

IMPACT OF NATIONAL INFLUENZA VACCINE CAMPAIGN ON RESPIRATORY ILLNESS IN THAILAND, 2010-2011

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Abstract. The National Influenza Vaccine Campaign in Thailand was implemented in 2009 after the worldwide 2009 pandemic influenza (H1N1) outbreak. While the campaign costs almost USD 2 million yearly, the impact of the program on respiratory illness incidence is still unclear. This study determined the effectiveness of influenza vaccine on outpatient visit and hospitalization related to influenza-like illness (ILI), influenza, pneumonia from all causes and pneumonia due to influenza among high risk population in Thailand. This retrospective cohort study compared the incidence rate of the abovementioned illnesses among vaccinated and non-vaccinated high risk population. Vaccination status was defined according to the influenza vaccination registration in 2010 and the incidence rates of the illnesses of interest were determined using the national administrative data of the National Health Security Office during 2010-2011 and reported as incidence rate ratio (IRR), 95% confidence interval (CI) and vaccine effectiveness. In 2010, of the 2,244,594 high risk individuals according to the influenza vaccination registration, 61.05% were unvaccinated and the remaining were. Influenza vaccine effectiveness in preventing ILI was 56% (IRR = 0.44; 95% CI: 0.44-0.45), but there is no significant reduction of outpatient visits related to influenza infection, pneumonia from all causes and pneumonia due to influenza infection. Influenza vaccine effectiveness in preventing hospitalization related to ILI, pneumonia from all causes and pneumonia due to influenza infection were 25% (IRR = 0.75; 95% CI: 0.71-0.78), 38% (IRR = 0.62; 95% CI: 0.54-0.72) and 32% (IRR = 0.68; 95% CI: 0.53-0.86), respectively. Interestingly, there is no significant reduction of hospitalization related to influenza infection; however, among children between 6 months and 2 years of age vaccine effectiveness in preventing hospitalization due to influenza was 60% (IRR = 0.40; 95% CI: 0.13-0.96). Influenza vaccine effectiveness in preventing hospitalization due to pneumonia, ILI and pneumonia related to influenza in high risk population were 25.0%, 38.0% and 32.0%, respectively; however, children of 6 months to 2 years of age demonstrated 60% vaccine effectiveness in preventing influenza hospitalization.

Keywords: hospitalization, influenza, vaccine effectiveness, Thailand

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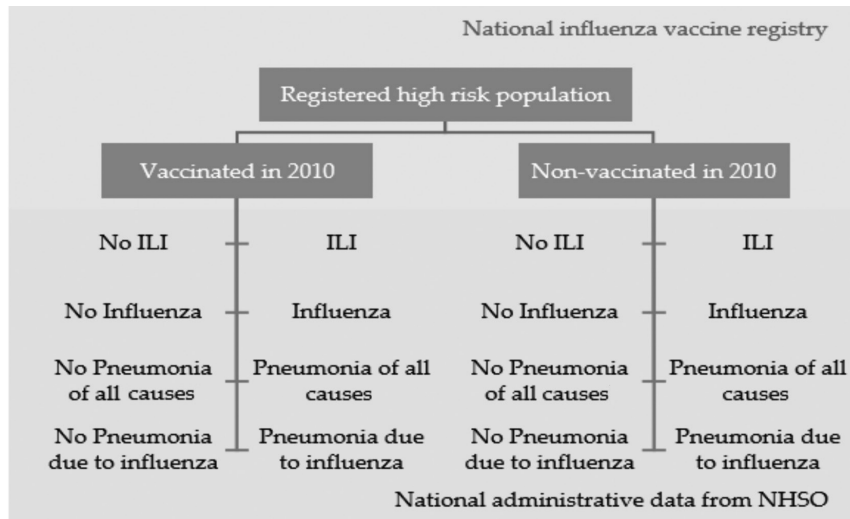


Fig 1–National influenza vaccine registry 2011 and National administrative data from NHSO, 2010-2011.

INTRODUCTION

The National Influenza Vaccination campaign in Thailand was implemented in 2010 following the global H1N1 influenza 2009 pandemic (Bureau of General Communicable Diseases, 2011). The campaign targets population with high risk of developing severe illness after influenza infection, who are defined as pregnant women, healthcare workers, elderly persons, individuals with chronic diseases [*viz.* chronic obstructive pulmonary disease (COPD), asthma, heart disease, cerebrovascular accident (CVA), renal insufficiency, diabetes, and malignancy with ongoing chemotherapy] and persons with thalassemia or immune-incompetence disorder or neuro-developmental disorders (Bureau of General Communicable Diseases, 2011; WHO, 2012).

