duplicate data entry. Data were analyzed on a personal computer using the SAS software package (SAS Software Release 6.04, SAS Institute Inc., Cary, North Carolina). These analyses do not adjust for cases which appear in the cohort...
sample group; as a result, the confidence intervals are somewhat too wide and understate the precision of these findings (22).

RESULTS
Response rate
A total of 61 nursing homes in New York State met the case definition, and 122 cohort sample nursing homes were selected. Of case and cohort sample homes, 57 (93.4 percent) of 61 case nursing homes and 114 (93.4 percent) of 122 cohort sample homes responded to the survey. Eleven of the responding case nursing homes had also been randomly selected in the cohort sample.

Residents' status
At both case and cohort sample nursing homes, there was a similar distribution of residents' age and functional status (p > 0.1). Only 4.9 percent of patients were aged 64 years or less, 13.2 percent 65–74 years, 33.4 percent 75–84 years, and 47.7 percent 85 years and older. In comparing the percent of residents aged 75 years and older in case nursing homes, there was no significant difference (80.2 vs. 81.5 percent, p > 0.05). In the case nursing homes, 16.7 percent were fully ambulatory compared with 17.2 percent in cohort sample nursing homes (t-test, p = 0.87).

Both case and cohort sample nursing homes had similar high levels of influenza vaccination among residents (average percent, 87.2 vs. 85.4). These results persisted when restricting case homes to those that had only respiratory disease outbreaks compared with all cohort sample homes. By contrast, there were very low levels of influenza vaccination among staff in both case and cohort sample nursing homes (25.4 vs. 28.9 percent; p > 0.1).

Facility characteristics
The number of beds in case and cohort sample nursing homes ranged from 20 to 889 (table 1). Over 80 percent of both case and cohort sample nursing homes were not hospital-based. On average, 23 percent of patient-care beds were in private rooms at both case and cohort sample nursing homes, with a range from zero to 100 percent. Case and cohort sample nursing homes had similar sources of payment for patient care. Of the sources of payment, Medicaid accounted for the majority (68.0 percent of case nursing homes and 71.8 percent of cohort sample homes), followed by private pay (20 percent in the case homes and 24 percent in the cohort sample homes). The occupancy level was above 97 percent at both case and cohort sample nursing homes in 1992.

The mean bed capacity for case nursing homes (219.8) was significantly greater than that for cohort sample homes (149.0, t-test, p < 0.002). Case nursing homes had
homes were twice as likely to be publicly sponsored as cohort sample nursing homes (17.5 vs. 8.8 percent) (crude rate ratio [RR] = 2.21, 95 percent confidence interval [CI] 0.86–5.67). In nursing homes with multiple nursing units, respiratory or gastrointestinal disease outbreaks were more likely to occur if staff worked in more than one unit (crude RR = 1.62, 95 percent CI 0.81–3.25). Case homes were also more likely to have a single nursing unit (crude RR = 1.85, 95 percent CI 0.59–5.79). The differences in sponsorship and shared staffing patterns were not statistically significant.

### Infection control programs and practices

Written policies for the management of ill employees with fever, respiratory symptoms (e.g., cough), and diarrhea were reported in 31 of 57 case nursing homes (54.3 percent), and 69 of 114 cohort sample homes (60.5 percent) (crude RR = 0.60, 95 percent CI 0.19–1.88 for having all three policies vs. none) (table 2). The percent of facilities offering paid sick leave for employees was lower in case nursing homes than in cohort sample homes (77 vs. 86 percent, crude RR = 0.56, 95 percent CI 0.25–1.26).

Almost all responding nursing homes had at least one designated infection control practitioner. The exception was one cohort sample nursing home that was hospital-based and shared infection control staff with the hospital. The mean number of infection control practitioners in case and cohort sample nursing homes were 1.12 and 1.05, respectively (t-test, p = 0.24). Nearly half of case and cohort sample homes had a designated consulting infection control or infectious disease physician (41 vs. 43 percent; \( \chi^2, p = 0.74 \)).

