**Title:**

**Infection control and prevention factors affecting outbreaks of influenza and acute viral gastroenteritis in long-term care facilities in Japan**

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**Abstract**

**Background:** Long-term care facilities (LTCFs) residents are at high risk for infectious diseases, and some facilities have not implemented standard precautions correctly. As a result, outbreaks are reported annually. In this study, we investigated outbreaks of influenza and acute viral gastroenteritis in LTCFs to clarify infection control measures that are effective in reducing the risk of an outbreak.

**Methods:** We randomly selected LTCFs from the Welfare, Health and Medical Care Information Network database of the Welfare and Medical Service Agency in Japan, 865 of which agreed to participate in the study. We examined the type of healthcare services provided and the prevalence of infectious diseases during 2012. We then assessed the presence or absence of an outbreak of influenza and acute viral gastroenteritis in 2012, and examined the relationship between outbreak occurrence and infection control using a multiple regression analysis. We also examined the relationship between the number of residents affected per outbreak and the type of infection control measures used.

**Results:** Outbreaks of influenza and acute viral gastroenteritis occurred in 13.6% and 21.6%, respectively, of the LTCFs surveyed. Control measures effective at reducing the number of influenza outbreaks were restricting visitors with symptoms, moving symptomatic residents to private rooms, and maintaining humidity levels inside the facility. Control measures effective against outbreak of acute viral gastroenteritis outbreak were using disposable gloves, facial masks, and gowns when handling vomitus and excreta of persons suspected of infection, monitoring and surveillance of infections, and providing staff training to increase awareness of infection control measures.

**Conclusions:** To prevent outbreaks, it is imperative that facilities take appropriate actions to block the route of infection and to maintain room humidity. In addition, staff must be trained in infection prevention and control measures on a regular basis.

**Keywords:** infection control, long-term care facility, outbreak, influenza, acute viral gastroenteritis

**Background**

Long-term care facilities (LTCFs) can be defined as institutions that provide healthcare to people who require chronic care management or short-term rehabilitative services. LTCF residents are at high risk for infectious diseases because of compromised immune systems and reduced physical strength [1].

In the 15 years since Japan introduced the long-term care insurance system, the supply of long-term care services has increased, but its quality is still a matter of great concern. Recent outbreaks of various infectious diseases, including influenza and norovirus, have prompted the Japanese government to require appropriate infection controls in LTCFs [2-4]. The 2007 revision of the Medical Care Act mandates the implementation of infection management systems in LTCFs. The difficulty of preventing infection development means that the focus rests on managing infection control, surveillance, and staff training. In the United States, outbreaks of respiratory diseases in nursing homes have led to changes in hand hygiene of staff and nurse hours per resident [5]. A Japanese study found that outbreaks of respiratory infection and gastroenteritis in LTCFs could be controlled by the staff wearing face masks, gargling with an antiseptic rinse, and hand hygiene [6]. However, there is no clear protocol for specific infection control strategies at LTCFs in Japan. The number of residents per nurse is high in Japan, compared with other OECD member countries [7]. Some facilities have not implemented standard precautions correctly [8-9]. As a result, outbreaks are reported each year.

To evaluate the quality of healthcare services at LTCFs, this study focused on the implementation of infection control and prevention measures. We investigated outbreaks of influenza and acute viral gastroenteritis in LTCFs to clarify the factors affecting the occurrence of outbreak.

**Methods**

***Sample selection***

The sample consisted of welfare facilities for the elderly and healthcare facilities for the elderly. Facility residents are classified into 5 levels of care in Japan: Level 1 is a state that requires partial care for some aspects of activities of daily living (ADL); level 2 requires a low level of care; level 3 requires a moderate level of care; level 4 requires a high level of care, and level 5 requires the highest level of care.

We randomly selected 2000 facilities from LTCFs registered with the Welfare, Health and Medical Care Information Network of the Welfare and Medical Service Agency. A questionnaire was mailed to the nurse managers or facilities officers who had agreed to participate in the study. Questionnaires were returned by 865 of the facilities (43.3%). Of those, 541 (62.5%) were welfare facilities, and 324 (37.5) were healthcare facilities.

