

## The evaluation of free influenza vaccination in health care workers in a medical center in Taiwan

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### Abstract

**Objective** To evaluate the outcome of free influenza vaccination for healthcare workers in Taiwan.

**Method** A retrospective observational study was conducted in a partially vaccinated sample of healthcare workers in a medical centre in the southern part of Taiwan. A convenience sample of 500 employees received a questionnaire.

**Main outcome measure** Incidence of influenza like- illness (ILI), rates of absenteeism and costs savings.

**Results** A final number of 407 returned questionnaires could be evaluated. Forty respondents were not vaccinated. The incidence of ILI was lower in the vaccinated group than the nonvaccinated group (13.6 vs. 15%). Fever was the most frequently occurring ILI. Rate of absenteeism because of ILI in the non-vaccinated employees was higher than in the group of vaccinated employees. The costs per saved lost working day was US \$ 36.

**Conclusion** Free influenza vaccination may cause reduc-

tions in incidence, absenteeism, and costs associated with ILI in healthcare workers in Taiwan.

**Keywords** Adverse drug reactions · Cost · Healthcare worker · Influenza · Influenza vaccine · Taiwan

### Introduction

Free influenza vaccination has been recommended in Taiwan for persons in high-risk groups, including elderly persons aged 65 and older with cardiovascular diseases, lung diseases, cancers, or diabetes mellitus, residents of authorized nursing homes and children at age of 6 months–2 years since 1998. It is the first country in Asia to implement an influenza vaccination program by the health authority for all hospital health care at no charge since the outbreak of SARS (Severe Acute Respiratory Syndrome). The influenza vaccine is also available for the general public not included in the above groups, but with a charge. Almost all hospital employees are reported to receive the vaccine. Overall, about 68.4% of people in high-risk groups and about 10% of the general population receive the vaccine each year [1]. This high vaccination rate can be attributed to the fact that risk-groups receive it free of charge, and also to the promotion of vaccination in the mass media. In November 2005 about 60% of the high-risk groups received the vaccine because of the fear for the outbreak of the bird-flu.

The cost-effectiveness of influenza vaccination for elderly and other high-risk populations is well established [2, 3]. Two studies in Taiwan concluded that influenza vaccination program for elderly people aged 65 years and above seems cost-effective in reducing mortality or gaining life years [4, 5].

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Some studies of healthy working adults show that the influenza vaccination decreases the rates of lost workdays, reduces the rates of influenza-like illness [6, 7] and increases cost-saving from \$ 89.3 to \$ 237.8 per vaccinated employee [8–10]. But one review study concluded that parenteral vaccines have low effectiveness and high incidence of trivial local adverse reactions resulting in an unfavorable trade-off [11]. Another review study also concluded that influenza vaccines are effective in reducing serologically confirmed cases of influenza, but they are not effective in reducing cases of clinical influenza and number of working days lost. Universal immunization of healthy adults is not supported by the results of the review [12].

Recently, studies evaluated the vaccination rates among healthcare workers in the health care setting. They found that the vaccination rates are still low in western countries although the effectiveness in reducing influenza infections, absenteeism and also the cost saving have been shown in some studies [13]. The main reasons given for not being vaccinated were: do not think it was needed, not aware of the vaccine and concerned about side-effects as well as low effectiveness of the vaccine. But the vaccination rates in our country are almost 100%, because our health authority provides the influenza vaccination program to all healthcare workers at no charge. This mass vaccination program is expensive, and there are only very few studies that evaluate the cost-effectiveness of an implemented vaccination program, except some studies conducted nearly two decades ago. Therefore, we conducted this pilot study to assess whether the mass vaccination program for all healthcare workers was cost-effective.

### Aim of the study

The aim of the study was to evaluate the incidence rate of ILI, absenteeism, incidence rate of vaccine side effects and cost associated with ILI in healthy workers in health care setting.

### Methods

This retrospective and observational study was conducted in the workforce of a hospital in Taiwan between Oct 2004 and May 2005. The cost-effectiveness was determined from the hospital's perspective based on the data collected.