The mean hours per week of infection control practitioners working on infection control in case and cohort sample homes were 28.3 and 29.3, respectively. The findings were similar when the analysis was restricted to homes with only part-time practitioners (mean hours in case homes = 10.9 vs. 12.2 in cohort sample homes; t-test, p = 0.5).

Because the occupancy rates in case and cohort sample nursing homes were over 97 percent in 1992, the bed capacity was used as a surrogate for the number of residents in the patient-to-staff ratio calculation. The number of staff included physician assistants, registered nurses, certified nursing aides, and licensed practical nurses. The patient-to-staff ratios in case and cohort sample nursing homes were 1.62

<table>
<thead>
<tr>
<th>Variable</th>
<th>Case nursing homes</th>
<th>Cohort sample nursing homes</th>
<th>Crude risk ratio</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Written protocol for control of fever, diarrhea, and respiratory symptoms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All three</td>
<td>31</td>
<td>69</td>
<td>60.5</td>
<td>0.60*</td>
</tr>
<tr>
<td>None</td>
<td>6</td>
<td>8</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>Unknown</td>
<td>14</td>
<td>22</td>
<td>18.3</td>
<td></td>
</tr>
<tr>
<td>Offer paid employee sick leave</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>44</td>
<td>97</td>
<td>85.9</td>
<td>0.56</td>
</tr>
<tr>
<td>No</td>
<td>13</td>
<td>16</td>
<td>14.2</td>
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</tr>
<tr>
<td>Designated ICP†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>57</td>
<td>113</td>
<td>99.1</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>0</td>
<td>1</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>Consulting infection control physician</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>23</td>
<td>49</td>
<td>43.0</td>
<td>0.92</td>
</tr>
<tr>
<td>No</td>
<td>33</td>
<td>65</td>
<td>57.0</td>
<td></td>
</tr>
<tr>
<td>Mean no. of ICP</td>
<td>1.12</td>
<td>1.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean hours per week of ICP working on infection control</td>
<td>28.33</td>
<td>29.27</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient-to-staff ratio‡</td>
<td>1.62</td>
<td>1.70</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Comparison between "all three" and "none."
† ICP, infection control practitioner.
‡ Staff includes physician assistants, registered nurses, certified nursing aides, and licensed practical nurses.
(range 0.9–3.4) and 1.70 (range 0.02–5.6), respectively (t-test, \( p = 0.35 \)).

**Surveillance techniques for detecting nosocomial infections**

Techniques for detecting nosocomial infections reported by responding nursing homes included chart reviews for fever, gastrointestinal and respiratory symptoms, laboratory results, and antibiotic utilization. Case homes were more likely to review daily patient charts, laboratory results or antibiotic utilization than cohort sample homes (crude RR = 1.51–1.70 for patient charts, 1.77 for laboratory results, and 1.71 for antibiotic utilization) (table 3).

**Written policies and staff education**

Most case and cohort sample nursing homes had written policies for the control of influenza and tuberculosis (case nursing homes, 94 and 98 percent, vs. cohort sample nursing homes, 91 and 96 percent, respectively). On average, case nursing homes were slightly less likely than cohort sample homes to have written policies for the control of methicillin resistant *Staphylococcus aureus*, *C. difficile*, and hepatitis B infections (76.8 vs. 83.9 percent, 67.9 vs. 76.1 percent, and 89.5 vs. 92.0 percent, respectively). Case homes were slightly more likely to have a written policy for gastrointestinal outbreaks (89.3 vs. 82.9 percent). None of these differences was statistically significant.

Infection control education for infection control practitioners included continuing education, in-service training, and attending an Association of Professionals in Infection Control meeting during the past 3 years. In-service training had been conducted in more than 94 percent in both case homes and cohort sample nursing homes in 1990–1991 and was 100 percent in 1992.