***Data collection***

We collected information on healthcare services and the prevalence of infectious diseases at the facilities in 2012. The questionnaire was composed of three parts: Structure indicators, process indicators, and outcome indicators. Structure indicators included facility organization, personnel allocation, and characteristics of the standard care system in the facility. Process indicators included the frequency of implementing infection control management strategies, such as performing a risk assessment or conducting training. Process indicators also included individual measures taken to control and prevent infection. Outcome indicators included the prevalence of influenza and acute viral gastroenteritis in the facility during the preceding year.

***Data analysi*s**

An outbreak was defined as two or more occurrences of infection in the same period. We assessed the presence or absence of an outbreak of influenza and acute viral gastroenteritis in the year preceding the data collection, along with an analysis of the number of outbreaks at the time.

Next, we compared the implementation of infection control and prevention strategies at LTCFs during times of outbreak and no outbreak using a chi-squared test, Mann-Whitney U test, and Student's *t*-test, after confirming the normality of each indicator.

Using a multivariable logistic regression model with stepwise selection methods, we examined the relationship between each indicator and the presence or absence of outbreak. Using multivariate linear regression models with stepwise selection methods, we examined the relationship between the number of residents affected per outbreak and the practices of infection control and prevention in the participating LTCFs. The analyses were performed using SPSS for Windows, version 20.0J (IBM; Japan), with the level of significance set at *p* < 0.05.

***Ethics approval***

This study was conducted with approval by the ethics committee of the Graduate School of Nursing of Nagoya City University. Survey respondents were given a written explanation of the study’s purpose, and informed that participation was voluntary, and that the confidentiality of their personal information would be protected. Return of the questionnaire was considered implied consent to participate in this study.

**Results**

Table 1 displays the characteristics of participating facilities. The average number of residents per facility was 75.3 people, and their average age was 77.8 years.

***Outbreaks of influenza***

Outbreaks of influenza were reported by 13.6% of LTCFs. On average, each outbreak affected 9.2 residents in each facility. Table 2 shows the data for infection control and prevention strategies reported by each facility, stratified by the presence or absence of influenza outbreaks. Table 4 lists the odds ratios calculated for four factors, as a measure of association with outbreaks of influenza. Two of the factors were structure indicators (the number of residents in the facility and the number of residents per nurse), while the other two were infection control and prevention strategies (restricting visitors with symptoms and maintaining room humidity using humidifiers). While the number of residents in the facility and the number of residents per nurse did not affect the characteristics of the outbreak, restricting symptomatic visitors and maintaining humidity levels were protective against contracting influenza (odds ratios: 0.70 and 0.72, respectively). Table 5 shows the measure of association between two infection control and prevention strategies (moving residents to private rooms when an infection is suspected and maintaining room humidity using humidifiers) and the number of facility residents affected by influenza during an outbreak. The analysis shows that moving symptomatic residents to private rooms and maintaining room humidity levels reduces the number of residents who contract influenza.

***Outbreaks of acute viral gastroenteritis***

Outbreaks of acute viral gastroenteritis were reported by 21.6% of LTCFs. The average number of residents affected per outbreak was 10.7. Table 3 shows the data for infection control and prevention strategies reported by each facility, stratified by the presence or absence of outbreak. Table 4 lists the odds ratios calculated for five factors, as a measure of association with outbreaks of acute viral gastroenteritis. Two of the factors were structure indicators (the number of residents in the facility and the number of residents per nurse), while the other three were infection control and prevention strategies (monitoring of infection occurrence, using gloves and a face mask when handling vomitus and excreta of persons suspected of infection, and wearing a disposable gown under the same circumstances). While the number of residents in the facility and the number of residents per nurse barely affected the characteristics of the outbreak (odds ratios: 1.04 and 1.02, respectively), monitoring of infection occurrence, using gloves and masks, and using disposable gowns were protective against contracting acute viral gastroenteritis (odds ratios: 0.78, 0.83, and 0.74, respectively). Table 5 shows the measure of association between one structure indicator (the number of residents in the facility) and two infection control and prevention strategies (increasing awareness and knowledge among the staff and using a disposable gown when handling vomitus and excreta of persons suspected of infection) and the number of facility residents affected by acute viral gastroenteritis during an outbreak. The analysis shows that the number of residents in the facility, increasing awareness and knowledge among the staff, and using disposable gowns when handling body fluids from symptomatic residents are all factors inversely correlated with the number of residents who contract acute viral gastroenteritis.

