Age-specific incidence/fatality of novel influenza during the 2009 epidemic in Japan

Etsuji Okamoto

Abstract: The author analyzed the daily, age-specific incidence data from the mandatory reporting of the novel (H1N1) influenza which plagued the country in 2009 as well as the subsequent hospitalization reporting data to illustrate age-related epidemiological pattern of the disease. The young population, particularly teen agers, showed higher susceptibility and vulnerability in terms of incidence, hospital admission rate and relative fatality than the elderly population. The observed discrepancy between the young and the old was larger than the traditional seasonal influenza although the severity of the disease did not differ much. The age-related epidemiological pattern suggests the "novel" nature of the disease and provides valuable evidence for future tactics against the recurrence of the epidemic.

Key words : novel influenza, surveillance, epidemic, fatality, H1N1

Introduction

On 28th April 2009, WHO announced the outbreak of novel (swine) influenza (A/H1N1) in Mexico and raised the alert level to phase 4 (it later further raised the alert level to phase 6 on 12 June). Many countries including Japan strengthened the surveillance and quarantine to keep the disease at bay.

Unfortunately Japan's strengthened quarantine (bay-side tactics) was escaped by the disease and the entire country was plagued with the epidemic. The outbreak started from a high school and quickly spread to the entire country despite large-scale school closures suggesting high susceptibility and transmissibility among the young, school-age population.

In the article, the author analyzes the age-related epidemiologic pattern of the influenza outbreak in Japan in 2009 based on the mandatory reporting surveillance data and illustrates the "reverse ageism" of its incidence, admission rate and relative fatality.

The then bureau chief of public health, Dr. Ueda later described the initial response by the Ministry of Health, Labor & Welfare (MHLW)[1]. MHLW

【correspondence】
Etsuji Okamoto
Department of Health & Welfare Service Research
National Institute of Public Health
2-3-6, Minami, Wako-shi, Saitama 351-0197 JAPAN
TEL&FAX : 048-458-6208

learned the first information on the outbreak from the latest issue of MMWR published by CDC on 23rd April. On 24th April, the world media started to report the outbreak from Mexico. MHLW was alerted by the high fatality in Mexico.

There were two direct flights/week between Mexico and Japan and a flight arrived from Mexico on 25th April. MHLW conducted in-flight inspection on passengers and no patients were found. However, no retrospective survey was conducted for passengers entering the country before that date. Such retrospective survey would have been difficult without health questionnaire including the passenger's name, address and phone number. However it would not have been entirely impossible by requesting airliners to disclose passenger's information. Such disclose of personal information was permissible for public interest like disease control. However, the then minister of MHLW, Masuzoe described that airliners tended to be uncooperative[2].

On 29th April, next day after the WHO alert, MHLW strengthened the airport quarantine and issued a mandate for reporting of diagnosed cases to doctors together with a formal definition of cases[3] (Japan maintains a "sentinel" surveillance for seasonal influenza, in which selected hospitals and clinics [sentinels] report the number of new cases weekly to the National Institute of Infectious Diseases. The mandatory reporting of novel influenza was a separate measure to the existing sentinel surveillance). The strengthened airport quarantine included in-flight inspection and distribution of health questionnaire. The questionnaire included the passengers' name, address and telephone number for follow-up.

Actually, a molecular analysis suggested that infected persons had possibly entered the country as early as 22th April eventually spreading the disease in Kobe-Osaka region[4]. However, no such follow-up was conducted and it was unquestionably presumed that no infected persons had entered the country yet. Consequently the so-called "bay-side" tactics, keeping the infected persons at bay through quarantine were pursued.

On 9th May, the first infected persons were detected in in-flight inspection at Narita international airport. They were high school students and teachers flying back from Canada. They were taken into a nearby hospital and a total of 49 exposed persons were detained in a nearby hotel for a week[5]. It appeared that the strengthened quarantine had successfully stopped the entrance of the disease. Actually the disease was already spreading in somewhere else.

On 16th May, minister Masuzoe announced that the first confirmed case was found in Kobe city. The case was a high school boy who developed fever on 11th May[6]. The examining doctor sent the specimen to the Kobe City Public Health Institute next day for PCR testing but the exam was delayed because the boy had no history of traveling abroad and hence did not fulfill the case definition. Later active surveillance by the city found that influenza had already been prevalent among students of the high school. The first student developed the symptom as early as 5th May (Japan had a five consecutive holidays 2-6 May and many clinics were closed, which might have delayed visiting doctors).

