Original Article

Evaluation of Estimated Number of Influenza Patients from National Sentinel Surveillance Using the National Database of Electronic Medical Claims

Yuuki Nakamura^{1,2}, Tamie Sugawara¹, Hirokazu Kawanohara³,
Yasushi Ohkusa^{1*}, Miwako Kamei⁴, and Kazunori Oishi¹

¹Infectious Disease Surveillance Center, National Institute of Infectious Diseases, Tokyo;

²Graduate School of Pharmacy and ⁴School of Pharmacy, Nihon University, Chiba; and

³EM Systems Co. Ltd., Osaka, Japan

SUMMARY: Officially, the national official sentinel surveillance of infectious diseases (NOSSID) has been used to estimate the number of influenza patients nationwide; NOSSID is based on the Law Concerning the Prevention of Infectious Diseases and Medical Care for Patients of Infections (the Infectious Diseases Control Law). Prescription Surveillance (PS) has also provided a numerical estimate of influenza patients. This study compared these 2 estimations using NOSSID and PS with the numbers of influenza patients from all electronic medical claims (NDBEMC), which had the nearly-comprehensive data from surveys. Results showed that the estimate from NOSSID was about twice the estimate from the NDBEMC. However, the estimated number from the PS was almost equivalent to that from the NDBEMC. The estimated number of patients from NOSSID might not be precise, but NOSSID itself may be useful to monitor influenza trends.

INTRODUCTION

Currently, the national official sentinel surveillance of infectious diseases (NOSSID), which is based on the Law Concerning the Prevention of Infectious Diseases and Medical Care for Patients of Infections (the Infectious Diseases Control Law), has been done. Hereafter, we have denoted this surveillance system as NOSSID for short in this paper. NOSSID publishes data related to the activity of 26 infectious diseases. Among these, 18 infectious diseases are reported weekly, and 8 are reported monthly. For influenza, NOSSID provides the number of patients from weekly reports of influenza-like illness cases from approximately 5,000 sentinel pediatric and internal medicine hospitals and clinics. Moreover, one estimate of the number of influenza patients nationwide is based on this surveillance (1). To date, it is the only official estimator of the number of patients. For example, the estimated cumulative number of patients of the 2009 pandemic, from the 28th week of 2009 to the 10th week of 2010 had been reported as about 20 million from estimates produced using NOSSID data (2–4).

Prescription Surveillance (PS) has been conducted by the National Institute of Infectious Diseases and EM Systems Co. Ltd. (Osaka, Japan) since March 2009 (5). It monitors prescriptions including those for anti-influenza drugs from more than 9,300 pharmacies (as of November 1, 2013), which accounts for 17% of all

pharmacies in Japan. It has been providing a numerical estimate of influenza patients by prefecture and nationwide based on anti-influenza drug prescriptions (5).

Recently, all electronic medical claims nationwide (National Database of Electronic Medical Claims [NDBEMC]) have been disclosed as “Data of Medical Claims and Health Check-Ups for Metabolic Syndrome” from the Ministry of Health, Labour and Welfare (6–8). These account for about 95% of all medical claims (9). All doctors must record a diagnosis on all medical claims. Therefore, they should constitute the most reliable data source for numbers of patients. Using NDBEMC, we checked the estimated number of influenza patients from NOSSID and PS.

MATERIALS AND METHODS

NOSSID: NOSSID for influenza estimates the total number of influenza patients nationwide based on the weekly reports of influenza-like illness cases from approximately 5,000 sentinel pediatric and internal medicine hospitals and clinics; this has been enforced since 1999 according to the Infectious Diseases Control Law. The sentinel medical institutions are selected by prefecture in accordance with the related guideline (10), which requires that they be selected randomly and representatively in public health areas. NOSSID was designed to monitor the activity of infectious diseases, not for a precise estimation of patient numbers.

For influenza, because aggregating these data takes time, NOSSID results are published with a 7–10 days delay.

The number of influenza patients nationwide is estimated as described below.