**Discussion**

This study examined the prevalence of influenza and acute viral gastroenteritis in elderly care facilities over a period of one year. We then assessed independent predictors of prevention and control of outbreaks, as well as factors affecting how many residents would contract a disease during an outbreak.

We determined that in 2012, outbreaks of influenza occurred in 13.6% of the facilities surveyed, and outbreaks of acute viral gastroenteritis occurred in 21.6% of the same facilities. These numbers concur with the findings in a 2008 study of nursing homes in the United States [5]. The rates of influenza outbreaks in the present study were lower than those reported in previous studies of LTCFs in Japan [3-4, 10], while the incidence of acute viral gastroenteritis is comparable [3]. The difference may be attributed to better awareness of infection control and prevention strategies by LTCF staff. The source of infection is most likely outside influences – new residents moving in, family and friends visiting, and care staffers who reside off the premises.

We found a relationship between the outbreak of influenza and restricting symptomatic visitors. This shows the importance of prevention by restricting the infection’s source. We also found a relationship between segregating symptomatic residents to private rooms and the overall number of residents affected by influenza. This demonstrates the importance of preventing the spread of disease by cutting off the route of infection within the facility.

The present study found that the factor related to both the occurrence and magnitude of influenza outbreaks is the maintenance of humidity levels in the residents’ rooms. Many facility residents are susceptible to infection, because of co-morbidities and weak or compromised immune systems. To prevent the spread of influenza, it is imperative that facilities maintain proper levels of humidity indoors.

Previous studies showed that influenza morbidity declined in many facilities when residents were vaccinated against the virus [11-13]. However, the present study found no relationship between immunization and the incidence of influenza.

Acute viral gastroenteritis is caused by multiple agents, including norovirus, and the main route of infection is contact. The infection can be spread via handling of contaminated stool or vomitus [1]. In the present study, we showed that the use of disposable gowns, gloves, and facial masks when handling vomitus and excreta of persons suspected of infection, along with monitoring and surveillance, reduced the occurrence of the disease. This study also found a relationship between increasing the awareness and training among staff members and the number of residents who contract acute viral gastroenteritis. Implementation strategies for infection control and prevention are clearly stated in guidelines [14], but staff awareness of the guidelines is generally low [8-9]. It is essential to educate LTCF staff on infection prevention and control measures.

This study may have been limited by the cross-sectional design, precluding conclusions on causality. In addition, these findings were based on a survey of only 865 LTCFs, and may not be generalizable to all LTCFs.

**Conclusions**

This study found that influenza outbreaks in LTCFs could be controlled by restricting symptomatic visitors, moving residents to private rooms when infection was suspected, and maintaining humidity levels using humidifiers. To prevent outbreaks of influenza, the facility must take appropriate actions to block the route of infection and to maintain proper humidity levels.

Our findings also indicate that outbreaks of acute viral gastroenteritis may be affected by the number of residents in the facility, and could be controlled by using disposable gloves, facial masks, and gowns when handling vomitus and excreta of persons suspected of infection, monitoring the occurrence of infections, and increasing the awareness and knowledge among staff. To prevent outbreaks, facilities must conduct training in infection control on a regular basis. Altogether, our findings suggest that to prevent outbreaks, LTCFs must improve infection control measures.

**Abbreviations**

LTCFs: long-term care facilities; OECD: Organization for Economic Co-operation and Development; ADL: activities of daily living.

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**Competing interests**

The authors declare that they have no competing interests.

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**Authors’ contributions**

SK conceived the study, designed the questionnaire, collected the data, analyzed the results, and wrote the manuscript.

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Table 1. Characteristics of participating LTCFs

|  |  |  |
| --- | --- | --- |
|  |  | N (%) |
| Number of residents | <50 | 91 (10.5) |
|  | 50-100 | 533 (61.6) |
|  | 101< | 241 (27.9) |
| Funding type | Private | 822 (95.0) |
|  | Public | 43 ( 5.0) |
| Location | Rural | 468 (54.1) |
|  | Urban | 397 (45.9) |
| Facility type | Welfare facility for the elderly | 541 (62.5) |
|  | Healthcare facility for the elderly | 324 (37.5) |

