

SHORT COMMUNICATION

Cost analysis of influenza vaccination for pregnant women in Thailand

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arthorn.rie@mahidol.ac.th**KEYWORDS:**Influenza vaccine, Pregnant women,
Thailand, Cost, FLUTool**ABSTRACT**

In Thailand, influenza vaccine has been providing for risk groups including pregnant women based on availability of budget and voluntary basis. This study aimed to estimate the service delivery cost per pregnant woman vaccinated against influenza. Economic costs of influenza vaccination at 8 district hospitals from different regions were estimated based on the perspective of the hospital. The micro-costing approach was applied covering labor, material and transportation costs. Costs of using refrigerator, cold box, vaccine and related materials including supply chain from central procurement to district hospital were not included. The vaccination program was defined as a set of activities including planning and training, vaccine preparation, transportation to vaccination sites, screening, vaccine delivery, AEFI surveillance and reporting. The study was based on services in 2016. Seven of eight hospitals provided campaign-based vaccination. One hospital included the service in routine antenatal care clinic (ANC). The number of pregnant women received the vaccine in each district varied from none to thirty-one depending on size of the population in each catchment area and vaccine uptake. Cost per dose vaccinated was calculated by activity and total cost. Total cost per vaccinated dose was in the range of 24 - 349 Thai baht (2016 prices). Comparing to the costing template for the influenza vaccination; the FLUTool version 3.0. The major difference in this study and that of the tool was objective and scope. The FLUTool was applied for the whole national program in a public health perspective. This study was conducted in a hospital perspective. Therefore, costs of planning and training and others were only costs incurred by the hospitals (not included those of other organizations). When comparing the micro-costing approach in this study to the FLUTool, the FLUTool does not cover mobile delivery service. This might be an input to develop the next version.

1. INTRODUCTION

The WHO Initiative for Vaccine Research (WHO/IVR) with the consulting firm Levin & Morgan has developed an Excel-based cost projection tool (FLUTool) to estimate the costs of influenza vaccination strategies for pregnant women. In collaboration

with the WHO/IVR and the Thailand Ministry of Public Health's Health Intervention Technology Assessment Program (HITAP), Centers for Disease Control and Prevention (CDC) conducted a pilot of the FLUTool in Thailand. One of the objectives was to provide recommendations to the WHO/IVR and the FLUTool developers to improve the FLUTool, the process of using the FLUTool, and accompanying guidance materials.

The service delivery was an activity component of the FLUTool in which there might be the greatest uncertainty and potential variation across geographies and health facility levels in Thailand. In this regard, it would be necessary to provide a benchmark against which to validate some of the key unit cost estimates used in the FLUTool by using a micro-costing study; a more precise 'gold standard' methodology. Service delivery micro-cost estimates would be an important consideration for immunization program planners in Thailand. This study aimed to estimate the service delivery cost, including health care human resource costs required, per pregnant woman vaccinated against influenza under the 2 strategies evaluated during the FLUTool pilot in Thailand using ingredients-based micro-costing methods in a sample of health facilities from different regions of the country.

2. METHOD

2.1 Study design

Economic costs of influenza vaccination for pregnant women at district hospitals were estimated based on the perspective of the provider at vaccine delivery facilities (district hospitals). The micro-costing approach¹ was applied covering labor, material and transportation costs. For transportation, operational and capital costs of vehicles were included. Costs of using refrigerators, cold box and others, vaccine and related materials (syringe, safety box) was not included. Cost of the supply chain from central procurement to district hospital was not included as well. The study was based on services in 2016. Costs are presented in Thai baht (THB) at 2016 prices (US\$1=35.298 THB, Int\$=12.44 THB)^{2,3}. In addition, to estimate the actual costs of services provided in 2016, respondent

at each site were also asked about a hypothetical scenario of integration into routine ANC setting.

2.2 Study sites and activities

Eight district hospitals, which were the same as those included in the project estimating the cost of health promotion and disease prevention (PP) granted by the National Health Security Office (NHSO) were used as the sample in this study. These were selected from 4 geographical regions of Thailand (Central, North, Northeast and South). Site selection was based on convenient sampling method regarding the availability of cost data and intention to participate. This information was from previous research experiences and connection with provincial health officers who knew the situation and select district hospitals for the project. First, one province was selected from each region. Then, two districts were selected from each province. In each district, the district hospital was the study site (Table 1). Influenza vaccination program at district hospitals was defined as a set of activities including planning and training (there were integrated meetings at provincial health office, district health office and hospital on management and technical issues of the vaccination), exploring target groups (survey on number of target group), vaccine preparation (requesting from the cold store for each day of vaccinating), transportation to vaccination sites (in case of out-of-hospital services), screening (eligibility of vaccinating before vaccinating), vaccine delivery (vaccine injection), AEFI surveillance and reporting (let the vaccinated person stay for half an hour to observe the symptoms) (Table 2). These were modified from those of the FLUTool that includes micro planning, training, social and mobilization/introduction/IEC, vaccine procurement, continuing IEC, service delivery, supervision/monitoring/evaluation, other current cost, cold chain supplement and other capital costs. The major difference was objective and scope. The FLUTool was applied for the whole national program in a public health perspective. This study was conducted in a district hospital perspective. Therefore, costs of planning and training and others were only costs incurred by the hospitals (not included those of other organizations).