“For each disease, prefecture, and type of medical institution, the incidences in sentinel medical institutions (SMIs) follow a multi-hypergeometric distribution under the fixed condition of the total number of SMIs un-

Received February 25, 2014. Accepted May 26, 2014.
J-STAGE Advance Publication November 25, 2014.

DOI: 10.7883/yoken.JJID.2014.092

*Corresponding author: Mailing address: Infectious Disease Surveillance Center, National Institute of Infectious Diseases, 1-23-1 Toyama, Shinjuku-ku, Tokyo 162-8640, Japan. Tel: +81-3-5285-1111, Fax: +81-3-5285-1129, E-mail: ohkusa@nih.go.jp

der the assumption that SMIs are randomly selected from all medical institutions. The total incidence in each prefecture and type of medical institution was estimated as the total incidence in SMIs divided by the proportion of SMIs to all medical institutions. The total incidence in all medical institutions was estimated to be the total of those in all prefectures and types of medical institution.” (1)

The NOSSID database system can produce an estimate of the number of influenza patients each week.

PS: PS has been conducted by the National Institute

of Infectious Diseases and EM Systems Co. Ltd. since March 2009. It provides daily estimates of the number of influenza patients by prefecture every day based on prescriptions of anti-influenza viral drugs. It estimates the total number of patients in a prefecture by multiplying the reciprocal number of the participation rate of pharmacies to PS, and the reciprocal number of the percentage of external prescriptions in the prefecture to the total number of prescriptions in the prefecture, using this formula:

$$\begin{aligned} & [\text{Total estimated number of patients}]_s \\ &= \sum_{p=1}^{47} \frac{[\text{Total number of prescriptions at participate pharmacy}]_{ps}}{[\text{Participation rate of pharmacies}]_{ps} \times [\text{Percentage of external prescription}]_{ps}}, \quad (1) \end{aligned}$$

where, p denotes the prefecture and s represents the season.

The estimated number of patients nationwide was obtained by summing up the estimated numbers of patients in all prefectures. It is provided on the home page at 7:00 a.m. the following morning (URL: [http://syndromic-surveillance.net/yakkyoku/\[in Japanese\]](http://syndromic-surveillance.net/yakkyoku/[in Japanese])).

NDBEMC: NDBEMC is provided as the “Data of Medical Claims and Health Check-Ups for Metabolic Syndrome.” These data are only provided to the researchers who intend to improve the quality of medical services and who complete an application process. The application is then evaluated by experts (9).

NDBEMC can count patients who have been diagnosed as having influenza, excluding suspected cases, in electronic medical claims. In September 2013, the coverage of electronic medical claims was approximately 96.2% (of all medical claims) by the Health Insurance Claims Review & Reimbursement Services. The number counted by NDBEMC has been regarded as the true number of influenza patients.

Study period and area: In Japan, the influenza season is defined as lasting from the 36th to the 35th epidemiological week. NOSSID and PS can follow this definition, but NDBEMC cannot match it exactly because it uses monthly data. Therefore, the influenza season in NDBEMC is arranged as September through August, which corresponds almost exactly to the definition. Unfortunately, NDBEMC has not been available since March 2013, so we remain restricted for the 2012/2013 season to the NDBEMC data from September 2012 to March 2013. For these periods, we compared the estimated numbers of influenza patients from 3 data sources (NOSSID, PS, and NDBEMC) nationwide.

Ethical considerations: This study used only anonymous data that had been unlinked to individual patient information. Therefore, ethical issues related to medical institutions and pharmacies were unrelated to this study. YO and TS were approved to use the NDBEMC by the Ministry of Health, Labour and Welfare of Japan on September 25, 2013 (Research project: Estimation of the number of patients of infectious diseases).