While the campaign costs almost USD 2 million annually, the program's impact on respiratory illness incidence is still unclear. Hence, this study was conducted to determine the effectiveness of influenza vaccine on out-patient visit and hospitalization related to influenza-like illness

(ILI), influenza, pneumonia from all causes and pneumonia due to influenza among high risk population in Thailand. It should be noted that at the time that the study was undertaken, person with morbid obesity and children of 6 month to 2 years of age were not included in Thailand universal health benefit package (Bureau of General Communicable Diseases, 2011).

MATERIALS AND METHODS

Study population and case definition

This retrospective cohort study was conducted in high risk population who had been registered at the National Influenza Vaccination Registration of National Health Security Office (NHSO). Vaccinated and non-vaccinated groups were defined according to the influenza vaccination record of 2010. Then the national administrative data of the National Health Security Office (NHSO) during 2010-2011 were used to categorize the study population into those who were diagnosed with influenza, ILI, pneumonia from any causes, and pneumonia due to influenza (Fig 1).

Table 1
ICD-10 code for case definition of influenza-like illness (ILI), influenza, pneumonia and pneumonia due to influenza.

ICD-10	Disease of respiratory system	ILI	Influenza	Pneumonia	Pneumonia due to influenza
J00	Acute nasopharyngitis	✓			
J02.9	Acute pharyngitis, unspecified	✓			
J06.9	Acute upper respiratory infection, unspecified	✓			
J09	Influenza due to certain identified influenza virus	✓	✓		
J10	Influenza due to other identified influenza virus	✓	✓		
J10.0	Influenza with pneumonia, other influenza virus identified			✓	✓
J10.1	Influenza with other respiratory manifestations, other influenza virus identified	✓	✓		
J10.8	Influenza with other manifestations, other influenza virus identified	✓	✓		
J11	Influenza, virus not identified	✓	✓	✓	✓
J11.0	Influenza with pneumonia, virus not identified	✓	✓		
J11.1	Influenza with other respiratory manifestations, virus not identified	✓	✓		
J11.8	Influenza with other manifestations, virus not identified	✓	✓		
J12.9	Viral pneumonia, unspecified	✓		✓	

If a person sought care at public hospital and was diagnosed with any of the aforementioned illnesses, their diagnosis would be recorded in the national administrative data using ICD10 coding (Table 1).

The national administrative records were aimed to determine the incidence of respiratory infection.

Statistical analysis

Incidence rate ratio (IRR) between vaccinated and non-vaccinated group, its 95% confidence interval (CI) and vaccine effectiveness were determined as follows:

$$\text{Incidence rate of outpatient visit (IR)} = \frac{\text{Number of out-patient visits}}{\text{person-day}}$$

$$\text{Incidence rate of hospitalization (IR)} = \frac{\text{Number of hospitalizations}}{\text{person-day}}$$

$$\text{Incidence rate ratio (IRR)} = \frac{\text{IR}_{(\text{vaccinated})}}{\text{IR}_{(\text{non-vaccinated})}}$$

$$\text{Vaccine effectiveness} = 1 - \text{IRR}$$

Table 2
 Characteristics of high risk population in the national influenza vaccination registry,
 National Health Security Office, Thailand 2011 (N = 2,244,594).

Characteristic	Number (%)
Sex, <i>n</i> = 2,244,267	
Female	1,473,354 (65.7)
Male	770,913 (34.3)
Age (year), <i>n</i> = 1,769,271	
Mean \pm SD	51.5 \pm 18.7
Type of health insurance, <i>n</i> = 2,239,936	
Universal Coverage Scheme	1,612,089 (72.0)
Civil Servant Medical Benefit Scheme	428,358 (19.1)
Social Security Scheme	196,091 (8.8)
Other	3,398 (0.1)
High risk group, <i>n</i> = 2,244,594	
Person with chronic diseases	1,278,188 (57.0)
Elderly (> 65 years of age; no underlying disease)	446,839 (19.9)
Healthcare worker (no underlying disease)	424,245 (18.8)
Thalassemia disease and immune-incompetency disorder including symptomatic HIV infection	38,912 (1.7)
Children (6 months to 2 years of age)	21,985 (1.0)
Morbid obesity (BW >100 kg and BMI >35)	21,684 (1.0)
Neurodevelopmental disorders	7,869 (0.4)
Pregnant (GA >28 weeks)	4,872 (0.2)
Influenza vaccination history (2010), <i>n</i> = 2,244,594	
Vaccinated	874,221 (38.9)
Non-vaccinated	1,370,373 (61.1)

BMI, body mass index; BW, body weight; GA, gestation age.