Attendance at continuing education and Association of Professionals in Infection Control meetings increased during the same time period in both case and cohort sample nursing homes. The percent of facilities with staff who attended continuing education increased from 58.9 percent in 1990 to 83.9 percent in 1992 for case nursing homes, and from 60.7 percent to 73.2 percent for cohort sample nursing homes. The greater increase in attendance at continuing education observed in case nursing homes was not statistically significant (\( \chi^2, \ p = 0.55 \)). In comparison, the percent of nursing home staff who attended association meetings in both case and cohort sample homes was low (43.9 percent vs. 40.4 percent, respectively) in 1992, even though this represented an increase compared with the previous years (not shown).

**Multivariate analysis**

Based on the univariate analyses, those variables with some apparent association with the occurrence of respiratory or gastrointestinal disease outbreaks were included in an unconditional logistic regression model to further describe the relation between the outcome variable (multiple respiratory or gastrointestinal outbreaks) and selected exposure variables. In addition, some variables, such as the percent of private beds, the ratio of beds to nursing unit, and the patient-to-staff ratio, which were not significantly associated with case status in the univariate analyses, were also included in the model based on the expectation that they might be important in determining the risk of communicable disease outbreaks.

The selected variables in the logistic regression model were the number of beds, the ratio of beds to nursing unit, the percent of private beds (single rooms), patient-to-staff ratio, sponsorship of nursing homes, nursing units and staff, paid sick leave for employees, and daily reviewing of laboratory results. Daily review of laboratory results was chosen to represent the measures of surveillance techniques in the model in order to avoid possible collinearity in the

<table>
<thead>
<tr>
<th>Variable</th>
<th>Case nursing homes</th>
<th>Cohort sample nursing homes</th>
<th>Crude risk ratio</th>
<th>95% confidence interval</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Daily</td>
<td>Non-daily</td>
<td>Daily</td>
<td>Non-daily</td>
</tr>
<tr>
<td>Reviewing patient charts</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For fever</td>
<td>29</td>
<td>51.8</td>
<td>27</td>
<td>48.2</td>
</tr>
<tr>
<td>For GI symptoms*</td>
<td>31</td>
<td>54.4</td>
<td>26</td>
<td>45.6</td>
</tr>
<tr>
<td>For respiratory symptoms</td>
<td>31</td>
<td>55.4</td>
<td>25</td>
<td>44.6</td>
</tr>
<tr>
<td>Reviewing laboratory results</td>
<td>40</td>
<td>70.2</td>
<td>17</td>
<td>29.8</td>
</tr>
<tr>
<td>Reviewing antibiotic utilization</td>
<td>27</td>
<td>47.4</td>
<td>30</td>
<td>52.6</td>
</tr>
</tbody>
</table>

* GI symptoms, gastrointestinal symptoms.
TABLE 4. Crude and adjusted risk ratios (RR) and 95% confidence intervals (CI) for the association between selected variables and case status, New York State, 1993

