

# **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**

Long-term care facility (LTCF) residents are at high risk for infectious diseases, and because of poor implementation of standard precautions, outbreaks frequently occur. We investigated influenza and acute viral gastroenteritis outbreaks in LTCFs to identify effective infection control measures. We investigated 865 LTCFs from the Welfare, Health and Medical Care Information Network database of the Welfare and Medical Service Agency in Japan. We examined the healthcare services provided, the prevalence of infectious diseases, and the occurrence of outbreaks of influenza or acute viral gastroenteritis during 2012. We analyzed the relationships between outbreak occurrence, number of residents affected, and infection control measures used. Influenza and acute viral gastroenteritis outbreaks occurred in 13.6% and 21.6%, respectively, of the LTCFs. Effective influenza outbreak control measures were restricting of symptomatic visitors, moving symptomatic residents to private rooms, and maintaining facilities' humidity levels. Measures effective against acute viral gastroenteritis outbreak were using of disposable gloves, facial masks, and gowns when handling vomitus and excreta of persons suspected of infection, monitoring of infections, and staff awareness of infection control measures. To prevent outbreaks, facilities must block the route of infection, maintain room humidity, and regularly train staff in infection prevention and control measures.

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

## 1 Introduction

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.

## 2 Methods

### 2.1 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.

## **2.2 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.

## **2.3 Data analysis**

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  $p < 0.05$ .

## **2.4 Ethics approval**

This study was conducted with approval by the ethics committee of the Graduate School of Nursing of Nagoya City University (12024-2). 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.

### 3 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.

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)

#### 3.1 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 3 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 4 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.

Table 2: Participating LTCFs and influenza control measures

	Facilities reporting outbreaks (N=122)	Facilities reporting no outbreaks (N=743)	<i>p</i> value
Structure indicators <sup>1</sup>			
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 <sup>2</sup>			
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 residents <sup>3</sup>	91.1 (16.2)	93.8 (13.1)	0.084
Influenza vaccination for staff <sup>3</sup>	91.7 (13.0)	91.8 (13.9)	0.926

<sup>1</sup> Median (min–max), Mann–Whitney U test<sup>2</sup> Number (%), chi-squared test score<sup>3</sup> Mean (standard deviation), Student's *t*-test

Table 3: Factors associated with outbreak of infection

	OR	(95% CI)	<i>p</i> value
<b>Influenza</b>			
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
<b>Acute viral gastroenteritis</b>			
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 4: Factors associated with number of residents affected by outbreak

	$\beta$	<i>p</i> value
<b>Influenza</b>		
Moving residents to private rooms when infection is suspected	-0.11	0.013
Maintaining room humidity using humidifiers	-0.15	0.011
<b>Acute viral gastroenteritis</b>		
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

$\beta$ , standardized coefficient by multiple linear regression analysis using stepwise selection methods

### 3.2 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 5 shows the data for infection control and prevention strategies reported by each facility, stratified by the presence or absence of outbreak.

Table 3 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).

Table 5: Participating LTCFs and acute viral gastroenteritis control measures

	Facilities reporting outbreaks (N=187)	Facilities reporting no outbreaks (N=678)	<i>p</i> value
<b>Structure indicators<sup>1</sup></b>			
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
<b>Process indicators<sup>2</sup></b>			
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

<sup>1</sup> Median (min–max), Mann–Whitney U test<sup>2</sup> Number (%), chi-squared test score

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 4 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.

## 4 Discussion

In this study, we examined the prevalence of influenza and acute viral gastroenteritis in elderly care facilities over a period of 1 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 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.

In the present study, we 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, we found no relationship between immunization and the incidence of influenza in the present study.

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. In this study, we 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.

## **5 Conclusion**

In this study, we 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.

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