Identifying Important Factors Impacting the Adoption of New Vaccines in Thailand by Using a Best-Worst Scaling

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Abstract

The introduction of new vaccines depends on various criteria, including policies, clinical guidelines and economic considerations. Various stakeholders have differing criteria they view as important in selecting vaccines into a national immunization program. The present study aimed to identify factors impacting the adoption of new vaccines from the perspective of policy makers, healthcare professionals and healthcare administrators. The vaccine attributes identified from a literature review and semi-structured interviews were categorized into burden of disease, age group, budget impact, fever from vaccine, severity of disease, vaccine effectiveness and cost of vaccine. Main-effects orthogonal design was used to identify 18 profiles. Then a postal survey was conducted among policy makers, healthcare professionals and healthcare administrators. Respondents were asked to choose the most important and the least important choices in each profile. Conditional logistic regression was used to estimate importance weights of attribute levels, and then relative attribute importance was calculated. A total of seventy respondents completed the questionnaires (a 55% response rate), including 11 policy makers, 26 healthcare professionals, and 33 healthcare administrators. The attributes listed by all groups as being the most important for new vaccine adoption were severity of disease (35.9%), fever from vaccine (16.7%) and burden of disease (13.5%), respectively. Policy makers and healthcare professionals listed severity of disease (35.0% and 35.9%), fever from vaccine (22.9% and 17.0%) and burden of disease (14.8% and 15.3%) as the most important, respectively; whereas healthcare administrators listed severity of disease (32.5%), budget impact (15.1%) and fever from vaccine (15.0%) as the most important, respectively. New vaccines with high protection targeting severe disease in young children have a greater chance of being selected by respondents in the present study. The findings reveal the importance of attributes from public healthcare workers and will be useful for policy development of new vaccine adoption.

Keywords: *best-worst scaling method, vaccine, decision-making*

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การหาปัจจัยที่มีความสำคัญต่อการเลือกวัคซีนใหม่ในประเทศไทยโดยวิธี best-worst scaling

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บทคัดย่อ

การนำวัคซีนใหม่เข้ามาใช้ขึ้นอยู่กับหลายปัจจัย ได้แก่ นโยบาย แนวทางปฏิบัติ และการประเมินทางเศรษฐศาสตร์ ผู้ที่เกี่ยวข้องต่างๆ จึงพิจารณาปัจจัยสำคัญที่แตกต่างกันไปในการนำวัคซีนใหม่เข้าสู่โครงการสร้างเสริมภูมิคุ้มกันแห่งชาติ การศึกษานี้มีวัตถุประสงค์เพื่อหาปัจจัยที่มีผลต่อการคัดเลือกวัคซีนใหม่จากมุมมองของผู้กำหนดนโยบาย นักวิชาการ และบุคลากรสาธารณสุข ปัจจัยที่เกี่ยวข้องกับวัคซีน (attribute) ที่ใช้ในการศึกษาได้มาจากการทบทวนวรรณกรรมและการสัมภาษณ์บุคลากรสาธารณสุข ปัจจัยดังกล่าว ได้แก่ ภาระโรค กลุ่มอายุ ผลกระทบด้านงบประมาณ อาการไข้หลังได้รับวัคซีน ความรุนแรงของโรค ประสิทธิผลของวัคซีน และราคาของวัคซีน การศึกษานี้ใช้ main-effects orthogonal design เพื่อกำหนด 18 สถานการณ์ จากนั้นเก็บข้อมูลเชิงสำรวจทางไปรษณีย์จากผู้กำหนดนโยบาย นักวิชาการ และบุคลากรสาธารณสุข โดยผู้ตอบแบบสอบถามเลือกตัวเลือกที่มีความสำคัญมากที่สุดและน้อยที่สุดในแต่ละสถานการณ์ การวิเคราะห์ข้อมูลใช้ conditional logistic regression เพื่อหา importance weight ของปัจจัยต่างๆ และคำนวณ relative attribute importance ต่อไป จากการส่งแบบสอบถาม ได้รับแบบสอบถามคืนทั้งสิ้น 70 ชุด (อัตราตอบกลับร้อยละ 55) ได้แก่ ผู้กำหนดนโยบาย 11 คน นักวิชาการ 26 คน และบุคลากรสาธารณสุข 33 คน ปัจจัยที่ผู้ตอบให้ความสำคัญมากที่สุดในการคัดเลือกวัคซีนใหม่ได้แก่ ความรุนแรงของโรค (ร้อยละ 35.9) อาการไข้จากวัคซีน (ร้อยละ 16.7) และภาระโรค (ร้อยละ 13.5) ตามลำดับ โดยผู้กำหนดนโยบายและนักวิชาการให้ความสำคัญกับความรุนแรงของโรค (ร้อยละ 35.0 และ 35.9) อาการไข้จากวัคซีน (ร้อยละ 22.9 และ 17.0) และภาระโรค (ร้อยละ 14.8 และ 15.3) ตามลำดับ ส่วนบุคลากรสาธารณสุขให้ความสำคัญกับความรุนแรงของโรค (ร้อยละ 32.5) ผลกระทบด้านงบประมาณ (ร้อยละ 15.1) และอาการไข้จากวัคซีน (ร้อยละ 15.0) ตามลำดับ ผู้ตอบแบบสอบถามในการศึกษานี้ให้ความสำคัญต่อวัคซีนใหม่ที่สามารถป้องกันโรคที่มีความรุนแรงในเด็กเล็ก ผลการศึกษานี้แสดงให้เห็นถึงปัจจัยที่มีความสำคัญในการคัดเลือกวัคซีนใหม่จากบุคคลที่เกี่ยวข้อง ซึ่งจะเป็นประโยชน์ต่อการพัฒนานโยบายในการคัดเลือกวัคซีนใหม่เข้าสู่ประเทศต่อไป