Table 2. Participating LTCFs and influenza control measures

|  |  |  |  |
| --- | --- | --- | --- |
|  | Facilities reporting outbreaks(n=122) | Facilities reporting nooutbreaks(n=743) | *p* value |
| Structure indicators1 |  |  |  |
|  | Number of residents in facility | 77 (27-243) | 75 (14-199) | 0.038 |
|  | Rate of capacity utilization | 97.0 (82-106) | 98.0 (49-103) | 0.279 |
|  | Level of care required for residents in facility |  |  |  |
|  | Rate of level 1 | 4.1 (0-28) | 3.8 (0-38) | 0.264 |
|  | Rate of level 2 | 12.1 (0-59) | 10.4 (0-36) | 0.155 |
|  | Rate of level 3 | 21.5 (2-36) | 22.0 (2-64) | 0.635 |
|  | Rate of level 4 | 30.1 (10-57) | 30.0 (6-60) | 0.707 |
|  | Rate of level 5 | 25.7 (7-76) | 28.9 (5-80) | 0.169 |
|  | Human resources |  |  |  |
|  | Number of residents per doctor | 99 (6-1340) | 85 (25-1860) | 0.005 |
|  | Number of residents per nurse | 13 (3-145) | 10 (3-53) | 0.008 |
|  | Number of residents per care staff | 3 (1-56) | 3 (1-51) | 0.655 |
| Process indicators 2 |  |  |  |
|  | Infection management system |  |  |  |
|  | Revision of manuals for measures against infection | 113 (92.6) | 650 (88.2) | 0.096 |
|  | Increasing awareness of required actions and improving measures against infection among staff | 117 (96.7) | 715 (97.3) | 0.447 |
|  | Holding review meetings and seminars related to measures against infection | 119 (97.5) | 723 (98.2) | 0.403 |
|  | Conducting rounds for risk identification | 95 (78.5) | 541 (74.6) | 0.212 |
|  | Monitoring occurrence of infection (surveillance)  | 100 (85.5) | 635 (86.7) | 0.399 |
|  | Measures of influenza prevention |  |  |  |
|  | Persuading visitors to use fast-drying hand sanitizers | 122 (99.2) | 713 (96.0) | 0.052 |
|  | Instructing residents, staff, and visitors with a cough to wear a mask  | 103 (84.4) | 643 (86.5) | 0.307 |
|  | Restricting visitors with symptoms | 88 (72.1) | 569 (76.6) | 0.170 |
|  | Moving residents to private rooms when infection is suspected  | 100 (82.0) | 599 (80.6) | 0.417 |
|  | Maintaining room humidity using humidifiers | 102 (83.6) | 666 (89.6) | 0.040 |
|  | Restricting staff with suspected influenza from working until 3 days after fever alleviation | 94 (77.0) | 571 (76.9) | 0.533 |
|  | Washing hands before food consumption | 95 (77.9) | 618 (83.2) | 0.099 |
|  | Washing hands after excretion | 94 (77.0) | 607 (81.7) | 0.139 |
|  | Influenza vaccination for residents3 | 91.1 (16.2) | 93.8 (13.1) | 0.084 |
|  | Influenza vaccination for staff3 | 91.7 (13.0) | 91.8 (13.9) | 0.926 |

