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Effectiveness of the Influenza Vaccine 2016-2017 Against Seasonal Infection in Japan

Jin-Ichi Sasaki[1, *], Toshiko Nakajima[2]

[1]Junior College Emergency Medical Technology, Hirosaki University of Health and Welfare, Hirosaki, Japan

[2]Health Care Center, Hirosaki University of Health and Welfare, Hirosaki, Japan

Email address

jnsasaki@tk2.so-net.ne.jp (Jin-Ichi S.), nakajimt@jyoto-gakuen.ac.jp (Toshiko N.)

[*]Corresponding author

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Abstract

Influenza vaccinated students at the University in Japan were subjected for evaluation of effectiveness/ineffective studies. Vaccine 2016-2017 was consisted of the influenza A (H1N1, H3 N2) viruses and influenza B (Yamagata, Victoria) viruses. Influenza A viruses were predominantly circulated at that period in Japan. All 39 students were vaccinated as a group in autumn, and the vaccinated twenty seven students were protected from Influenza illness at 70% rate (27/39) by 4 valents vaccine, and the rest 30% (12/39) were infected with influenza virus. Influenza A viruses were isolated from 11 students (91.6%) and one of influenza B viruses (8.3%) was isolated from the infected students. Infection preventive potency of the vaccine 2016-2017 was at 70% in our study. It was higher in the infection preventive ability than that of CDC estimation at 50%.

Keywords

Influenza Vaccine 2016-2017, Vaccine Effectiveness/Ineffectiveness, Field Work Analysis 2017, University Students

1. Introduction

The influenza season generally begins in the autumn and continues through the winter and spring months, and can cause mild to severe illness, and serious case can result in hospitalization or death. Generally people like older people and young children and people with certain health conditions are at high risk of serious influenza complications. Further the influenza infection also can make chronic health problems worse. For instance people with asthma may experience a worsening of this asthma attacks while they have the flu, and people with chronic congestive heart failure may experience a worsening of condition triggered by flu. Severity of disease and the predominant viral strains can vary by geographic location and season [1, 2]. The best way to avoid the influenza infection is recommended for all persons to influenza vaccination each year, and it also reduces transmitting virus to others.

CDC conducts studies each year to determine how well the flu vaccination protect against influenza illness. The estimates provide more information about how well this season's vaccine is working. Recent studies show that vaccine can reduce the risk of influenza illness by about 50-60% among the overall population during seasons when most circulating influenza viruses meet the designed vaccines. Influenza vaccine effectiveness for the 2016-2017 was estimated to be 60% effective in preventing laboratory-confirmed influenza A and B viral infection associated with medically attended acute respiratory illness. Against influenza A (H1N1) viruses effectiveness was 51% and 76% was against all influenza B viruses [3].

However vaccine effectiveness is a controversial subject each year [4, 5]. We introduced herein our field work data what percentage was effective/ineffective to the vaccinated students 2016 performed at University in Japan.

2. Methods

2.1. Subjects

Thirty nine University Students (male: 19 and female: 20

aged at 20-25 years old) at the Department of Occupational Therapy Hirosaki University Health and Welfare were subjected to evaluate the flue vaccine efficacy against the seasonal influenza infection 2016-2017.

All students subjected were vaccinated by the following 4 valents vaccine as a group in October 12th at the University Affiliated Hospital in Hirosaki as one of annual health care events.

2.2. Identification of Influenza Virus Infection

Rapid diagnostic tests (RIDT) for influenza virus infection was used to identify influenza virus as a cause respiratory ill students. Positive RIDT results from ill persons can support decisions to promptly implement infection, but negative RIDT results do not exclude influenza virus infection because of the limited sensitivity of these tests.

2.3. Constituents of Influenza Vaccine 2016-2017

Four-valents influenza vaccine were used for vaccination composites described below [6];

Influenza A; H1N1 pdm09: A/California/7/2009 (X-179A)

Influenza A; H3N2 Hong Kong/4801/2014 (X-263)

Influenza B; Yamagata Lineage: B/Phuket/3073/2013

Influenza B; Victoria Lineage: B/Texas/2/2013

These viruses used for vaccine production were detected in the United States and worldwide during May-September 2016, and have been characterized antigenically/genetically to the reference viruses representing vaccine components.