คำสำคัญ: *best-worst scaling method, วัคซีน, การตัดสินใจ*

Background and Rationale

Vaccination differs from other health interventions in the strength of supporting evidence, the extent of improving health, delivery rates and economic considerations. Vaccines provide primary intervention of future morbidity and mortality, thus vaccines targeted before, or in the initial stage of disease. Vaccines also generate broad intangible social benefits that may not be captured in economic analysis, for example, educational benefits due to reduced school absenteeism, avoidance of potential social disruption caused by disease with high emotional and political impact such as poliomyelitis or Ebola, the possibility of preventing or controlling pandemic infections, such as severe acute respiratory syndrome (SARS), economic losses from reduction in trade and tourisms, herd immunity, and quality of life lost in young children.[1-3] Any decision to select one vaccine may need to con-

sider opportunity costs of not investing in other vaccines or health interventions.[4]

Vaccines included in national immunization programs vary due to differences in finances, politics, and priorities.[5] The introduction of new vaccines depends on various criteria, including policies, regulations, clinical guidelines, expert recommendations, clinical efficacy and economic considerations. Many guidelines have been proposed to determine criteria for decision-making regarding new vaccine adoption in developed countries.[5-9] However, there is no standardized way to combine multiple criteria. Simply mimicking policies of developed countries may not be the best strategy for developing countries to adopt because of the differences in epidemiology and costs.[10]

In Thailand, introduction of new vaccines is authorized by the Ministry of Public Health (MoPH) based on the recommendation of the Advisory Committee on Immunization Practices (ACIP). The ACIP makes recommendations for vaccine schedules, vaccine formulations, and the choice of vaccines on the national formulary. The subjective judgement of experts can influence decisions, and little is known about decision weights that are applied in these judgments.[11] Currently, there are many licensed vaccines that are being considering for introduction into the Expanded Program on Immunization (EPI): for example, pneumococcal conjugate vaccine (PCV-13), *Haemophilus influenzae* type b (Hib) vaccine, rotavirus vaccine, inactivated poliomyelitis vaccine and human papilloma virus (HPV) vaccine. Understanding factors that influence importance for vaccines can help improve the system of new vaccine adoption. The present study aimed to identify factors impacting the adoption of new vaccines from the perspective of policy makers, healthcare professionals and healthcare administrators.