RESULTS

The estimated numbers of influenza patients from 3 data sources (NOSSID, PS, and NDBEMC) for 3 seasons are presented in Table 1. The number of influenza patients estimated by NDBEMC was equivalent to that estimated by PS. For the 2010/2011 season, the estimated numbers of patients by PS and NDBEMC were 7.315 and 7.356 million, respectively. The difference between PS and NDBEMC was 0.56%. The differences were 4.6% for the 2011/2012 season and 3.2% for the 2012/2013 season. In contrast, the numerical estimates produced using NOSSID were 1.89, 1.81, and 1.61 times greater than those by NDBEMC.

In general, the influenza season has been defined as lasting from September through August in Japan. However, since NDBEMC was not available after March 2013 in the scope of our obtained permission, the 2012/2013 season for NDBEMC was shortened. As shown in Table 1, in the 2012/2013 season, the estimated numbers of patients of PS and NOSSID were, respectively, 8.054 and 13.790 million. Both the PS and NOSSID durations were limited to September through March, which was comparable with NDBEMC. The respective numbers of patients were 7.5 and 11.8 million. The discrepancy of PS from NDBEMC was 3.2% during this period.

DISCUSSION

In Japan, 96.2% of all medical claims had been processed electronically by September 2013. The remaining 4% were paper medical claims. However, when evaluated based on the number of medical institutions, the proportion was 86.2%, which meant that the number of patients per medical institution using electronic medical claims was 3 times that of patients using paper medical claims. Therefore, NDBEMC was apparently a complete survey. One can infer that the paper-written medical claims and the proportion of influenza patients to all claims in a medical institution were the same for electronic medical records. The number of influenza cases

Table 1. (Estimated) number of influenza patients (in thousands)

	NOSSID ¹⁾	PS ²⁾	NDBEMC ³⁾
2010/2011	13,880	7,315	7,356
2011/2012	16,800	9,703	9,273
2012/2013	13,790	8,054	—
2012/2013 ⁴⁾	11,800 ⁵⁾	7,522	7,287

Duration was from the 36th to 35th epidemiological week for NOSSID and PS, and September through August for NDBEMC for each season.

¹⁾: National Official Sentinel Surveillance of Infectious Disease.

²⁾: Prescription Surveillance.

³⁾: National electronic medical claims.

⁴⁾: Duration was limited to March 31, 2013 because we had obtained permission to use NDBEMC to compare the 3 datasets up to that date.

⁵⁾: Duration was from the 36th week of 2012 to the 13th week of 2013 (September 3, 2012 to March 31, 2013).

from NDBEMC could change to multiply the constant. This adjustment accounted for the inverse of the proportion of medical claims among all medical claims: 1.04 (= 1/0.96). By this adjustment, the estimated numbers of influenza patients from the NDBEMC in respective seasons (Table 1) were expected to be 7,650, 9,644, and 7,578. Therefore, the discrepancy of PS from adjusted NDBEMC becomes 4.4%, 0.61%, and 0.74%, respectively. Its average for 3 seasons was 1.8%. Consequently, the discrepancy between PS and NDBEMC was smaller according to this adjustment.

We demonstrated that NOSSID overestimated the influenza patients by about 1.61 to 1.89 times. This report is the first to identify such a large difference. Earlier studies have reported the difference as 1.06 times higher (1). The reason for that difference was apparently associated with the selection method of the sentinel medical institutions (1,11). NOSSID requires the random and representative selection of medical institutions in public health areas. However, sentinels can apparently be recruited on a voluntary basis (11). These were not random selections but may be considered representative if hospitals or clinics with more outpatients were selected as sentinels. This tendency might engender overestimation of influenza patients nationwide. Our findings suggested that the sentinel selection appeared not to be random or representative. The sentinel hospitals and clinics appeared to have 1.61 to 1.89 times higher than the average number of outpatients in all hospitals and clinics.

On the other hand, the estimation of influenza patients from PS was apparently more accurate than that from NOSSID. This fact might be associated with the number and share of reported sites. In NOSSID, there were about 5,000 sentinels and these accounted for 10% of all pediatric and internal medicine clinics; however, there were about 9,300 participating pharmacies in PS, which accounted for 17% of all pharmacies. Although the participating pharmacies in PS were also not selected randomly, the larger number and share of participation seemed to overcome these shortcomings. Moreover, a previous study had demonstrated that pharmacy data were more sensitive to outbreaks than medical institutions (12). Therefore, PS was apparently more accurate than NOSSID, at least for influenza.