<table>
<thead>
<tr>
<th>Variable</th>
<th>Crude RR</th>
<th>95% CI</th>
<th>Adjusted RR</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of beds</td>
<td>1.004</td>
<td>1.001–1.006</td>
<td>1.005</td>
<td>1.002–1.009</td>
</tr>
<tr>
<td>Ratio of beds to unit</td>
<td>1.009</td>
<td>0.98–1.04</td>
<td>1.02</td>
<td>0.99–1.06</td>
</tr>
<tr>
<td>% of private beds</td>
<td>1.00</td>
<td>0.98–1.01</td>
<td>1.00</td>
<td>0.98–1.02</td>
</tr>
<tr>
<td>Patient-to-staff ratio</td>
<td>0.76</td>
<td>0.43–1.36</td>
<td>0.60</td>
<td>0.33–1.46</td>
</tr>
<tr>
<td>Sponsorship (1 = public, 0 = other)</td>
<td>2.21</td>
<td>0.86–5.67</td>
<td>1.29</td>
<td>0.38–4.38</td>
</tr>
<tr>
<td>Staffing pattern†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Single unit</td>
<td>1.85</td>
<td>0.59–5.79</td>
<td>3.93</td>
<td>0.98–15.71</td>
</tr>
<tr>
<td>2. Multiple units and shared staff</td>
<td>1.62</td>
<td>0.81–3.25</td>
<td>2.51</td>
<td>1.07–5.89</td>
</tr>
<tr>
<td>Paid employee sick leave (1 = yes, 0 = no)</td>
<td>0.56</td>
<td>0.25–1.26</td>
<td>0.38</td>
<td>0.15–0.99</td>
</tr>
<tr>
<td>Laboratory result checking (1 = daily, 0 = other)</td>
<td>1.91</td>
<td>0.96–3.81</td>
<td>1.90</td>
<td>0.88–4.20</td>
</tr>
</tbody>
</table>

* Adjusted for Department of Health, Office of Health Systems Management area offices within New York State in the model.
† Design variable, with the referent group being "multiple units with separate staff."

The adjusted risk ratios and 95 percent confidence intervals for the association between selected variables and case status are presented in table 4. The risk of having respiratory or gastrointestinal disease outbreaks was significantly and positively associated with the size of nursing homes. Each 100-bed increase in nursing home size resulted in a 1.7-fold increased risk of having an outbreak (95 percent CI 1.20–2.42) (data not shown). Significantly elevated adjusted risk ratios were also observed for nursing homes with single nursing units and for nursing homes with multiple nursing units and shared staff (adjusted RRs = 3.93, 95 percent CI 0.98–15.71, and 2.51, 95 percent CI 1.07–5.89, respectively) compared with homes with multiple units and separate staff.

Other selected variables with elevated but nonsignificant adjusted risk ratios were type of sponsorship, ratio of beds to nursing unit, and the daily laboratory reviews. Public sponsorship was associated with a slightly increased risk of communicable disease outbreaks (adjusted RR = 1.29, 95 percent CI 0.38–4.38). The adjusted risk ratio was 1.53 (95 percent CI 0.78–2.98) for each 20-bed per nursing unit increase in size. Daily checking of laboratory results was associated with 1.9 (95 percent CI 0.88–4.20) times increased likelihood of communicable disease outbreaks.

A significantly decreased adjusted risk ratio was found for paid sick leave (adjusted RR = 0.38, 95 percent CI 0.15–0.99). Case nursing homes were less likely to offer paid sick leave for employees. An inverse association but nonsignificant was observed for patient-to-staff ratio (adjusted RR = 0.69, 95 percent CI 0.33–1.46).

**DISCUSSION**

In this case-cohort study, institution size was significantly associated with nosocomial respiratory or gastrointestinal disease outbreaks. To our knowledge, this finding has not been well recognized or reported in the past. That larger nursing homes have a higher risk of having nosocomial respiratory or gastrointestinal disease outbreaks might be due to the observed differences in infection control programs and practices resulting in more nosocomial outbreaks being detected and reported. However, when factors indicating strong infection control programs, such as written protocols, education for infection control practitioners and regular checking of laboratory results were controlled for in the unconditional logistic regression model in this study, the institution size was still highly associated with nosocomial respiratory or gastrointestinal disease outbreaks. We believe, therefore, that institution size itself might lead to a true increase in nosocomial outbreaks. The relative difficulty in managing greater number of patients, as well as the increased person-to-person contact among a greater number of different individual residents, visitors, and staff in large nursing homes might create greater opportunity for the introduction and transmission of respiratory or gastrointestinal infections in larger than in smaller nursing homes.