Methodology

Best-worst scaling method (BWS) is becoming widely used in healthcare research, for example, valuing health outcomes and investigating preferences from stakeholders.[12] A BWS study is a multiple–criteria approach allowing for a trade-off between multiple criteria in a consistent, systematic, and transparent manner.[13] The present study used the BWS profile case in which the level of each attribute is shown, and the profile has the structure of a single profile. Respondent was asked to consider the value of the whole profile and identify the best and the worst (the most and the least preferred or the most and the least important) choices within a series of different profiles.[13] This method has the ability to estimate and compare the relative importance of all attribute levels on a common scale.[14,15] This method is also less cognitively demanding on respondents and easy to complete.

The present study followed the International Society for Pharmacoeconomics and Outcomes Research (ISPOR)'s Good Research Practices for Conjoint Analysis Task Force Checklist.[16] Key steps include identifying attributes and levels, experimental design, determination of attribute importance and statistical analysis.

Identifying attributes and levels

The BWS method required identification of relevant attributes (representing topic areas) and levels (representing attribute variables, such as category or amount of attributes) for a meaningful study outcome.[17] A systematic literature review was used to identify attributes that are important for vaccine adoption.[5,6,8,9,18] Then a semi-structured interview was conducted with 11 experts, including policy makers, healthcare providers, healthcare professionals, vaccine manufacturers, logisticians, and healthcare managers. The semi-structured format allowed new ideas to be brought up during the interview. The attributes and levels proposed by the interviewees were synthesized into the following attributes: burden of disease, target age group, budget impact, fever from vaccine, severity of disease, effectiveness of vaccine and cost of vaccine. The attributes and levels included in the present study are shown in Table 1.

Experimental design

Based on seven attributes with three levels

Table 1 Attributes and levels included in this study

Attributes	Levels
Burden of disease: number of cases affected by the disease, or health problem that can be prevented by the vaccine	1. 10,000 new cases per 100,000 population per year 2. 20,000 new cases per 100,000 population per year 3. 30,000 new cases per 100,000 population per year
Target age group of the vaccine	1. < 5 years old 2. 5–15 years old 3. > 15 years old
Budget impact: financial consequences for adopting the new vaccine	1. 100 million baht per year 2. 500 million baht per year 3. 1,000 million baht per year
Fever from vaccine: fever defined by an oral temperature of 37.5°C occurring 12 hours after vaccination and lasting for 1 day	1. 10 out of 100 vaccinated people 2. 30 out of 100 vaccinated people 3. 50 out of 100 vaccinated people
Severity of disease: symptoms that affect the patient	1. Not severe: mild disease that can be successfully treated 2. Moderately severe: disease affecting normal life and requiring treatment, but not affecting long-term health 3. Most severe: disease causing death, permanent disability, or long-term effects that require continuity of treatment
Vaccine effectiveness: the percentage reduction of disease provided by vaccine	1. 60% 2. 70% 3. 80%
Cost of vaccine: the retail price per course of vaccination	1. 100 baht per course 2. 300 baht per course 3. 500 baht per course

each, there would be 2,187 (3^7) possible profiles. Main-effects orthogonal design was identified from SAS database of orthogonal arrays.[19] Orthogonal array design is a type of fractional factorial design that generates a subset of profiles from all possible profiles.[20] This design consisted of 18 profiles, the minimum number necessary to ensure no correlations between the attributes. This design also ensured that all attribute levels appear equally in a questionnaire. The prototype BWS instrument underwent piloting through in-depth interviews among 7 researchers and 8 healthcare professionals. This interview aimed to ensure understanding of choice context, to clarify the meaning of attributes and levels, and to check task complexity. The unclear questions and wording were revised and re-tested to check the informants' understanding of the question.

Determination of attribute importance

The questionnaire consisted of 18 profiles and demographic questions. Before completing the questionnaire, respondents were presented with a detailed description of attributes and levels, and detailed instruction. Figure 1 shows a sample profile. Each profile showed a specific level for seven attributes which represented characteristics of a new vaccine. The levels in each attribute varied across profiles. Respondents were presented with one profile at a time. They were asked to choose the most important and the least important choices in each profile.