1Median (min-max), Mann-Whitney U test

2Number (%), chi-squared test score

3Mean (standard deviation), Student’s *t*-test

Table 3. Participating LTCFs and acute viral gastroenteritis control measures

|  |  |  |  |
| --- | --- | --- | --- |
|  | Facilities reporting outbreaks(n=187) | Facilities reporting no outbreaks(n=678) | *p* value |
| Structure indicators1 |
|  | Number of residents in facility | 77 (24-243) | 75 (14-199) | 0.018 |
|  | Rate of capacity utilization | 97.2 (77-100) | 98.0 (49-106) | 0.263 |
|  | Level of care required for residents in facility |  |  |  |
|  | Rate of level 1 | 3.8 (0-28) | 3.8 (0-38) | 0.252 |
|  | Rate of level 2 | 11.4 (0-59) | 10.7 (0-36) | 0.119 |
|  | Rate of level 3 | 22.4 (6-37) | 22.0 (2-64) | 0.546 |
|  | Rate of level 4 | 29.9 (12-57) | 30.1 (6-60) | 0.389 |
|  | Rate of level 5 | 27.8 (6-77) | 29.5 (5-80) | 0.084 |
|  | Human resources |  |  |  |
|  | Number of residents per doctor | 98 (15-1200) | 92 (7-1860) | 0.340 |
|  | Number of residents per nurse | 13 (3-145) | 11 (4-48) | 0.036 |
|  | Number of residents per care staff | 3 (1-56) | 2 (1-51) | 0.538 |
| Process indicators 2 |
|  | Infection management system |
|  | Revision of manuals for measures against infection | 165 (88.7) | 597 (88.7) | 0.559 |
|  | Increasing awareness of required actions and improving measures against infection among staff | 184 (98.9) | 648 (96.7) | 0.078 |
|  | Holding review meetings and seminars related to measures against infection | 184 (98.9) | 658 (97.9) | 0.291 |
|  | Conducting rounds for risk identification | 142 (77.6) | 96 (74.8) | 0.251 |
|  | Monitoring occurrence of infection (surveillance) | 170 (92.4) | 564 (84.9) | 0.004 |
|  | Measures of acute viral gastroenteritis prevention |
|  | Providing disposable towels in the facility and bathrooms | 170 (90.9) | 634 (93.5) | 0.143 |
|  | Using disposable gloves and facial masks when handling vomitus and excreta of persons suspected of infection | 175 (93.6) | 607 (89.5) | 0.059 |
|  | Using disposable gowns when handling vomitus and excreta of persons suspected of infection | 111 (59.4) | 330 (48.7) | 0.006 |
|  | Separating contaminated linen into designated plastic bags to disinfect with sodium hypochlorite and then wash separately | 182 (97.3) | 646 (95.3) | 0.153 |
|  | Disinfecting handrails and doorknobs using sodium hypochlorite when infection is suspected | 184 (98.4) | 652 (96.2) | 0.096 |
|  | Moving residents to private rooms when infection is suspected | 158 (84.5) | 571 (84.2) | 0.515 |
|  | Restricting staff from working until several days after alleviation of symptoms such as vomiting and diarrhea | 142 (75.9) | 517 (76.3) | 0.499 |
|  | Checking the expiration dates of foods brought in from outside  | 162 (86.6) | 601 (88.6) | 0.262 |
|  | Washing hands before food consumption | 144 (77.0) | 568 (83.8) | 0.023 |
|  | Washing hands after excretion | 152 (81.3) | 550 (81.1) | 0.527 |
|  | Using hand sanitizers and changing gloves after each diaper change | 183 (97.9) | 665 (98.1) | 0.519 |

1Median (min-max), Mann-Whitney U test

2Number (%), chi-squared test score

Table 4. Factors associated with outbreak of infection

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | OR | (95% CI) | *p* value |
| Influenza  |  |  |  |
|  | Number of residents in facility | 1.01 | (1.00-1.02) | 0.024 |
|  | Number of residents per nurse | 1.01 | (1.00-1.02) | 0.025 |
|  | Restricting visitors with symptoms | 0.70 | (0.42-0.98) | 0.041 |
|  | Maintaining room humidity using humidifiers | 0.72 | (0.37-0.96) | 0.030 |
| Acute viral gastroenteritis  |  |  |  |
|  | Number of residents in facility | 1.04 | (1.01-1.18) | 0.028 |
|  | Number of residents per nurse | 1.02 | (1.00-1.07) | 0.031 |
|  | Monitoring of infection occurrence (surveillance) | 0.78 | (0.42-0.89) | 0.039 |
|  | Using disposable gloves and facial masks when handling vomitus and excreta of persons suspected of infection | 0.83 | (0.53-0.99) | 0.046 |
|  | Using disposable gowns when handling vomitus and excreta of persons suspected of infection | 0.74 | (0.32-0.93) | 0.036 |

OR (95% CI): odds ratio (95% confidence interval) by multivariable logistic regression analysis using backward selection methods

Table 5. Factors associated with number of residents affected by outbreak

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | β | p |
| Influenza  |  |  |
|  | Moving residents to private rooms when infection is suspected | -0.11 | 0.013 |
|  | Maintaining room humidity using humidifiers | -0.15 | 0.011 |
| Acute viral gastroenteritis  |  |  |
|  | Number of residents in facility | -0.19 | 0.021 |
|  | Increasing awareness of actions required and improving measures against infection among staff | -0.17 | 0.043 |
|  | Using disposable gowns when handling vomitus and excreta of persons suspected of infection | -0.24 | 0.001 |

β, standardized coefficient by multiple linear regression analysis using stepwise selection methods