

# THE PRIVATE DEMAND FOR HIB VACCINATION IN A PROBABLE LOW HIB DISEASE INCIDENCE COUNTRY: THAILAND 2006

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**Abstract.** This study aimed to determine the private demand for Hib vaccination in Thailand. A willingness-to-pay (WTP) survey was performed by face-to-face interviews of 662 pregnant women attending antenatal clinics in 4 regions of the country. Hypothetical incidence scenarios of Hib disease and hypothetical vaccine market scenarios were presented to the respondents. Regarding the scenarios, the respondents responded to discrete choice questions asking for their WTP for Hib vaccination for their children. Probit regression models were used to predict median WTP for Hib vaccine per child. A median WTP for Hib vaccine per child per vaccination course was estimated at THB 3,800, or USD 106. Although Hib disease incidence in Thailand is probably low, high monetary value of WTP for Hib vaccine probably reflects concern among Thai people about severity of the disease and good perceptions about safety and efficacy of the vaccine.

**Key words:** Hib vaccination, private demand, willingness-to-pay, Thailand

## INTRODUCTION

*Haemophilus influenzae* type b (Hib) is recognized as an important cause of invasive disease in pediatric populations, including meningitis and pneumonia. Beyond the neonatal period, Hib is the most common (42.3%) organism to cause bacterial meningitis in Thai children (Yuengsrigul and

Lolekha 1991; Chotpitayasunondh, 1994; Brinsmead *et al*, 2004). Meningitis due to Hib is characterized by grave morbidity and mortality, with survivors commonly suffering from long term sequelae (Sell, 1987). About 94% of Hib meningitis cases in Thai children are between 2 months and 2 years old (Chotpitayasunondh, 1994). Conjugation of antigen to carrier proteins, such as tetanus or diphtheria toxoids, outer membrane proteins of group b *Neisseria meningitidis*, and diphtheria toxin mutant CRM197, has resulted in a new generation of "T cell-dependent" vaccines that are safe, immunogenic, and efficacious in infants (Eskola *et al*, 1990; Black *et al*, 1991; Santosham *et al*, 1991).

A recent prospective population-

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based study in 2000 estimated the annual incidence rate of Hib meningitis in Thailand is low at 3.8 per 100,000 children under 5 years of age (95% CI 1.1-9.7). (Rerk-Ngarm *et al*, 2004). This estimate is compatible with the results from several retrospective studies in the country and from other countries in Asia. (Yang *et al*, 1998; Lolekha *et al*, 2000; Kim *et al*, 2004; Shao *et al*, 2004; Anh *et al*, 2006). Not only the low disease incidence a conjugate Hib vaccine is more costly than other vaccines in the EPI program. A full course of Hib vaccine is about USD9.3 compared to USD0.5 for measles vaccine. A cost benefit analysis (CBA) of Hib vaccine would be useful in providing information for policy consideration. In the context of probable low incidence of Hib disease, if the CBA does not include all benefits that occur due to Hib vaccination, it is likely the results of the evaluation will underestimate its benefit. The benefits of immunization commonly ignored in the analyses are intangible parts, probably because the values of the intangible benefit do not exist in the real market. A common method used to determine the intangible benefit is the contingent valuation (CV) (Boardman *et al*, 1996; Drummond *et al*, 1997; Fuguitt, 1999; Brent, 2003; Denil *et al*, 2005). The benefits determined by this method are the valuation of preferences expressed as maximum willingness to pay (WTP) for goods presented in hypothetical scenarios. The benefits expressed by WTP usually cover both health and non-health components (Drummond *et al*, 1997; Denil *et al*, 2005). The examples of intangible health benefits are avoidance of health risks and suffering from the disease (Denil *et al*, 2005). In this study, we measured the intangible health benefits by interviewing pregnant women about their WTP for Hib vaccine for their newborn children.

## MATERIALS AND METHODS

A cross-sectional survey was conducted to interview pregnant women to determine the private demand for Hib vaccine for their newborn children. Postpartum women were also interviewed to compare their demand with that of pregnant women. Reliability of the demand was determined by participant re-interviewing. Probit regression models were applied to estimate the demand of Hib vaccination per birth cohorts.

### Study population and sampling techniques

The study population was pregnant women who attended ANC clinics at selected hospitals in 4 geographical regions of the country: the North, Northeast, Central and South. A multi-stage sampling technique was used to select provinces, hospitals, and pregnant women. A province from each region was purposively selected to represent the region according to willingness to participate in the study by the hospital staff. Finally, we selected Chiang Mai for the North, Khon Khaen for the Northeast, Nonthaburi for the Central, and Nakhon Si Thammarat for the South; 4 provincial hospitals in these provinces were selected. To enroll enough numbers of respondents two additional hospitals were also included: the Mother and Child Hospital and the Christian Hospital in Chiang Mai. These hospitals were added after data collection began. Pregnant women who attended ANC clinics at the study hospitals were screened and asked to participate in the study. Those who agreed to participate gave verbal consent. The inclusion criterion was having at least one child and the exclusion criterion was having any pregnancy complication diagnosed by a physician, such as diabetes mellitus (DM) and HIV/AIDS. To decrease

waiting time for the interview, an interval sampling technique with appropriate or flexible interval width to randomly select the respondents was applied. The width of the interval was adjusted depending on the number of the pregnant women at each hospital during the data collecting session. This sampling technique was applied to avoid selection bias of enrolling or excluding specific groups of eligible pregnant women.