There were three groups of respondents: policy makers, healthcare professionals, and healthcare administrators. There was no specific formula or consensus for minimum sample size calculation in the design.[21,22] The appropriate sample size depends on many factors, for example, question format, the availability of respondents, the complexity of choice task.[16] We applied a rule of thumb based on experience of researchers.[23] A minimum of twenty respondents per group was requried. By using a rule of thumb, we set a goal of 70 respondents. Respondents were purposively selected based on their leadership in national societies, advocacy organizations, academic institutions, and government organizations. Policy makers were defined as being involved with the ACIP, the committee on the National List of Essential Medicines, or the National Health Security Board. Healthcare professionals were defined by membership in a professional society of a specific field: for example, pediatrics, obstetrics and gynecology, infectious diseases, or preventive medicine. Healthcare practitioners and researchers were also included. Healthcare administrators were those having an administrative role at various levels of the healthcare system: for example, the regional National Health Security Office, the Provincial Health Office, or the Community Hospital. Respondents were excluded if they were unwilling or unable to complete the questionnaire.

The postal survey was conducted between October 2013 and January 2014. Telephone communications and electronic mails were used to ensure understanding of the study, to clarify the questions, and for follow-up. Respondents who

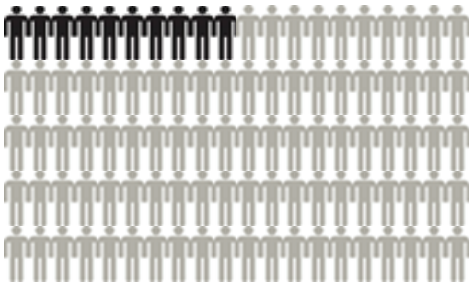
If this vaccine was adopted, please choose the most important and the least important aspects of this vaccine		
Most important	Vaccine	Least important
	Vaccine is used for a disease with a low disease burden of 10,000 new cases per 100,000 population per year 	
	Vaccine is used in children age less than 5 years old	
	The budget impact of this vaccine is 100 million baht per year	
	Vaccine causes fever in 10 out of 100 vaccinated people 	
	Vaccine is used in non-severe disease	
	Vaccine can prevent disease by 60%	
	Cost of vaccine is 100 baht per course	

Figure 1 An example of a best–worst scaling profile

did not respond within two weeks were contacted again. Follow-up reminders were made up to four times before a respondent was coded as "no response".

Statistical analysis

Data were analyzed by STATA® version 11.0 (STATA Corp, College Station, TX). Demographic data were analyzed by descriptive statistics and a Kruskal–Wallis test to check for differences among groups of respondents. For the BWS data, frequencies of attribute levels being ranked most important and least important were tabulated and a conditional logistic regression (clogit) model was estimated. A conditional logit model was used to determine coefficients for attribute levels and test for their significance. A clogit command with adjustment for robust standard errors was used to allow for intragroup correlation.[24] Effect coding was used with one level being omitted for each

attribute. The value of the omitted level was minus one times the sum of alternative level in the same attribute. In addition, the relative attribute importance was calculated by dividing the difference between the maximum and minimum coefficient of each attribute with the sum of all differences.

Ethical committee approval

The protocol of the present study was reviewed and approved by the Institutional Review Board, Mahidol University, Thailand (COA. No. MU-DT/PY-IRB 2013/011.2702). Respondents received information of the study protocol and its potential risks and benefits. They were not reimbursed and each was assured of anonymity and confidentiality. Informed consent was obtained from all individual respondents included in the study.

Results

Seventy of 128 questionnaires were completed, yielding a response rate of 55%. Eleven of 19 policy makers (58% response rate), 26 of 56 healthcare administrators (46% response rate), and 33 of 53 healthcare administrators (62% response rate) completed the questionnaires. The characteristics of respondents are shown in Table 2. Mean age was 47.4 years (SD 10.2, range 26–70). Respondents' mean experience working with vaccines was 11.6 years (SD 10.1, range 0.5–40). Healthcare professionals have most experience with vaccines (mean 16.6 years, SD 11.2). Of the respondents, 45.7% were involved in healthcare settings and 32.9% were affiliated with the MoPH. Most of the respondents worked at the regional (55.7%) and national (40%) level. The median time spent in completing the questionnaire was 30 minutes. The median time of policy makers and healthcare administrators is higher than healthcare professionals (40 vs. 30 minutes).