The entire hospital workforce (N=3,079) in a hospital in the south of Taiwan was offered free vaccination, except pregnant women, or persons with a history of egg allergy or a previous allergic reactions to an influenza vaccine. The vaccine administered was the 2004–2005 formula. It contained A/New Caledonia/20/99(H1N1) like

virus, A/Fujian/411/2002/(H3N2)-like virus, and B/Shanghai/361/2002 like virus. Vaccines were administered between September 22, 2004 and November 30, 2004. A total of 2,694 employees were willing to receive the vaccine. According to the calculation of sample size with a significance level of 0.05 and a power level of 0.80, a convenience sample of 500 employees received a questionnaire.

In the questionnaires we asked for provided demographic data, incidence rate of adverse reaction, symptoms of ILI and employment specific data, including level of responsibility within the hospital. In mid-April 2004, questionnaires were sent to the selected department and after one week the completed questionnaires were collected. All respondents completed the questionnaire on basis of their own retrospective perception.

All ILI was defined as the occurrence of flu-like illness of at least 2 days duration with at least one of the following systemic symptoms: fever, chills, myalgia, and at least one respiratory-tract symptom: rhinorrhoea, sore throat, cough, and hoarseness. Adverse events included fever, tiredness, muscle aches, headache, and allergic reaction.

The cost-effectiveness evaluation was based on Weinstein and Stason [14].

The outcome measure for cost-effectiveness was the cost to the hospital for each day of absence from work caused by ILI that was prevented by the vaccine, named "a saved lost workday."

The cost of the vaccination program was assessed from the hospital's perspective.

The statistical analysis was performed by using of SPSS V10.0. Categorical data were analysed using chi-squared test. To compare continuous data, the Student's t-test was used for normally distributed variables. A non-parametric multiple comparisons was used to analyze the correlation between the acceptance of influenza vaccination and incidence of influenza-like symptom.

### Results

This retrospective cost-effectiveness study was performed to the employees of a medical center in Taiwan. From the total workforce of 3,079 employees, 2,694 employees received the vaccine at no charge. We received 447 questionnaires back, of which 407 could be further evaluated. In this group 367 employees were vaccinated (90.2%) and 40 were not vaccinated (9.8%).

The mean age of non-vaccinated employee in our sampling was significantly younger than that of the vaccinated employee ( $P = 0.05$ ). Differences in gender and work-place responsibility were not significant because the low number of non-vaccinated employees (Table 1).

**Table 1** Comparisons of baseline information about the sampled subjects

	Vaccinated( <i>n</i> = 367)	Non-vaccinated( <i>n</i> = 40)	<i>P</i> -value
Age range(±SD)	32.21 ± 6.95	29.26% ± 4.94	0.059
Sex, F/M	79%/21%	78%/22%	NS
Ave. working experience (years)	7.08 ± 5.63	3.61 ± 3.6	0.004
Main workplace responsibility			NS
Physicians	12%	18%	
Nurses	41%	40%	
Paramedical-personnel	27%	25%	
Administration	12%	10%	
Miscellaneous	9%	8%	

About 32.4% (120/367) of the vaccinated employees had suffered local or systemic adverse events, the most frequent being tiredness, myalgia, pain at injection site, headache, fever. Two employees had an allergic reaction, such as itching and redness at the injection site (Table 2).

Fifty respondents in the vaccinated group reported to have ILI episodes and six respondents reported to have ILI episodes in the non-vaccinated group. The incidence of ILI was 13.6% (50/360) in the vaccinated and 15% (6/40) in non-vaccinated group. Data showed that the vaccination has reduced ILI rates although the difference was not significant (Table 3). From the analysis of the ILI symptoms, fever and sore throat were the most reported (Table 4).

A total of 17 employees took sick leave because of ILI, 14 in vaccinated and 3 in non-vaccinated group. The average number of workdays lost due to ILI was 1.09 in vaccinated respondents and 1.5 in non-vaccinated respondents. There were no significant differences between the vaccinated and non-vaccinated subjects in the measures of severity of ILI (Table 5).