Table 1. List of study sites.

Hospital	Province	Region	Number of bed
Banmoh	Saraburi	Central	33
Khangkhoi	Saraburi	Central	75
Borglua	Nan	Northern	21
Pua	Nan	Northern	105
Phratongkhum	Nakhonratchasima	Northeastern	30
Buayai	Nakhonratchasima	Northeastern	139
Kantang	Trang	Southern	60
Palien	Trang	Southern	30

Table 2. List of hospital vaccination activities costed.

1. Planning
2. Training
3. Exploring and preparing the target group
4. Vaccine preparation; cover only vaccinator time, not included district inventory management operated by the hospital's department of pharmacy
5. Traveling to vaccine delivery sites
6. Screening
7. Vaccine delivery including pre-vaccine education
8. AEFI surveillance
9. Medical recording/ reporting

2.3 Data collection and management

Data collection form was designed based on a review of the FLUTool and interview of a few hospital vaccination staff. The draft was tested at a hospital then revised. Data collectors were the researcher and research assistants who were trained by the researcher. Respondent, giving answers to all questions, of each hospital was a staff who managed the vaccination. The data were entered into the Microsoft Excel file for costing calculations and analysis.

2.4 Costing methods

Based on the micro-costing approach, the vaccination program was categorized into activities (activity-based approach) and the component of costs included in the study (ingredient-based approach). Reference values used in the cost

calculations are presented in Table 3. Labor cost was composed of salary and per diem. Salary per working day was estimated based on 22 working days of monthly salary⁴. For working time calculation, 60 minutes are equal to 1 hour. Six productive hours is equal to 1 working day⁴. The labor cost of health center staff participating in the vaccination campaign was assumed to be equal to those of the hospital. The labor cost of village health volunteer helping the vaccination campaign was assumed as minimum daily wage (300 baht) for their opportunity cost⁵. Capital cost covering cars was calculated using an economic approach⁶ with a 3% discount rate and 5 useful years⁴. Original prices of cars were adjusted to the current price in the study year by the consumer price index⁷. Cars were assumed to be used for 365 days per year in the calculation of the capital cost of car per day. Operational costs of cars were assumed to be a rate of 4 baht per kilometer⁸.

Table 3. Reference values.

Number of working days/month ⁴	22 days
Number of productive hours/day ⁴	6 hours
Value of vans (adjusted price in 2016) (average from study hospitals)	1,398,850 THB
Value of ambulances (adjusted price in 2016) (average from study hospitals)	1,709,752 THB
Useful year of car (van and ambulance) ⁴	5 years
Discount rate ⁴	3 %
Annuity factor ⁴	4.5797
Annual economic cost of van (calculated)	305,445 THB
Annual economic cost of ambulance (calculated)	373,332 THB
The economic cost of van per day (calculated)	837 THB
The economic cost of ambulance per day (calculated)	1,023 THB
Operational cost of car/ kilometer ⁸	4 THB
Village health volunteer labor cost = reference minimum wage/day ⁵	300 THB

3. RESULTS

In 2016, all hospitals, except Buayai Hospital, provided campaign-based vaccination. Buayai Hospital provided the vaccine at routine antenatal care clinic (ANC). Among the campaign-based service locations, four hospitals provided service at Tambon health promoting hospital (THPH) or former health center. THPHs in each district are members of the contracting unit for primary care (cup), in the national health insurance system, led by the district hospital. Therefore, THPHs and the district work closely as a network. Two hospitals provided the service only at the hospital. Only one hospital provided mobile clinics at villages. Among the respondents surveyed at the sample sites, none indicated that their hospital would require additional staff to be able to include influenza vaccination as part of routine ANC.