WHO recommended for the coming year's vaccine 2017-2018 in use northern hemisphere influenza season as listed below [7];

Influenza A/Michigan/45/2015 (H1N1) pdm09-like virus Influenza A/Hong Kong /4801/2014 (H3N2)-like virus, and Influenza B/Brisbane/60/2008-like virus (Yamagata Strain).

For southern hemisphere it is recommended that quadrivalent vaccines containing two influenza B viruses contain the above three viruses and a B/Phuket/3073/2013-like virus.

2.4. Influenza Infected Student's Obligation

Influenza infected students were obliged to report immediately after diagnosed at hospital to the Health Center of University, and had to stay home until complete recovery from disease; concretely additional one week home stay after withdrawal of clinical symptoms.

3. Results

In Japan the influenza season generally starts from the autumn and reaches its peak in January or February next year as shown in Figure 1 [8]. Influenza illness circulation through year is nearly same trend in other countries like US. According to the official statement the predominant spreading of viruses 2016-2017 were influenza A viruses in Japan.

Vaccine effectiveness 2016-2017 was at 69.2% and 30.7% was ineffectiveness in our data. Effectiveness against influenza A viruses was at 71%, and 97% was effective against influenza B viruses.

Effectiveness percentage among our students was higher to the CDC estimation at 50% [4]. Vaccine effectiveness of the citizens varies depending on the age in subjects. Adult group's responsiveness to vaccination is estimated at 50% by the CDC report, and the children and aged are less in response than that of the adults.

Virus type isolated from the vaccinated students in our University an Japan was predominantly type A (H3N2) viruses. Type A viruses were identifies at 91.6% and Type B were 8.3% from flu illness students as listed in Table 1.

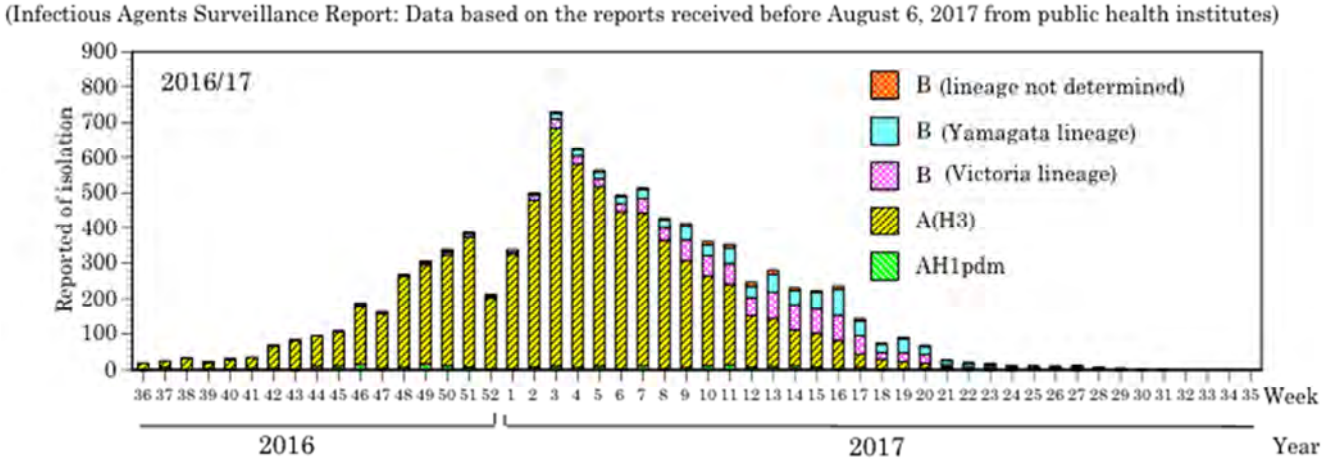

Figure 1. *Weekly reports of influenza virus isolation/detection in Japan 2016-2017.*

Table 1. *Virus types isolated from flu infected University students after flu vaccination in Japan.*

