Title: How H1N1 influenza epidemic spread among university students in Japan: Experience from Shinshu University

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Abstract

Background: A worldwide outbreak of influenza A/H1N1 occurred in 2009. Little information is available regarding how the epidemic spread among young people, who comprised the majority of individuals infected with this virus. We therefore assessed the route of transmission of H1N1 among university students at Shinshu University, Japan.

Methods: A total of 11,424 students were monitored from August 2009 to March 2010, and those who were diagnosed with confirmed, probable or suspected H1N1 at a hospital or clinic were registered based on self-reporting to the university. Data including date of onset and suspected infection route were collected from the affected patients.

Results: Of the 11,424 students, 1016 (8.9%) were infected with H1N1. In most infected students, the suspected transmission route was associated with club activity, followed by close contact with friends and through lectures or laboratory work. Following suspension of activity by clubs with more than 2 infected members, the number of infected individuals decreased.

Conclusions: H1N1 influenza spread in the university through specific routes, such as club activity, close contact with friends or lectures or laboratory work. During future outbreaks of influenza, interventions to reduce transmission through these routes may be effective for infection control among university students.

Brief Report

The routes of transmission of H1N1 infection among students were investigated in Shinshu University, Japan. Of the 11,424 students monitored from August 2009 to March 2010, 1016 (8.9%) were infected with H1N1. The most common route of transmission was club activity, followed by close contact with friends and contacts during lectures or laboratory work. Interventions to reduce transmission through these routes during new outbreaks of influenza may be effective for infection control among university students.

Introduction

A worldwide outbreak of swine-origin influenza A/H1N1 (H1N1) occurred in April 2009.[1] Before the pandemic, the Ministry of Health, Labor, and Welfare of Japan released guidelines outlining action plans for new cases of influenza infection.[2] Despite these guidelines, however, H1N1 influenza spread throughout Japan and caused many cases of illness. The epidemic was thought to be influenced and triggered by various factors, including a lack of effective precautions due to the presumption of low H1N1 toxicity and lack of information regarding routes of transmission. This led to incomplete implementation of these guidelines, with several clusters of H1N1 causing 15 million infections and resulting in the deaths of 200 patients between May 2009 and March 2010.[3]

Several studies have indicated that H1N1 influenza spread predominantly among younger rather than older people.[4-6] These findings indicated that, during future influenza epidemics, precautions against infection should target organizations with high concentrations of young people, especially "schools."[7-8] Reports describing H1N1 in schools have provided some insight regarding this epidemic.[9-11] In our previous overview of the H1N1 epidemic at Shinshu University,[12] we found that the most common suspected route of transmission among university students was club activity. However, the detailed route of transmission among university students was not fully investigated or clarified. We therefore further assessed the routes of H1N1 transmission and its serial changes among university students, as well as evaluating the effects of precautions among this population.

Materials and Methods

We prospectively investigated patients with confirmed, probable or suspected H1N1 at hospitals or clinics from August 2009 to March 2010. All subjects in this study were university students, approximately 18–24 years old. Shinshu University has a freshman organization for general education and 8 faculties (Arts, Agriculture, Economics, Education, Engineering, Medicine, Science, and Textile Science and Technology) for upper grades in 5 districts in Nagano prefecture. The total number of students at Shinshu University between August 2009 and March 2010 was 11424.

Before and during the 2009 H1N1 epidemic, all subjects were encouraged, via distribution of circulars, the university website, and cellular phone text messages, to practice certain precautions, including gargling, washing their hands, and wearing a mask.[12] Since priority for vaccination was given to specific groups (medical staff, pregnant women, those with specific diseases, and children approximately 1–10 years old), few university students were vaccinated during the study period. Patients with influenza-like symptoms were encouraged to go to a hospital or clinic for diagnosis and to stay home until 2 days after their body temperature had returned to normal. Temporary suspension of classes or laboratories was indicated when at least 10% of the students were infected within a given week or as decided by the administrator of each department. Club activities for university students were suspended for one week when more than 2 members were infected at the same time. In addition, a survey system for H1N1 patients was established, and all information was collected at the university headquarter and the Center for Health, Safety, and Environmental Management. Immediately after being diagnosed with influenza at a hospital or clinic, each patient was instructed to call the designated person in each university faculty. A telephone

inquiry record was made for each such patient using a standardized case report form, which included patient name, sex, age, date of onset, medical examination by a clinician, and suspected infection route. All designated persons were clerks who were not medical staff, but had been trained to record newly diagnosed influenza before the start of the pandemic. Collected records were faxed immediately to the university headquarter, and to the Center for Health, Safety, and Environmental Management. The number of infected patients was counted weekly, with each week considered one unit. Serial changes in route of transmission were determined using a descriptive epidemiological method.