Table 3 shows the results of most-least count and the conditional logistic regression. For all groups, being a vaccine for a more severe disease was most often chosen (262) as the most important level for adopting a new vaccine. The second most important level was being a vaccine against a disease with a high disease burden of 30,000 cases per 100,000 population per year (152) followed by being a vaccine against a disease causing fever in 50 out of 100 vaccinated people (113). A vaccine costing 100 baht (US$3.00) per course (164) was most often chosen as the least important attribute level. This was followed by being a vaccine targeting people older than 15 years of age (138) and then being a vaccine targeting the age group between 5–15 years old (127).

The conditional logistic regression allows the estimation of 21 coefficients (see Table 3). These coefficients reflect the average weighting that respondents gave to various attribute levels. The higher coefficient indicates that individuals assign a higher importance to that attribute level. All groups listed being a vaccine for a most severe disease (2.0), being a vaccine with the lowest safety (0.9) – causing fever in 50 out of 100 vaccinated people – and being a vaccine against a disease with a high disease burden of 30,000

Table 2 Characteristics of respondents

Demographic data	Policy maker (n=11)	Healthcare professional (n=26)	Healthcare administrator (n=33)	All groups (n=70)	*p*-value**
Sex (%)					0.008
Male	10 (90.9)	14 (53.8)	12 (36.4)	36 (51.4)	
Female	1 (9.1)	12 (46.2)	21 (63.6)	34 (48.6)	
Age (years old)					0.028
Mean (SD)	53.7 (5.8)	48.3 (11.6)	44.6 (9.4)	47.4 (10.2)	
Range	43-61	30-70	26-59	26-70	
Vaccine experience (years)					0.003
Mean (SD)	9.8 (5.9)	16.6 (11.2)	8.4 (9.0)	11.6 (10.1)	
Range	2-20	1-40	1-37	0.5-40	
Vaccine involvement (%)					0.156
Healthcare setting	0	17 (65.4)	15 (45.5)	32 (45.7)	
Ministry of Public Health	10 (90.9)	4 (15.4)	9 (27.3)	23 (32.9)	
University/research institute	0	5 (19.2)	0	5 (19.2)	
NHSO*	1 (9.1)	0	9 (27.3)	10 (14.3)	
Level of involvement (%)					0.000
Regional	0	13 (50.0)	26 (78.8)	39 (55.7)	
National	10 (90.9)	11 (42.3)	7 (21.2)	28 (40.0)	
International	1 (9.1)	2 (7.7)	0	3 (4.3)	
Time spent in completing the questionnaire (minutes)					0.029
Median	40	30	40	30	

*The National Health Security Office (NHSO) acts as a public purchasing agency for the Universal Coverage Scheme which covers around 75% of the Thai population

**_p-values_ were tested by a Kruskal–Wallis test.

cases per 100,000 population per year (0.7) as the most important. Being a vaccine for a less severe disease (-1.5), being a vaccine against a disease causing fever in 10 out of 100 vaccinated people (- 0.8) and being a vaccine against a disease with a low disease burden of 10,000 cases per 100,000 population per year (- 0.7) were listed as the least important, respectively.