RESULTS

There were 2,244,594 high risk individuals registered during the 2010 National Influenza Vaccination campaign, of whom 874,221 (38.95%) were vaccinated and the remaining unvaccinated. Among the high risk population, those with chronic diseases, elderly people and healthcare workers constituted the majority while pregnant women the smallest (Table 2).

Regarding out-patient visits, influenza vaccine was effective in reducing ILI visits (Table 3). People with neurode-

velopmental disorders gained the highest benefit from the vaccination compared to the other groups; however, there is no significant reduction in out-patient visits for influenza for any other group, including those with pneumonia from any causes and pneumonia caused by influenza. As for hospitalizations, influenza vaccination afforded the highest benefit to children 6 months to 2 years old, with 60% reduction in numbers of admission, while only 24% and 29% drop of pneumonia of all causes and influenza pneumonia admission among chronic diseases (Table 4).

Table 3
Influenza vaccine effectiveness on reduction of out-patient visit for influenza-like illness (ILI), influenza, pneumonia from all causes, and pneumonia due to influenza among high risk population, Thailand 2010.

Category	High risk group	Vaccinated		Non-vaccinated		RR (95%CI)
		Number of visits	IR per 1,000 PY	Number of visits	IR per 1,000 PY	
ILI	Total	263,887	-41,275.05	590,813	-93,155.36	0.44 (0.44-0.45)
	Morbid obesity (BW>100 and BMI>35)	1,421	366.32	7,198	448.62	0.82 (0.77-0.86)
	Elderly person: age> 65years (no underlying disease)	27,495	297.20	101,145	329.48	0.90 (0.89-0.91)
	Children: 6 months to 2 years	2,662	1,449.74	28,511	1,581.63	0.92 (0.88-0.95)
	Healthcare workers (no underlying disease)	100,320	659.40	95,830	457.18	1.44 (1.43-1.46)
	Person with chronic diseases	127,418	364.29	340,839	448.80	0.81 (0.81-0.82)
	(COPD, asthma, heart disease, cerebrovascular disease, renal failure, DM, cancer with chemotherapy)					
	Thalassemia disease and immunocompetency disorders include symptomatic HIV infection	3,992	422.24	13,184	535.90	0.79 (0.76-0.82)
	Neurodevelopmental disorders	489	274.82	2,593	545.75	0.50 (0.46-0.55)
	Pregnant woman (GA > 28 weeks)	90	575.09	1,513	329.53	1.75 (1.39-2.16)
Influenza	Total	4,458	1,253.19	5,565	345.53	3.63 (3.49-3.77)
	Morbid obesity (BW>100 and BMI>35)	23	5.85	77	4.72	1.24 (0.74-2.00)
	Elderly person: age> 65years (no underlying disease)	360	3.85	704	2.26	1.70 (1.49-1.93)
	Children: 6 months to 2 years	38	19.62	205	10.73	1.83 (1.26-2.60)
	Healthcare workers (no underlying disease)	1,948	12.49	1,262	5.92	2.11 (1.97-2.27)
	Person with chronic diseases	1,934	5.45	3,105	4.02	1.36 (1.28-1.44)
	(COPD, asthma, heart disease, cerebrovascular disease, renal failure, DM, cancer with chemotherapy)					
	Thalassemia disease and immunocompetency disorders include symptomatic HIV infection	148	15.41	183	7.29	2.11 (1.69-2.64)
	Neurodevelopmental disorders	5	2.78	15	3.09	0.90 (0.26-2.60)
	Pregnant woman (GA > 28 weeks)	2	12.51	14	3.01	4.15 (0.46-18.07)

Table 3 (Continued).

