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ABSTRACT

Real-time estimation and prediction for pandemic A/H1N1 (2009) in Japan

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Objective
This paper summarized our effort for real-time estimation of pandemic influenza A/H1N1pdm in Japan.

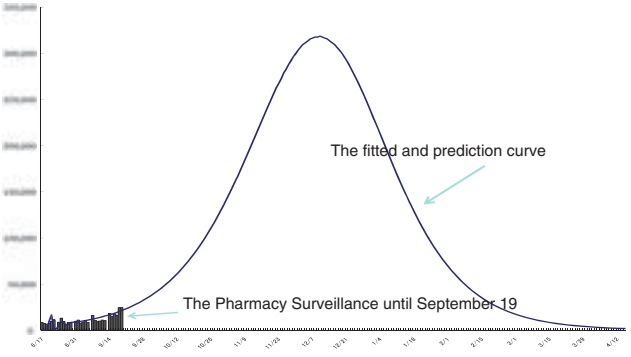
Introduction
Unfortunately, confirmation and notification of all A/H1N1 (2009) patients in Japan was ceased on 24 July when the cumulative number of patients was about 5000. After that, as all suspected patients are not necessarily confirmed or reported, the only official surveillance was the sentinel surveillance for influenza-like-illness (ILI) patients from 5000 clinics accounting for almost 10% of all clinics and hospitals in Japan. However, because the surveillance results are reported weekly, it tends to lack timeliness. To collect and analyze the information in more timely manner, we, Infectious Disease Surveillance Center, National Institute of Infectious Diseases, developed a full automatic daily reporting system of ILI patients. Using this information, we had estimated *R*v and predict its course in every week.

Methods
In Japan, prescription of anti-flu drugs, such as oseltamivir and zanamivir, have been automatically monitored daily since April 2009 at about 3350 pharmacies that account for almost 7% of all pharmacies in Japan. By weighing the number of prescription for oseltamivir and zanamivir with the proportion of participating pharmacies, we can estimate the total number of patients in Japan of the previous day. We usually publish it online at 0700 hours daily.

Our estimation and prediction model is a very simple SIR model and parameters used are described in the previous study, that is, natural history, period when the patient is infectious, rate and infectiousness of asymptomatic patients, and withdrawal rate are borrowed from these two previous researches. *R*v is estimated by maximum likelihood, which minimizes the difference between an actual epidemic curve and estimated one, assuming it to have a normal distribution. Taking into the situation in Japan, we can assume that all symptomatic patients visit a doctor to receive oseltamivir or zanamivir on onset date. Thus, we can compare the number of prescription of oseltamivir or zanamivir in the pharmacy surveillance and the number of patients on onset date in the SIR model. Confidence interval (CI) of *R*v is calculated using the second derivative of likelihood as its estimator of variance. We estimated and predicted every week since September 2009.

Results
Bars in the figure show the estimated total number of patients each day from the pharmacy surveillance between August and 19 September, and the smoothed line is a fitted curve by the model. The estimation on 19 September shows estimated *R*v of 1.797, but we did not provide its CI at that time. The figure shows prediction results over the whole course of the pandemic, and its predicted peak would be 10 December.

The estimation on 29 November shows estimated *R*v of 1.72 and its 95% CI was 1.69, 1.75. It is estimated that the peak will be reached on the 23 December with 95% CI of 14 December and 2 January 2010. Then, the number of patients is estimated to reach 227 000 with 95% CI of 193 000 and 262 000 at the peak. The cumulative number of patients over the period will be as high as 17.8 (16.6, 19.0)% of total



population. These estimates are circulated weekly among central and local government officers in charge of pandemic control.

Conclusions

We, Infectious Disease Surveillance Center, National Institute of Infectious Diseases, performed real-time estimation and prediction every week from September till the end of November, and the obtained information was circulated among central and local government officers fighting pandemic. It was a helpful tool to understand the speed and impact of pandemic and to plan for better countermeasure against pandemic.

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