The total costs of the vaccine program were U.S.\$ 4,278, including the direct cost of U.S.\$ 347 and indirect cost of U.S.\$ 3,931. The cost of vaccine was not borne by our hospital and therefore excluded from the calculation of

**Table 2** Incidence and types of adverse reaction of vaccinated subjects

	Vaccinated <i>n</i> (%)	<i>P</i> -value
Adverse reaction (ADR)	120 (32.7%)	<0.0001
No adverse reaction	247 (67.3%)	
Types of ADR		
Fever	14 (11.6%)	
Tiredness	70 (58.3%)	
Myalgia	67 (55.8%)	
Headache	26 (21.6%)	
Pain at injection site	60 (50%)	
Redness, itchiness	2 (1%)	

**Table 3** The Correlation between incidence of ILI and number of vaccinated subject

Event	Vaccinated ( <i>n</i> = 367)	Non-vaccinated ( <i>n</i> = 40)	<i>P</i> -value
<i>ILI</i>			
At least one ILI	50(13.6%)	6(15%)	0.821
No ILI	317(86.4%)	34(85%)	
Employees with lost workdays because of ILI	14(28%)	3(50%)	
Workdays because of ILI			
ILI, influenza-like Illness			

total direct cost, because the vaccine is provided for free by the health authority. Therefore, our hospital may save U.S.\$ 21.5 per day of saved” lost workdays” per vaccinated employee.

## Discussions

The benefit of influenza vaccination in healthy workers against influenza is well acknowledged and vaccination also reduces incidence of ILI and the absenteeism and cost

**Table 4** Measures of severity of ILI for persons having ILI symptom

Event	Vaccinated ( <i>n</i> = 367)	Non-vaccinated ( <i>n</i> = 40)
Days duration of ILI (total)	15	4.5
Days lost per ILI Employee (mean)	1.09 ± 0.507	1.5 ± 0.00
<i>Percentage of ill employees</i>		
Seeing a physician	10.3%(38)	15%(6)
Buying drugs at pharmacy	2.9%(11)	0
Hospitalization	0.27%(1)	0
Medical cost of per ILI	25	29

**Table 5** Types and calculations for cost-effectiveness

Type of cost	Vaccinated ( <i>n</i> = 367)	Non-vaccinated ( <i>n</i> = 40)
<i>Direct medical costs (U.S. dollars)</i>		
Vaccine, paid by Government (U.S 5.00/amp)	0	0
Medical care received for ILI	347	88
<i>Indirect medical costs (U.S. dollars)</i>		
Nursing times to administer vaccine; 1 h per employee; salary cost nurse = \$5/h salary cost assistant = \$3/h	2,936	0
Employee time to come to receive vaccine:1/2 h/employee	995	0
Physician:\$12/h		
Allied medical personnel:\$5/h		
Administrations personnel:\$3/h		
Lost work time because of vaccine side effects	0	0
Total costs (U.S. dollars)	4,278	88
Mean cost per person for vaccine program	11	2.2
Cost difference for vaccination program (dollars) per person	(8.8)	
Mean number of workdays lost per person	1.09	1.5
Saved mean number of lost workdays per person	$-1.5 + 1.09 = -0.41$	
Cost to hospital of saved "Lost workdays" per person	$8.8/0.41 = 21.5$	

associated with it in the workplace [3, 6–9, 15]. Nevertheless, the study of economic benefits of vaccination for healthcare workers are rare. Therefore this pilot study was conducted to determine if there was a potential savings by hospitals delivering free influenza vaccine to employees. Although the preliminary result of present study showed that the providing free influenza vaccine to healthcare workers in the selected hospital may reduce the incidence of ILI, absenteeism and the financial losses associated with absenteeism during the influenza season, the results of this study may have potential biases. The bias may result from the fact that the number of non-vaccinated subjects was much lower than the number of vaccinated subjects. This big difference in the number of employees in the two groups was due to the provision of free vaccination and the requirement that all employees should be vaccinated.

The average experience of employees in non-vaccinated subjects was less than in the vaccinated subjects (Table 1). The incidence of post-vaccination adverse effects was 32.7% in the vaccinated subjects. This is a low figure compared to published data (63.8%) of the western country for general healthy workers [9]. The high incidence of vaccine-related adverse events in this study could be the result of over-reporting by health care staff (Table 2).

The results of the study showed that ILI rates were lower in the vaccinated than in the non-vaccinated subjects but the difference was not statistical significant (Table 3). The absenteeism rates were possibly low because employees recognize that the hospital cannot offer replacement for sick leave and some therefore may decide not to ask for a sick leave.

## Conclusion

This pilot study showed that the free vaccination to the health care workers may be cost effective, but the costs of the vaccine were not included in the calculations. We will continue this research, in order to assess if free vaccination indeed saves costs in the hospitals in Taiwan.

**Conflicts of Interest** The authors of this paper have not declared any (potential) conflicts of interest.

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