The study design and procedure were reviewed and approved by the Committee for Medical Ethics of Shinshu University (approval number 1616). As the individual information was anonymous during data analysis by computer and this epidemiological study would not cause any disadvantages to any of the subjects, the Committee waived written informed consent from each patient.

Results

Of the 11,424 students at Shinshu University between August 2009 and March 2010, 1016 (8.9%) were reported infected to the university survey system. Each such patient was recorded once in the database during the study period, and multiple reports from individuals were not included.

Table 1 shows the routes of transmission, as determined by analysis of reports by infected students. Twenty-one responses were excluded from the registry because they were incomplete. Routes of transmission were unknown in 348 students (35.0%), club activity in 193 (19.4%), close contact with friends (excluding club activity) in 121 (12.2%), and lectures or laboratory work in 113 (11.4%). In other patients, the routes of transmission involved lodgings or apartments, employment, activities in the city, bus or train travel, and family.

Figure 1 shows serial changes in routes of transmission over time during the study period. The first and second peaks of infection coincided mainly with club activity. The first peak began in October after summer recess (until September 30). At this time, more than two individuals were infected at the same time in 5 clubs, and these club activities were suspended. The second peak, which was the largest peak, began in the middle of November, and the activities of 9 other clubs were restricted. Following university intervention to suspend these clubs, the numbers of patients decreased. Peaks associated with lecture or laboratory work and close contact with friends showed almost identical patterns, and followed the second peak of club activity. Between the two peaks, only one laboratory was closed. The third peak began after winter recess (from December 24 to January 7), but this epidemic ended in February without university intervention. Throughout the study period, there were no class or school closures.

Discussion

We reported an outbreak of H1N1 influenza among students at Shinshu University in Japan between August 2009 and March 2010. Among university students, suspected routes of transmission more frequently involved university-related activities, especially club activities, than other possible routes, such as part-time employment or family. H1N1 influenza virus may have spread more easily among students belonging to clubs, because club activities generally result in close contact among members. These

individuals frequently gather together at the same place (sometimes a shuttered room) for long periods of time, are in direct contact due to specific activities (e.g. dancing, theatrical productions, contact sports, martial arts), participate in training camps, have closer friendships than with other students, and often eat and drink together. Viral transmission was also due to lecture or laboratory work and close contact with friends, for similar reasons.

As there have been no previous reports regarding how H1N1 spreads in schools, the transmission route among students was unclear. However, the results presented here may reveal possible routes of H1N1 influenza transmission among university students. In future influenza pandemic outbreaks, strong intervention in club activities, lectures and/or laboratory work may reduce and prevent transmission among students.

We found that the number of infected individuals decreased after suspension of club activity. Previous studies showed that school closure probably has a beneficial effect in reducing transmission.[7-8, 13] Those studies, however, dealt mostly with the closure of whole schools rather than small units, making it unclear how the closure of small units, including high-risk groups, would affect the epidemic. In addition, we found that the second peak of infection, which included transmission via close contact with friends and lecture or laboratory work, may also be affected by closure of small units. These findings indicate that the immediate closure of small units containing high-risk individuals may effectively reduce the total number of infected university students during outbreaks of infectious diseases, such as H1N1 .

The present study had several limitations. First, the hospitals and clinics at which students were diagnosed did not utilize RT-PCR or viral culture with swabs for H1N1 diagnosis.[14] In addition, statistical analysis was based on the total number of self-reported university students because they could not be stratified as having confirmed, probable or suspected infection for detailed analysis. Therefore, our survey may have overestimated the number of H1N1 infected individuals. However, the National Institute of Infectious Diseases of Japan has reported that H1N1 accounted for almost all of the total number of individuals infected with influenza from the start of the study period,[15] therefore, we regarded all patients from Shinshu University as having H1N1 influenza. Second, there may have been information bias regarding the route of transmission, due to previous findings on other infectious diseases in the university or information on social pandemics obtained through the mass media in Japan. Third, patients were directed to stay at home until two days after their body temperature had returned to normal, a strategy that may have confounded the effects of suspension of club activity on the control of the epidemic. Therefore, we may have overestimated the effect of club activity suspension.