The number of vaccinated persons and pregnant women in each district varied (Table 4) depending on the size of the population in each catchment area and vaccine uptake. Planning and training were included in the same meeting. There were meetings at provincial health offices, district health offices and hospitals. Screening and vaccine

delivery were continuing activities and integrated. AEFI surveillance involved letting vaccinated persons stay in the clinic for 30 minutes for observation after receiving the vaccine while the health staff worked on other activities. Therefore, no labor cost was estimated for AEFI surveillance. For the campaigns providing service outside the hospital, costs included time used for traveling and working at the service sites. Therefore, labor cost for the services is presented into 2 formats. Screening and vaccinating A includes labor costs of staff of both district and Tambon health promoting hospitals. Screening and vaccinating B includes only the labor cost of staff of Tambon health promoting hospitals. Therefore, the total cost was composed of those of all activities except Screening and vaccinating A. This was to avoid double counting of the labor cost of district hospital staff in activity traveling to service site and screening and vaccinating. Each activity was estimated per vaccinated dose (person). Cost of vaccination by campaign outside the hospital had a higher cost than services within hospital clinics due to transportation costs (Table 5). The costs were broken down to labor costs (Table 6) and transportation costs (Table 7).

Table 4. Vaccination approach and outputs.

Site	Approach	Service place	Vaccinated cases	
			Total	Pregnant women
Kangkhoi	Campaign	THPH	1,316	0
Banmoh	Campaign	THPH	2,468	27
Pua	Campaign	Villages	3,173	24
Borglua	Campaign	THPH	671	0
Kantang	Campaign	THPH	622	5
Palien	Campaign	District hospital	3,758	31
Phratongkhum	Campaign	District hospital	337	19
Buayai	Routine ANC	District hospital	764	1

Note: THPH = Tambon health promoting hospital

Table 5. Cost per dose of vaccination classified by activities.

Activity	Total cost/ dose (THB in 2016 prices)							
	Kangkhoi	Banmoh	Pua	Borglua	Kantang	Palien	Phratongkhum	Buayai
1. Planning and training	4.86	1.64	3.51	14.57	7.11	1.17	14.70	7.31
2. Exploring target group	0.69	0.23	0.52	5.88	1.10	0.14	0.33	0.30
3. Vaccine delivery								
3.1 Vaccine preparation	0.86	2.30	0.52	5.49	2.44	0.09	0.11	0.05
3.2 Travelling to service site	42.56	78.77	11.63	137.27	299.89	-	-	-
3.3 A Screening and vaccinating A	59.74	110.48	183.08	61.41	94.96	22.67	105.19	56.35
3.3 B Screening and vaccinating B	22.05	31.68	91.54	39.48	38.24	-	-	-
4. Recording/ reporting	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
Total cost of vaccine delivery	65.48	112.76	103.71	182.25	340.58	0.10	0.13	0.05
Total cost of all activities	71.03	114.63	107.73	202.70	348.80	24.08	120.35	64.01

Note:

1. Screening and vaccinating A includes the labor cost of both district hospital and Tambon health promoting hospital staff. Screening and vaccinating B includes only the labor cost of Tambon health promoting hospital.
2. The total cost of vaccine delivery includes the cost of activity 3.1, 3.2, 3.3 B and 4. This because the labor cost of hospital staff (in activity 3.3 A Screening and vaccinating A) for vaccinating is already included in 3.2 Travelling to the service site.
3. Total cost includes the cost of activity 1, 2, 3.1, 3.2, 3.3 B and 4. This because the labor cost of hospital staff (in activity 3.3 A Screening and vaccinating A) for vaccinating is already included in 3.2 Travelling to the service site.

Table 6. Labor cost of health personnel per dose of vaccination.

Activity	Labor cost/ dose (THB at 2016 prices)							
	Kangkhoi Banmoh	Pua	Borglua	Kantang	Palien	Phratong khum	Buayai	
1. Planning and training	4.14	1.21	3.05	12.27	5.35	0.86	10.93	5.22
2. Exploring target group	0.69	0.23	0.52	5.88	1.10	0.14	0.33	0.30
3. Vaccine delivery								
3.1 Vaccine preparation	0.86	2.30	0.52	5.49	2.44	0.09	0.11	0.05
3.2 Travelling to service site	36.24	67.80	9.27	116.86	254.08	-	-	-
3.3 A Screening and vaccinating A	59.74	110.48	183.08	61.41	94.96	22.67	105.19	56.35
3.3 B Screening and vaccinating B	21.86	31.57	91.54	39.48	37.98	-	-	-
4. Recording/ reporting	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
Total cost of vaccine delivery	58.98	101.68	101.34	161.84	294.52	0.10	0.13	0.05
Total cost of all activities	63.81	103.12	104.91	179.99	300.97	23.77	116.59	61.92

Note:

1. Screening and vaccinating A includes the labor cost of both district hospital and Tambon health promoting hospital staff. Screening and vaccinating B includes only the labor cost of Tambon health promoting hospital.
2. The total cost of vaccine delivery includes the cost of activity 3.1, 3.2, 3.3 B and 4. This because the labor cost of hospital staff (in activity 3.3 A Screening and vaccinating A) for vaccinating is already included in 3.2 Travelling to the service site.
3. Total cost includes the cost of activity 1, 2, 3.1, 3.2, 3.3 B and 4. This because the labor cost of hospital staff (in activity 3.3 A Screening and vaccinating A) for vaccinating is already included in 3.2 Travelling to the service site.