The NOSSID data overestimated NDBEMC results: the former were approximately 2 times higher than the

latter. However, NOSSID certainly demonstrated the nationwide trend of influenza activity. Such information can be useful for public health management and for the general population, although it is delayed by 7–10 days.

In conclusion, results of this study showed that the NOSSID estimates were 1.61–1.89 times greater than those derived from NDBEMC data. Although they may not be precise, because they constitute official data, they can be used to monitor influenza activity, to evaluate countermeasures such as vaccines, and to prepare for pandemic influenza. This inaccuracy might engender mistakes in monitoring, evaluation, or preparation. We have concluded that estimates produced using PS data were extremely accurate. The data can be useful to produce timely and accurate estimates of influenza activity and are reported on the internet by 7:00 a.m. the following morning.

Acknowledgments We extend our respectful gratitude to Dr. Nagai of Saitama Medical University, Dr. Hashimoto of Fujita Health University, and Dr. Taniguchi of National Mie Hospital for their discussion related to the results presented in this paper.

Conflict of interest None to declare.

REFERENCES

1. Hashimoto S, Murakami Y, Taniguchi K, et al. Annual incidence rate of infectious diseases estimated from sentinel surveillance data in Japan. *J Epidemiol*. 2003;13:136-41.
2. Okabe N. Epidemiological situation on pandemic influenza H1N1 2009 in the world and in Japan. *JMAJ*. 2011;54:277-83.
3. Saitoh A, Nagai A, Tenjinbaru K, et al. Safety and persistence of immunological response 6 months after intramuscular vaccination with an AS03-adjuvanted H1N1 2009 influenza vaccine: an open-label, randomized trial in Japanese children aged 6 months to 17 years. *Hum Vaccin Immunother*. 2012;8:749-58.
4. National Institute of Infectious Diseases and Tuberculosis and Infectious Diseases Control Division, Ministry of Health, Labour and Welfare. 2009/10 influenza season, Japan. *Infect Agents Surveillance Rep*. 2010;31:248'-9'.
5. Sugawara T, Ohkusa Y, Ibuka Y, et al. Real-time prescription surveillance and its application to monitoring seasonal influenza activity in Japan. *J Med Internet Res*. 2012;14:e14.
6. Health Insurance Bureau, Ministry of Health, Labour and Welfare. Expert meeting of providing the information of medical claims and others. The report of providing the information of medical claims and health check-up for metabolic syndrome to the third party. 2013. Japanese.
7. Health Insurance Bureau, Ministry of Health, Labour and Welfare. Expert meeting of providing the information of medical claims and others. The guideline for providing the information of medical claims and health check-up for metabolic syndrome. 2011. updated at 2013 Aug. Japanese.
8. Miura K, Miyagawa N, Murakami Y, et al. Outlines of the national database on medical expenditure and health check-up. *Hoken Iryo Kagaku*. 2013;62:31-5. Japanese.
9. Health Insurance Bureau, Ministry of Health, Labour and Welfare. Fifth orientation meeting about providing the information of medical claims and others. material 1. The procedure about providing the information of medical claims and others to the third party. 2013. Japanese.
10. Health Service Bureau, Ministry of Health, Labour and Welfare. The guideline for National Epidemiological Surveillance of Infectious Diseases. 1999. Japanese.
11. Kawado M, Hashimoto S, Murakami Y, et al. Annual and weekly incidence rates of influenza and pediatric diseases estimated from infectious disease surveillance data in Japan, 2002–2005. *J Epidemiol*. 2007;17 Suppl:S32-41.
12. Yoshida M, Matsui T, Ohkusa Y, et al. Seasonal influenza surveillance using prescription data for anti-influenza medications. *Jpn J Infect Dis*. 2009;62:233-5.