Category	High risk group	Vaccinated		Non-vaccinated		RR (95%CI)
		Number of visits	IR per 1,000 PY	Number of visits	IR per 1,000 PY	
Pneumonia of all caused	Total	422	113.68	751	46.10	2.47 (2.18-2.78)
	Morbid obesity (BW>100 and BMI>35)	2	0.51	7	0.43	1.19 (0.12-6.23)
	Elderly person: age> 65years (no underlying disease)	36	0.38	83	0.27	1.44 (0.95-2.16)
	Children: 6 months to 2 years	19	9.81	95	4.97	1.97 (1.14-3.25)
	Healthcare workers (no underlying disease)	116	0.74	91	0.43	1.74 (1.31-2.32)
	Person with chronic diseases	233	0.66	445	0.58	1.44 (0.97-1.34)
	(COPD, asthma, heart disease, cerebrovascular disease, renal failure, DM, cancer with chemotherapy)					
Pneumonia due to influenza	Thalassemia disease and immunocompetency disorders include symptomatic HIV infection	13	1.35	26	1.04	1.31 (0.62-2.64)
	Neurodevelopmental disorders	3	1.67	2	0.41	4.05 (0.46-48.45)
	Pregnant woman (GA > 28 weeks)	0	0.00	1	0.22	0.00
	Total	217	58.33	304	18.64	3.13 (2.62-3.74)
	Morbid obesity (BW>100 and BMI>35)	2	0.51	4	0.25	2.07 (0.19-14.48)
	Elderly person: age> 65years (no underlying disease)	19	0.20	42	0.14	1.50 (0.83-2.64)
	Children: 6 months to 2 years	1	0.52	11	0.58	0.90 (0.02-6.17)
Pneumonia due to influenza	Healthcare workers (no underlying disease)	91	0.58	71	0.33	1.75 (1.27-2.43)
	Person with chronic diseases	96	0.27	167	0.22	1.25 (0.96-1.62)
	(COPD, asthma, heart disease, cerebrovascular disease, renal failure, DM, cancer with chemotherapy)					
	Thalassemia disease and immunocompetency disorders include symptomatic HIV infection	8	0.83	7	0.28	2.99 (0.95-9.68)
	Neurodevelopmental disorders	0	0.00	2	0.41	0.00
	Pregnant woman (GA > 28 weeks)	0	0.00	1	0.00	0.00

ILI, influenza-like illness; IR, incidence rate; PY, per year; RR, rate ratio; CI, confidence interval; BW, body weight; BMI, body mass index; COPD, chronic obstructive pulmonary disease; GA, gestational age.

Table 4
Influenza vaccine effectiveness on reduction of hospitalization for influenza-like illness (ILI), influenza, pneumonia from all causes, and pneumonia due to influenza among high risk population, Thailand 2010.

Category	High risk group	Vaccinated		Non-vaccinated		RR (95%CI)
		Number of visits	IR per 1,000 PY	Number of visits	IR per 1,000 PY	
ILI	Total	2,410	3.87	7,166	5.18	0.75 (0.71-0.78)
	Morbid obesity (BW >100 kg and BMI >35)	9	2.41	40	2.45	0.98 (0.42-2.06)
	Elderly (>65 years of age; no underlying disease)	254	2.71	946	3.04	0.89 (0.77-1.03)
	Children (6 months to 2 years of age)	67	34.61	785	41.12	0.84 (0.65-1.08)
	Healthcare workers (no underlying disease)	217	1.39	371	1.74	0.80 (0.67-0.95)
	With chronic diseases (COPD, asthma, heart disease, cerebrovascular disease, renal failure, DM, cancer with chemotherapy)	1,737	4.90	4,548	5.89	0.83 (0.79-0.88)
	Thalassemia disease and immune-incompetency disorders include symptomatic HIV infection	118	12.29	416	16.58	0.74 (0.60-0.91)
	Neurodevelopmental disorders	8	4.45	48	9.90	0.45 (0.18-0.96)
	Pregnancy (GA >28 weeks)	0	0.00	12	2.58	0.00
	Total	667	1.07	1,500	1.08	0.99 (0.90-1.08)
Influenza	Morbid obesity (BW >100 kg and BMI >35)	0	0.00	8	0.49	0.00
	Elderly (>65 years of age; no underlying disease)	69	0.74	235	0.76	0.98 (0.73-1.28)
	Children (6 months to 2 years of age)	5	2.58	123	6.43	0.40 (0.13-0.96)
	Healthcare workers (no underlying diseases)	96	0.62	121	0.57	1.08 (0.82-1.43)
	Person with chronic diseases (COPD, asthma, heart disease, cerebrovascular disease, renal failure, DM, cancer with chemotherapy)	467	1.32	941	1.22	1.08 (0.97-1.21)
	Thalassemia disease and immuno-incompetency disorders include symptomatic HIV infection	27	2.81	61	2.43	1.16 (0.71-1.85)
	Neurodevelopmental disorders	3	1.67	6	1.24	1.35 (0.22-6.32)
	Pregnancy (GA >28 weeks)	0	0.00	5	1.08	0.00
	Total					

Table 4 (Continued).