Table 4 shows relative attribute importance by groups of respondents. All groups showed the same trends of relative attribute importance. Severity of disease was considered as the most important attribute. The relative importance of other attributes, listed in order of decreasing im-

Table 3 Conditional logit results for all respondents (*n* = 70)

Levels	Most and Least Count*		Conditional logit	
	Most	Least	Coefficient	95% CI
Burden of disease (per 100,000 population per year)				
10,000 new cases	54	26	- 0.7	- 0.9, - 0.4
20,000 new cases	96	8	- 0.02	-0.1, 0.1
30,000 new cases	152	4	0.7	0.4, 0.9
Target age group				
< 5 years old	8	92	0.3	0.2, 0.5
5–15 years old	2	127	- 0.1	- 0.2, - 0.01
> 15 years old	4	138	- 0.2	- 0.4, - 0.04
Budget impact				
100 million baht per year	17	94	- 0.6	- 0.9, - 0.4
500 million baht per year	23	38	0.04	- 0.1, 0.2
1,000 million baht per year	84	45	0.6	0.3, 0.9
Fever from vaccine				
10%	22	85	- 0.8	- 1.0, - 0.6
30%	36	37	- 0.1	- 0.2, 0.04
50%	113	24	0.9	0.6, 1.1
Severity of disease				
Not severe	40	110	- 1.5	- 1.7, - 1.2
Moderately severe	42	21	- 0.5	- 0.7, -0.3
Most severe	262	3	2.0	1.7, 2.3
Vaccine effectiveness				
60%	82	34	- 0.2	- 0.5, 0.03
70%	57	4	- 0.1	- 0.3, - 0.01
80%	108	10	0.4	0.1, 0.6
Cost of vaccine				
100 baht per course	17	164	- 0.5	- 0.8, -0.3
300 baht per course	11	102	0.1	- 0.03, 0.3
500 baht per course	30	94	0.4	0.2, 0.7
Log pseudo likelihood				-5,148.7
Pseudo R^2				0.08

*Each level appeared 420 (6 × 70) times in the study (6 = number of times each level appeared in the questionnaire; 70 = total respondents). When respondents made a choice for the most and the least important factor, they chose only two choices in each profile. Most and Least Count shows the frequencies for attribute levels that were chosen as the most and the least important factors for adopting new vaccine

Table 4 Relative attribute importance by groups of respondents

Attribute	Policy maker (n = 11)		Healthcare professional (n = 26)		Healthcare administrator (n = 33)		All groups (n = 70)	
	Rank	Relative importance (%)	Rank	Relative importance (%)	Rank	Relative importance (%)	Rank	Relative importance (%)
Burden of disease	3	14.8	3	15.3	5	11.7	3	13.5
Target age group	7	2.3	5	8.1	6	6.2	7	5.7
Budget impact	4	12.0	4	10.3	2	15.1	4	12.8
Fever from vaccine	2	22.9	2	16.1	3	15.0	2	16.7
Severity of disease	1	35.0	1	35.9	1	32.5	1	35.9
Vaccine effectiveness	5	8.8	6	7.4	7	5.0	6	5.9
Cost of vaccine	6	4.2	7	7.0	4	14.5	5	9.6

portance, was fever from vaccine and burden of disease. Policy makers and healthcare professionals listed severity of disease (35.0% and 35.9%), fever from vaccine (22.9% and 17.0%) and burden of disease (14.8% and 15.3%) as the most important, respectively; whereas healthcare administrators listed severity of disease (32.5%), budget impact (15.1%) and fever from vaccine (15.0%) as the most important, respectively.

Discussion

To our knowledge, the present study represents the first BWS study that has been used in healthcare research in Thailand and also the first BWS study for vaccine. Criteria and evidence considered by the Thai ACIP for new vaccine introduction include public health priority, disease burden, economic considerations, vaccine safety and efficacy as well as programmatic issues like strength of the existing immunization program and vaccine availability.[11] The attributes included in the present study were the major concerns of experts from a qualitative interview. These attributes were consistent with the Thai ACIP concerns. The present study also provides information of attribute with high importance that was chosen by respondents.

All groups accorded high importance to being a vaccine for a more severe disease, being a vaccine causing fever in 50 out of 100 vaccinated people, being a vaccine against a disease with a high disease burden of 30,000 cases per 100,000 population per year and being a vaccine with a budget impact of 1,000 million baht per year (see Table 3). The findings accorded high importance to being a vaccine for severe disease, being a vaccine with high budget impact, high fever rate and high cost. This could imply that all groups may have the same policy stances, and thus reflect the underlying important factor of vaccine adoption for high protection against severe disease together with concerns about vaccines with high

budget impact and low safety. This may indicate that these aspects were of particular concern to the respondents while they were making their choices.