Infected Students	Date of Onset	Type of Virus Identified
1 (Female; F)	2/9	A
2 (Male; M)	2/10	A
3 (F)	2/13	A
4 (F)	2/16	A
5 (F)	2/16	A
6 (M)	2/17	B
7 (M)	2/20	A
8 (M)	2/20	A
9 (M)	2/20	A
10 (F)	2/20	A
11 (M)	2/20	A
12 (F)	2/21	A

Infection rate among the vaccinated students; 30.7% (12/39) and effectiveness rate was at 70%
Type A virus rate isolated from vaccinated students was 91.7 and Type B was 8.3%.
Virus typing was carried out by the laboratory in hospital

US Hospitalized Adult Influenza Vaccine Effectiveness data was displayed in Figure 2 as a reference [1]. For 2016-2017 influenza season vaccine effectiveness against influenza A/B was 30%, and 20% to influenza A/H3N2 and 53% to influenza B.

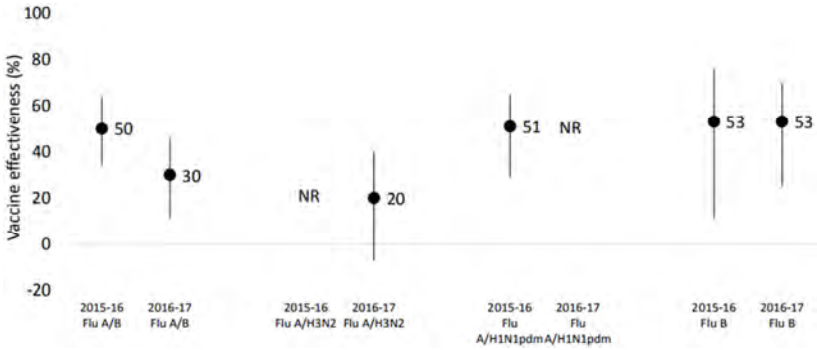

Figure 2. *Influenza vaccine effectiveness by virus type, 2015-16 and 2016-17 (US Flue VE Network & US Hospitalized Adult Influenza Vaccine Effectiveness Network (HAIVEN) NR: not reported) More detailed information will be available by the above reference on age group, sub-type, B lineage so forth.*

4. Discussion

During May-September 2016, influenza A (H3N2) viruses, influenza A (H1N1) pdm09 and influenza B viruses co-circulated worldwide. The majority of the influenza viruses collected from the United States and other countries during this season were characterized antigenically/genetically/both as being similar to the reference virus presenting vaccine components recommended for the 2016-2017 Northern Hemisphere influenza vaccines [1].

Interim estimates by US Flu Vaccine Effectiveness Network data for the 2016-2017 influenza season showed that this year's influenza vaccine has been 48% in preventing lab-confirmed influenza A and B viral infection associated with medically attended acute respiratory illness [3]. Further the exact effectiveness estimates was 43% against the influenza A (H3N2) viruses and 73% against influenza B viruses. Vaccine effectiveness studies are essential to determine how much protection has been provided to the community by vaccination. The other hand it is not easy to predict which virus will prevail, how severe virus-associated disease will be, or how effective flue vaccine will be during the 2016-2017 season.

According to the CDC's Laboratory-based studies of approximately 5,000 influenza viruses since 2016, most circulating viruses do not have significant antigenic changes. Antigenic change of influenza viruses are constantly occurred, so-called "Drift and Shift changing".

Antigenic components of influenza viruses, HA (hemagglutinin) and NA (neuraminidase) on particle surface as spikes, and nucleotide (virion) that are eight segments of viral RNA carrying all the information needed to produce influenza virus particles [Figure 3].

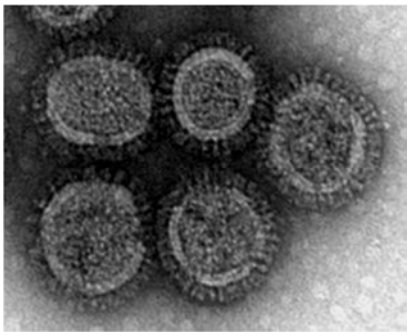

Figure 3. *Electron micrograph of Influenza virus (By Dr. NoDa, Tokyo University Japan) HA, NA spikes are clearly recognizable on the particle surface.*

These spikes, HA and NA protein easily change their antigenic nature during circulation in nature, and egg-based vaccine production that causes less effectiveness in vaccine activity [9]. This is why the influenza vaccine composition must be reviewed each year, and updated as needed to keep up with evolving viruses.