Category	High risk group	Vaccinated		Non-vaccinated		RR (95%CI)
		Number of visits	IR per 1,000 PY	Number of visits	IR per 1,000 PY	
Pneumonia of all caused	Total	259	0.42	920	0.67	0.62 (0.54-0.72)
	Morbid obesity (BW >100 kg and BMI>35)	0	0.00	1	0.06	0.00
	Elderly (> 65years of age; no underlying diseases)	24	0.26	75	0.24	1.06 (0.64-1.70)
	Children (6 months to 2 years of age)	21	10.84	247	12.92	0.84 (0.51-1.31)
	Healthcare workers (no underlying diseases)	15	0.10	24	0.11	0.85 (0.42-1.70)
	Person with chronic diseases (COPD, asthma, heart disease, cerebrovascular disease, renal failure, DM, cancer with chemotherapy)	185	0.52	532	0.69	0.76 (0.64-0.90)
Pneumonia due to influenza	Thalassemia disease and immune-incompetency disorders include symptomatic HIV infection	11	1.14	29	1.16	0.99 (0.45-2.04)
	Neurodevelopmental disorders	3	1.67	11	2.27	0.74 (0.13-2.79)
	Pregnancy (GA > 28 weeks)	0	0.00	1	0.22	0.00
	Total	91	0.15	297	0.21	0.68 (0.53-0.86)
	Morbid obesity (BW >100 kg and BMI >35)	0	0.00	0	0.00	0.00
	Elderly (> 65 years of age; no underlying diseases)	15	0.16	45	0.14	1.11 (0.57-2.02)
	Children (6 months to 2 years of age)	0	0.00	35	1.83	0.00
	Healthcare workers (no underlying diseases)	9	0.06	14	0.07	0.88 (0.34-2.18)
	With chronic diseases (COPD, asthma, heart disease, cerebrovascular disease, renal failure, DM, cancer with chemotherapy)	60	0.17	183	0.24	0.71 (0.53-0.96)
	Thalassemia disease and immune-incompetency disorders include symptomatic HIV infection	6	0.62	11	0.44	1.43 (0.43-4.20)
Pneumonia due to influenza	Neurodevelopmental disorders	1	0.56	4	0.82	0.67 (0.01-6.82)
	Pregnancy (GA >28 weeks)	0	0.00	1	0.22	0.00

DISCUSSION

The 2010 Influenza Vaccine campaign in Thailand was effective in reducing out-patient visits and hospitalizations for ILI among the high risk groups, especially those with neurodevelopmental disorders. However, this study also reveals absence of benefit of vaccination on out-patient visits for those with influenza and pneumonia due to influenza or other causes. This raises concerns regarding the effectiveness of the influenza vaccine in these types of illness. In addition, the rather low reduction (10% and 18%) in out-patient visits due to ILI among vaccinated elderly (> 65 years of age and with no underlying disease) and obese subjects, respectively, should be looked into, albeit the small samples sizes.

However, the campaign was successful in reducing 60% of hospitalization for influenza among children (6 months to 2 years of age), which is consistent with a prior study where 52% vaccine effectiveness were reported (Shuler *et al*, 2007). However, the vaccination program provided moderate (24-29%) reduction in hospitalization for pneumonia. Similarly, among vaccinated individuals with chronic diseases the reduction in hospitalization for pneumonia was consistent with previous studies among subjects >60 years of age with chronic disease showing 35% decrease in influenza infection and 24% in hospitalization for medical conditions (Vu *et al*, 2002; Van *et al*, 2011; Siriarayapon *et al*, 2013).

The lowest influenza vaccine uptake was among pregnant woman. This may in part be due to obstetricians' lack of confidence in the safety of influenza vaccine. Although hospitalization for influenza in pregnancy with no underlying diseases

is twice that of non-pregnant condition (Creanga *et al*, 2010), more should be done to promote this campaign in this high risk group.

The limitation of this study was the definition of the disease, lack of laboratory diagnosis, low sample size in some high risk groups and immunity of influenza after vaccination.

In summary, the 2010 National Influenza Vaccine campaign in Thailand resulted in 8-50% decrease of out-patient visits and 20-55% in hospitalizations for ILI among the high risk population. There was no evidence that this campaign reduced out-patient visits for influenza and pneumonia due to influenza or any other causes. Children from 6 months to 2 years of age benefited from influenza vaccine program; it reduced by 60% vaccine influenza associated hospitalization.

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