Conclusion

This descriptive epidemiological study showed that the spread of H1N1 influenza at a university was mainly caused by specific activities characteristic of students, such as club activity, close contact with friends, and lectures or laboratory work. Moreover, interventions such as suspension of club activities, may affect the transmission of infectious agents, even along other routes, such as contact with friends and lectures or laboratory work, reducing the number of infected individuals.

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Table 1 Suspected infection routes of H1N1 cases

Suspected infection route	Subjects (n=995)	(%)
Unknown	348	(35.0)
Club activity	193	(19.4)
Friends (excluding club activity)	121	(12.2)
Lecture or laboratory work	113	(11.4)
Lodging or apartment	65	(6.5)
Employment (part-time)	62	(6.2)
In the city (shopping/leisure)	38	(3.8)
Bus or train travel	34	(3.4)
Family	21	(2.1)

Figure legends

Figure 1. Change over time of routes of infection transmission.

The first and second peaks mainly coincided with club activity. The upper two arrows indicate club closures, which affected the epidemic curve.
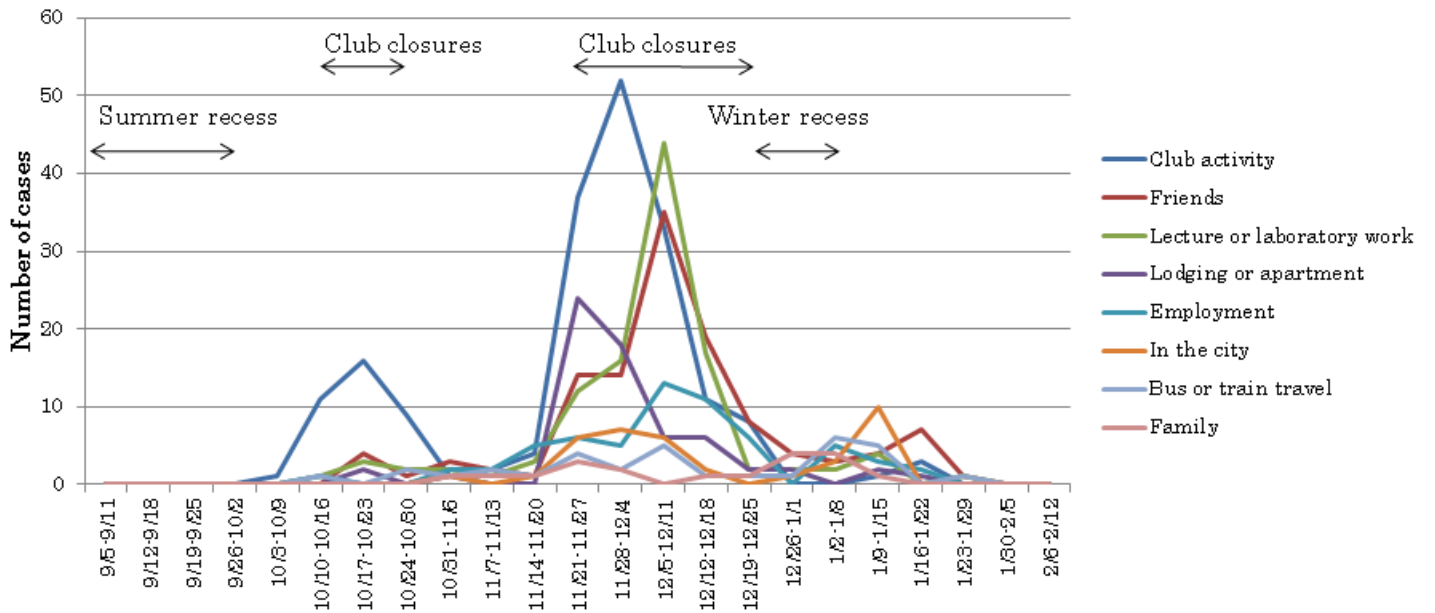
Figure 1.