Field work results have not yet reported on efficacy and effectiveness of the 2016-2017 vaccine, and we had opportunity to evaluate it even though it was a small scale of size in study.

Our data showed that the efficacy and effectiveness of the flue vaccine 2016-2017 was 70%, and the infection inhibition potency was higher than that of the US estimation at 50%. The rest of 30% students were, however, infected with circulating influenza viruses despite their vaccination as shown in Table 1. A good match is said to occur when the viruses in the vaccine and the viruses circulating among people during a give influenza season are closely related and the antibodies produced by vaccination protect against influenza infection.

Multiple influenza vaccines are now approved and recommended for use, and were distributed in the 2016-2017 season, including unadjuvanted or adjuvanted vaccine so on. A clinical study found that live attenuated influenza vaccine (LAIV) was superior to inactivated influenza vaccine (IIV) against drifted A (H3N2) viruses in children. During the 2014-2015 influenza season, it is known that widespread circulation of antigenically and genetically drifted A (H3N2) viruses [10].

As the concrete type of vaccine; 1) the egg-based inactivated influenza vaccine, 2) the cell culture-based inactivated influenza vaccine, and 3) the recombinant influenza vaccine. Among these types of vaccines we should be especially cautious to the egg-based flu vaccine because of the following two reasons; 1) possible occurrence of antigenic changes of viruses during egg-cultivation, 2) inclusion of egg-proteins into vaccine occasionally causing to development of allergy. By contrast other two types of vaccines, the cell-oriented and the recombinant vaccine, are recommendable candidates as the future vaccines after extensive studies in compare with the egg-based vaccine based on cost of production and vaccine effectiveness.

As mentioned above ineffectiveness of the vaccine 2016-2017 was estimated by the CDC at 50% causing to virus's antigenic drift changes. Additional ineffectiveness reason of vaccine might be related with the age of vaccinated people [11]. Because there is a fact that ineffectiveness of influenza vaccine occurs in the children at 70%, the adults at 50%, and the aged persons at 50-70%. We could partially explain this fact by the immune system ability/disability. Children and aged people's immune system are imperfect/disable to react against foreign substances invaded into body. We could observe a quite similar phenomenon among the increased cancer patients in both aged groups, children and elderly people. Their group's immune systems are incomplete or getting weak caused by their ages. We should recognize this fact that there are low/high responding persons against vaccination too. It is quite general phenomenon occurred in nature.

There is complicate interrelation between virus (antigen) and human (antibody) *in vivo on* infection protective actions. Among children aged 2-17 years, effectiveness for the IIV (Inactivated influenza vaccine) was 60%, while the intranasal LAIC (Live attenuated influenza vaccine) was not effective during 2015-2016 [12]. Thus several factors, such as vaccine participants ages, individual responsiveness to vaccine, adjuvanted or unadjuvanted, activated or inactivated, live attenuated or recombinant vaccine, vaccine production manners, are associating with vaccines effectiveness (ineffectiveness). High effectiveness of the influenza vaccine should be attained by vaccine researchers, virologists as urgent tasks.

The infected students in this study were complaining of the $45.0 payment to get ineffective vaccine (?). They further said no vaccination next year, and the student's say was that they used these money for nutritious foods to enforce an immune system to prevent flue infection. It is one of their distinguished consideration and critical messages to staffs of university, doctors in hospitals and researchers.

5. Conclusion

The flue vaccine effectiveness 2016-2017 was examined against the university students in Japan. Among 39 vaccinated subjects 12 students (30%) were infected with the circulating seasonal influenza virus. Influenza virus type isolated was 91% of Type A viruses and one was Type B viruses. The CDC estimation of effectiveness / ineffectiveness rate was each 50%. Ineffectiveness of the influenza vaccine was high value among the infectious diseases vaccines probably due to antigenic changes of viruses along with vaccinating people's age (immune ability). Studies on development of the more stable influenza vaccine will be intensively expected in the not too distant future.

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