Despite the strengthened quarantine and rigorous detention of exposed persons at the airport, the disease already entered into the country and the epidemic was under way. The fact that a high school student with no history of travelling abroad presented symptom on as early as 5th May suggests that the case was a secondary infection. Given the incubation time of the novel influenza, it was highly likely that the very first case infecting the students entered into the country before 28th

April or might have gone undetected by the strengthened quarantine.

The number of reported cases increased dramatically after the discovery of the first case. Within three days, by 19th May, a total of 172 confirmed cases were reported from Kobe and Osaka areas. The local governments of Kobe city and Osaka prefecture implemented extensive school closures, deciding to close not only schools with infected students but all schools in both districts, for one to two weeks from 16th May. As a result, over 4,200 schools with around 650,000 children/students were closed[7]. Recognizing that the disease was already prevalent in the country, MHLW discontinued the strengthened quarantine. Mandatory reporting continued until 24 July, by which time the cumulative number of patients reached 4,986. After the mandatory reporting was discontinued, only hospitalization cases were reported.

Materials and Methods

The daily data of mandatory reporting of confirmed novel (swine) influenza cases between 19th May and 24th July 2009 in Japan were analyzed. A cumulative total of 4986 confirmed cases were reported by 24th July and a total of 17640 hospitalized cases were reported between 16th July 2009 and 23rd March 2010. Ten-year age-specific number of reported cases was available on a daily basis (the report was not released on weekends except in the early phase) but no age-sex breakdown was available, hence the analysis was limited to age-specific incidence.

Results and Discussion

1) Results

Age-specific incidence was calculated by dividing the number of reported cases with age-specific population. The result is shown in [Table.1].

A total of 4,986 cases were reported between 16th May and 24th July 2009 or 39.1 cases per million population. By far the highest incidence was observed in teenagers (10-19 years old): 195/million population and the lowest among the elderly >=60yo: 1.3/million.

After the mandatory reporting was discontinued after 24th July, reporting was required only for hospitalized cases but with more detailed patient information such as the presence of underlying conditions. The hospitalization surveillance was continued to 23rd March 2010 whose results are summarized in [Table.2].

Admission rate was highest among 0-9 yo: 1.03/1000 population followed by teenagers: 0.26. Remarkably, the admission rate of the elderly was lower than high teenagers (0.05 for >=80yo vs. 0.26 for 10-19 yo). As for fatality of admitted patients, after excluding those with underlying diseases, the middle age (40-49 yo) showed the highest case-

Table.1　Age-specific incidence of novel influenza（16 May-24July 2009）

	population	N of cases	incidence*
0～9yo	11061	943	85.3
10～19yo	12028	2346	195.0
20～29yo	14415	874	60.6
30～39yo	18306	393	21.5
40～49yo	16407	241	14.7
50～59yo	16873	138	8.2
60～yo	38419	51	1.3
	127509	4986	39.1

*incidence per million population

fatality (8 deaths/406 admissions or 19.7 per thousand admissions) followed by 30-39 and 50-59 yo groups (12.3, 12.4 per thousand admissions respectively). However no fatalities were observed with 60-69 and >=80 yo groups and only 4 per thousand admissions for 70-79 yo group (2 deaths/505 admissions).

Although it appears that middle age hospitalized patients had the highest fatality, one should compare inter-age fatality considering age-specific mortality. Since older people have higher mortality than young people, one should compare by relative fatality (the ratio between crude fatality [deaths/admissions] and age-specific mortality). Ten-year age-specific mortality (both men and women) was obtained from Japan's 2009 life table.

When compared with relative fatality, a different pattern emerged: children aged 0-9 years showed the highest relative fatality during hospitalization (5.694) followed by people aged 20-49. Teen agers showed high hospitalization rate but their relative fatality was low. What was noteworthy was that the elderly over 60 yo showed lower relative fatality than younger generation.

2) Discussion

Influenza is a serious health threats to those with underlying conditions and the elderly. This is a prime reason why influenza vaccination is recommended for the elderly. However, when measured by age-specific incidence, the elderly shows lower incidence than the young. Kawado estimated age-specific incidence of influenza based on Japan's sentinel surveillance data as shown in

Table.2 Age-specific outcomes of hospitalization due to influenza (16th July 2009-23rd March 2010)

	population (P)*	mortality (M)**	admissions (A)	admission rate (A/P)	in-hospital deaths (D)***	crude fatality (D/A)*	ralative fatality (D/A/M)
0〜9	11061	3.695	11431	1.03	17	21.0	5.694
10〜19	12028	1.63	3100	0.26	2	0.6	0.344
20〜29	14415	4.55	443	0.03	4	9.0	1.983
30〜39	18306	6.94	408	0.02	5	12.3	1.765
40〜49	16407	15.54	406	0.02	8	19.7	1.268
50〜59	16873	36.38	483	0.03	6	12.4	0.341
60〜69	17798	80.39	474	0.03	0	0.0	0.000
70〜79	12724	198.24	505	0.04	2	4.0	0.020
>=80	7897	500.69	390	0.05	0	0.0	0.000
	127509		17640	0.14	44	2.5	