Table 7. Cost of transportation per dose of vaccination.

Activity	Transportation cost/ dose (THB at 2016 prices)							
	Kangkhoi Banmoh	Pua	Borglua	Kantang	Palien	Phratong khum	Buayai	
1. Planning and training	0.72	0.43	0.45	2.30	1.76	0.31	3.77	2.09
2. Exploring target group	-	-	-	-	-	-	-	-
3. Vaccine delivery	-	-	-	-	-	-	-	-
3.1 Vaccine preparation								
3.2 Travelling to service site	6.32	10.98	2.37	20.41	45.81	-	-	-
3.3 A Screening and vaccinating A	-	-	-	-	-	-	-	-
4. Recording/ reporting	-	-	-	-	-	-	-	-
Total cost of vaccine delivery	6.32	10.98	2.37	20.41	45.81	-	-	-
Total cost of all activities	7.04	11.41	2.82	22.71	47.56	0.31	3.77	2.09

4. DISCUSSION AND CONCLUSION

The strength of this study was a study design as a micro-costing study that is relatively high accurate and appropriate for estimating the cost of campaign-style influenza vaccination approaches in Thailand. However, the data were retrospectively collected from interviews of events that occurred for a year or more. While recall bias may be a limitation we were unsure if this would over-estimate their involvement in the vaccination campaigns. In addition, our results on cost per vaccinated dose were varied due to both inputs and outputs based on the difference of context. For inputs, the number of staff, salary and service patterns in each hospital were different. For instance, staff in some hospital were quite senior with a higher salary than the others. For outputs, vaccinated doses were based on the number of persons in each target group in the catchment area of each hospital. Population sizes were different among the study sites. In some district, no or very few pregnant women received the vaccine. This study had limitations on a small purposive/convenience sample size that may not be representative of all sites in Thailand. In addition, the labor cost of health center staff participating in the vaccination campaign was assumed to be equal to those of the hospital.

In Thailand, at the study time, the influenza vaccine was provided as an annual campaign for specific risk groups only, i.e. medical practitioners, pregnant women, children aged 6 months to 2 years, patients with selected chronic illnesses, elderly people aged from 65 years, people with mental disabilities, patients with thalassemia and HIV and obese people weighted over 100 kilograms or BMI > 35. Supply of the vaccine was estimated year by year based on numbers in each target group together with the availability of budget. However given that, in 2018, there were 13,043,590 persons in vaccine target groups and only 3,500,000 influenza vaccine doses provided, not all persons in target groups can receive the vaccine⁹. In addition, the vaccine was delivered on a “first-come-first-served” basis leading to a disproportionate number of elderly persons receiving influenza vaccination among those in the target groups¹⁰. The vaccination program was a campaign-based service. Due to rumors of AEFI in some areas, pregnant women

might be reluctant to be vaccinated¹¹. In addition, vaccine providers were also not confident to give the vaccine¹². Sometimes, the vaccine supply was not enough¹². Given these issues, there was no vaccinated woman in some hospitals and some years. However, the process of vaccination for each target group, except medical practitioners, was the same. Therefore, where there was no vaccinated woman, cost of vaccination for other risk groups was estimated.

When comparing the manual micro-costing approach in this study to the WHO FLUTool, the costing template tool (FLUTool v.3.0) did not cover mobile delivery service. This might be an input to develop the tool.

In conclusion, for the service for pregnant women, based on the one site delivering flu vaccine to pregnant women through routine ANC services, and responses from the other 7 sites about this hypothetical delivery scenario, no additional staff were required. Follow-up evaluation of actual resource implications once more sites implement influenza vaccination in ANC settings might be merited in the future.

Vaccine delivery activities should include planning together with training, inventory management, vaccinating including traveling time for mobile service, and reporting. The FLUTool should be modified to include the complete cost of mobile service.

5. ACKNOWLEDGEMENTS

I thank all respondents and special thanks to Dr. Samantha Kluglein (Deputy Director of the Center for Vaccine Equity, Task Force for Global Health), Dr Sarah Elizabeth (CDC/CGH/GID), Dr Joshua Mott CDC/CGH/GID) and Dr. Wanitchaya Kittikraisak (CDC/OID/NCIRD) for facilitating the project giving valuable comments.

Conflict of interest (If any)

None to declared

Funding

This publication was supported by a grant from the US Centers for Disease Control and Prevention (CDC) through The Partnership for Influenza Vaccine Introduction, a program of the Task Force for Global Health, Inc.

Ethical approval

Approved by the Institute for the Development of Human Research Protections (IHRP), Thailand. Ref: 667/2560.

Article info:

Received July 17, 2019

Received in revised form -

Accepted April 14, 2020

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