A variety of facility characteristics in nursing homes have been described in some previous studies of the risks of nosocomial infections in general (2, 17–19), but they have not been examined in association with risk of outbreaks. We found that room layout and staffing patterns for example, had a significant effect on the risk of nosocomial disease outbreaks. Nursing homes with single units or with multiple nursing units (wards) and shared staff among units had over twice...
the risk of communicable disease outbreaks as those with multiple units with separate staff on each unit. This again may be due to a greater number of patients and staff coming into contact in the former settings, thus increasing the risk of both introduction and transmission of disease. Shared staff on all shifts, or at nights and weekends may also increase the number of different staff that patients come into contact with and thus the chance of disease transmission. Furthermore, nursing staff working on more than one unit during a given shift may indirectly indicate a shortage of nursing staff. This could lead to more communicable disease outbreaks due, for example, to lack of prompt isolation and treatment of ill patients with respiratory or gastrointestinal disease.

In a study by Garibaldi et al. (2) in Salt Lake City, the authors suggested that offering a policy of paid employee sick leave may play a role in preventing nosocomial infections. However, they did not demonstrate a statistical association. The results in this study indicated that nursing homes with paid employee sick leave were less likely to have communicable disease outbreaks (adjusted RR = 0.56, 95 percent CI 0.15–0.99). Such a policy may minimize the contact between sick staff and residents, or reduce nosocomial infections which are introduced by sick staff to a minimal degree. This finding has direct implications for infection control policies in nursing homes.

It is also worth noting that a very low influenza vaccination rate for staff was observed in this study. Even though there was no significant difference between case and cohort sample nursing homes, the importance of staff vaccination and the role of staff health have been illustrated in several studies (8, 22). Illness among nursing home staff may disrupt patient care and introduce influenza into the nursing home residents. Staff vaccination could effectively minimize those influenza outbreaks initiated by staff and play a role in prevention of nosocomial diseases. The low level of staff vaccination in this study suggests the need to develop programs to improve staff vaccination in nursing homes.

In this study, case-based design sampling (20) was used to estimate association of interest without collecting data from all nursing homes. There was minimal potential selection bias in this study since the overall level of response was 93.4 percent. Moreover, the recall bias was minimized, because, first, the unit of observation was the nursing home with the infection control practitioner, infection control nurse or administrator who represented his/her nursing home as the respondent rather than the individual patient; second, most of the questions in our survey could be answered from computerized records or logbooks; and third, the study period of interest was in 1992 which was close to the date we conducted this study.

Some limitations of this study should be considered. One is the study power. Owing to the absence of relevant studies on institutional characteristics, the expected effects could not be determined prior to conducting this study, thereby affecting the power to detect a statistically significant difference for some comparisons. For example, the statistical power to detect the observed difference for paid employee sick leave (23 vs. 14 percent) was only 29.5 percent. Because of low power, we were not able to examine interactions between variables. Another potential limitation is underascertainment of cases. A case nursing home in this study was defined based on passive reporting; underreporting of outbreak events may have occurred.

In summary, this study evaluated the impact of institutional size, staffing pattern and the policy of paid employee sick leave on nosocomial respiratory or gastrointestinal disease outbreaks. Because of the host characteristics of nursing home residents, which include old age, poor immune status, and underlying chronic diseases, the elimination of nosocomial disease in this setting is impossible. Nevertheless, it should be possible to minimize nosocomial disease outbreaks to a lower rate than is currently observed if the important risk factors are recognized, understood, and controlled. The significant findings in this study may have direct implications for control and prevention of nosocomial communicable disease outbreaks in long-term care facilities.

Based on the present results, it is recommended that increased emphasis be placed on proper infection control measures, especially in large nursing homes. The institution of policies for paid employee sick leave and the development of separate staffing patterns in different nursing units may also be beneficial to prevent the occurrence of communicable disease outbreaks in long-term care facilities. In the future, new nursing home construction might be limited in terms of bed capacity. Other related possible risk factors, i.e., patient-to-staff ratio, sponsorship of facility, and the role of private beds need to be further studied.

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REFERENCES