*mortality, admission rate crude fatality are expressed per thousand, population
**mortality is based on Japan's 2009 life table (both sexes combined)
*** without underlying conditions

Table.3 Estimated age-sex-specific incidence of influenza (per thousand population)

year	MALE 15-59yo	MALE >=60yo	MALE ratio	FEMALE 15-59yo	FEMALE >=60yo	FEMALE ratio
2002	36.6	9.1	4.0	39.5	8.7	4.5
2003	60	21.7	2.8	66.9	20.7	3.2
2004	52.5	17.5	3.0	52.5	17.5	3.0
2005	97.6	51.1	1.9	111.3	48.6	2.3

source:Kawado M, et al. Annual and Weekly incidence rates of influenza and pediatric diseases estimated from infectious disease surveillance data in Japan, 2002-2005. J of Epidemiology 2007;17(suppl.):32-41

[Table.3][8]. When compared between the age group [15-59yo] and [>=60], the elderly consistently showed lower incidence than the young in both men and women. The ratio between the elderly and the young appears to be declining over time but the incidence of the elderly is nearly half of the younger generation.

The epidemic of novel influenza in 2009 showed a far larger age difference in every measure of severity of the epidemic, incidence, admission rate and relative fatality, in which the young people around teen agers showed more than ten-fold higher indices than the elderly over 60 years old.

These findings are consistent with those based on the surveillance of the U.S., in which researchers found that contacts 18 years of age or younger were twice as susceptible as those 19 to 50 years of age (relative susceptibility 1.96), and contacts older than 50 years of age were less susceptible than those who were 19 to 50 years of age (relative susceptibility 0.17)[9]. The high transmissibility among the young is also supported by applying three mathematical models to Japan's surveillance data[10]. These age-related epidemiologic patterns suggest that the influenza A (H1N1) was literally "novel" strain different from the existing "seasonal" influenza although the severity of the illness did not differ much.

Conclusions

The elderly showed stronger resistance against novel influenza than young population in terms of incidence, hospital admission rate and relative fatality, an age-related epidemiological pattern different from the traditional seasonal influenza. Preventive and precautionary measures targeted to the young and vulnerable population will be necessary to combat the recurrence of the pandemic in the future.

Acknowledgments

This study was supported by Ministry of Science & Education Grants-in-aid(B)[19390181] 'IT infrastructure for active disease surveillance' from the Japan Society for the Promotion of Science. This paper was presented at the 139th Annual Meeting & Exposition of the American Public Health Association held in Washington DC, USA on 31st October 2011 for the session "International Health for Older Adults".

References

1) Ueda H. Measures against novel influenza. Japanese J of Public Health 2010 ; 57 (3) : 157-164 [in Japanese].
2) Masuzoe Y. Masuzoe Memo. Shogakukan Dec 2009, p147 [in Japanese].
3) Directive issued by MHLW Bureau of Public Health on 29th April 2009.
4) Shiino T el al. Molecular Evolutionary Analysis of the Influenza A (H1N1) pdm, May-September, 2009: Temporal and Spatial Spreading Profile of the Viruses in Japan. PLoS ONE 2010 ; 5 (6) : 1-10.
5) Asahi newspaper. 9th May 2009.
6) Press Release from MHLW Bureau of Public Health on 16th May 2009 [http://www.mhlw.go.jp/kinkyu/kenkou/influenza/houdou/2009/05/dl/infulh0516-08.pdf]
7) Shimada T, et al. Epidemiology of influenza A (H1N1) virus infection in Japan, May-June 2009. Euro Surveillance 2009 ; pii=19244.
8) Kawado M, et al. Annual and Weekly incidence rates of influenza and pediatric diseases estimated from infectious disease surveillance data in Japan, 2002-2005. J of Epidemiology 2007 ; 17(suppl.) : 32-41
9) Cauchemez S, et al. Household Transmission of 2009 Pandemic Influenza A(H1N1) Virus in the United States. N Engl J Med 2009 ; 361 : 2619-27.
10) Nishiura H, et al. Transmission potential of the new influenza (H1N1) virus and its age-specificity in Japan. Euro Surveillance 2009 ; 14(22) : pii=19227.