This result accords with other studies showing that people not only give high priority to a vaccine being used in severe disease with a high disease burden but also are concerned about vaccine safety.[4,6,8,9] Mantel and Wang (2012) suggested that new vaccines should be concerned about their effectiveness, safety, and programmatic suitability.[4] Erickson (2005) showed that the burden of disease, efficacy, and safety were the main criteria in the initial evaluation of new vaccine and must be evaluated consequently.[6] Houweling, *et al* (2010) described that priority should be given to the vaccine that had a greater disease burden or serves the most urgent public health need, measured as the greatest health benefits at reasonable individual and societal costs.[8] Piso, *et al* (2011) suggested that burden of disease, vaccine, side effects, and ethical considerations were considered to be most important for new vaccine introduction.[9] Hall, *et al* (2002) used a stated preference discrete choice modelling to evaluate the introduction of varicella vaccination. They found that perception of disease severity was the important factor in acceptance of immunization.[25] Being a vaccine with high budget impact and causing low safety could be important while being not preferred or unwanted. Under the value of information approach, the attribute would receive greater weight when it was important to know about, for example, fever from vaccine would be more important the more frequent they are.

We cannot directly compare attributes in the regression model with other studies. However, they may be compared in terms of components of the attributes. Other structured frameworks for vaccine introduction included disease and vaccine characteristics, economic considerations, feasibility of the program, and qualitative concerns: for example, equity, politics, and social and legal issues.[5-9] These frameworks are useful in the decision-making process, but only subjectively for decision-making process.

The survey respondents considered high importance to severity of disease, fever from vaccine, and burden of disease, respectively (Table 4). This could imply that new vaccine with high efficacy and targets on more severe disease has a higher opportunity to be chosen by respondents. Cost of vaccine, cost effectiveness, and target age group were considered as low importance attributes. Cost of vaccine may be the subordinate attribute because the EPI vaccines were subsidized by the government; whereas vaccine effectiveness and protection for young children are the main criteria in the initial evaluation of new vaccine for the ACIP. Budget impact was the fourth rank by policy makers and healthcare professionals; whereas healthcare administrators considered it as the second rank. Each respondent had different roles and responsibilities; therefore, his or her concerns were different. However the attribute importance of policy makers reflected the vaccine policy of the public health system in a societal

perspective. The attribute importance of healthcare professionals reflected clinical practice and self-interest; whereas the attribute importance of healthcare administrators reflected a provider perspective for the administration and management of vaccines at different healthcare settings.[26] However, these results revealed viewpoints of healthcare workers, and thus reflect vaccine policy, clinical practice and management of vaccine in different settings. Then the results will be useful for policy development in the future.

Our study had limitations. First, the attributes and levels included in the present study were criteria that emerged among respondents in the qualitative study. The attributes may not reflect all possible criteria that were important to other stakeholders. Other qualitative concerns, for example, policy, politics, equity, social concern, were not incorporated into the design. Second, respondents were unfamiliar with the rationale of BWS study. Some found that the best-worst scaling task was difficult and time-consuming. It is possible that the answer may not reflect what they would do in a real situation. Third, the present study used a convenience sample of respondents who were purposively selected and willing to participate. The results may be skewed by the characteristics of respondents. However, the findings can reveal the importance of attributes from public healthcare workers and may lead to greater acceptance for new vaccine adoption. Larger sample sizes would be required to generalize the result findings. Moreover, generalization of this approach for other countries is warranted. The attribute and relative attribute importance for new vaccine adoption may vary across countries.[26]

Conclusions

The present study has demonstrated the application of multiple-criteria approach in new vaccine adoption. This can contribute to transparency and accountability in the decision-making process across various diseases. New vaccines with high protection targeting more severe disease in young children have a greater chance of being selected by respondents in the present study. The findings reveal the importance of attributes from public healthcare workers and will be useful for policy development of new vaccine. The methodology is generalizable but its application to another country would require the attributes as relevant to that country.

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