### **Ethical approval**

This study was reviewed and approved by two Human Research Ethics Committees, including the committee of the Department of Disease Control, Ministry of Public Health, Thailand, and the committee of the Bloomberg School of Public Health, Johns Hopkins University, USA.

### **Questionnaire and educational materials**

A structured questionnaire for face-to-face interviews was developed, which contained two main sections: socio-economical status of the respondent and her family and WTP for Hib vaccine. Questions about the WTP included: 1) natural history of Hib disease and its impact; 2) hypothetical Hib incidence scenarios; 3) questions evaluating participant understanding on the incidence; 4) information regarding the vaccine administration and adverse reactions; 5) a hypothetical market scenario of Hib vaccine; and 6) the WTP expression.

The hypothetical incidence was the possible number of cases of Hib meningitis and Hib pneumonia per 100,000 children under age five years over a five-year period. The efficacy of Hib vaccine during the vaccine era was 95% reduction in number of cases compared to the pre-vaccine era (WHO, 2001; Rerks-Ngarm *et al*,

2004). Four possible hypothetical incidence scenarios for Hib disease were applied (Fig 1). To explain the hypothetical incidence of the disease and the vaccine efficacy to participants, DOT diagrams were constructed and used along with other sources of materials. The diagrams contained dots on plain paper; each dot represented a child of under five years of age. The diagrams were divided into three types: the first diagram contained 100,000 dots representing a birth cohort of 100,000; the second diagram contained dots representing number of the cases in the pre-vaccine era; the third diagram representing number of cases in the vaccine era. The first diagram was shown to the respondent to show "100,000 children" then the second diagram was put over the first diagram to show number of "Hib disease cases in pre-vaccine era" and the third diagram was also put over the first diagram, next to the second diagram, to show number of "Hib disease cases in vaccine era". For each participant interviewed, the second and the third diagram were selected from the possible hypothetical incidence scenarios.

To make sure the respondents understood the scenarios, they were asked to identify the diagram representing each specific group. If at least one group was identified incorrectly, the diagrams were re-explained to the participants and their understanding were re-checked.

The WTP questions contained brief marketing scenarios regarding the source of vaccine, cost and WTP for a randomly selected vaccine list price (Boardman *et al*, 1996; Smith, 2000). The scenarios included information needed for the respondents to decide about their WTP for the vaccine. The information included the availability of the vaccine at both private

and governmental health facilities, including clinics, health centers and hospitals. The respondent had to pay for the vaccine from a portion of their household income (out-of-pocket expense). The cost of Hib vaccine would not be covered by the government or reimbursed by any health benefit programs. To prevent "yeah" saying, the respondents were told in the scenario "not all parents would buy the vaccine (Yeung, 2006)". "Parents who did not buy the vaccine may have several reasons for their decision".

The respondents were told before deciding about their WTP that they should consider several issues, including household income, their economic status, the probability of their children becoming infected with Hib, disease severity, and efficacy and safety of Hib vaccine. The respondents were then asked whether they were interested in having their children vaccinated with Hib vaccine or not. If they were interested they were randomly given a specific price for 3 doses of the vaccine: THB 500, 1,000, 3,000, 5,000, 10,000, and 15,000. The answer options were: 1) accept the price, 2) accept the price, if they had the money, 3) did not accept the price, and 4) were not sure or did not know. If they did not accept the selected price, they were asked for their willingness to accept a free vaccine (Fig 1).

### **Interviews and interviewers**

Sixteen trained health workers carried out the interviews. Participants were interviewed face-to-face in the ANC clinics, from June through September, 2006. The overall objective of the study and data collection process was first described to the participants. Then, they were asked for their willingness to participate in the interview. If they agreed, the interviewers explained the scenarios and asked the

questions. The interviewers were not allowed to give additional information other than that contained in the questionnaire. If the respondents requested for additional information, it would be given after finishing the interview.

After a period of one to three months, reliability of the WTP was tested by re-interviewing 46 pregnant women who came back to the ANC clinics. Color-coding was used to identify previously interviewed pregnant women. The same format was used for the interviews for selected parts: 1) natural history of the disease, 2) the hypothetical incidence scenarios and understanding testing, and 3) the WTP section. The incidence scenarios and vaccine list prices were the same as those used in the first interviews. The interviewers for the re-interviews were blinded on the answers of the previous interviews of each participant.

One hundred one post-partum women in postpartum wards (who recently gave birth) were also interviewed. The methods used to select participants and interview methods were the same as for the pregnant women, but only the Central and the South were purposively selected as study sites. The Post-partum women already interviewed earlier in the ANC clinic were excluded.

### **Data management and analysis**

Epi info version 6 was used for data entry and STATA version 8 and Microsoft Excel were used for data analysis. Descriptive statistics were used to explore the data and chi-square statistics were used for bivariate analyses. For cells with expected number less than 5, the Fisher's exact test were applied. The appropriate functional form that best fit the data was determined by applying the Probit Regression Model

(Fuguitt and Wilcox 1999). For ease of understanding, probit coefficients were transformed into marginal changes ( $dp/dx$ ) with the probability of purchasing the vaccine for a one-unit change in the explanatory variable, and evaluated as the mean of all explanatory variables. For dichotomous explanatory variables, comparison was the evaluation of the dependent variable when the explanatory variable set was equal to one, compared with the value when set was equal to zero. Statistically significant independent variables ( $p < 0.05$ ) were kept in the model. Once the coefficients were determined, the parsimonious model were used to predict the probability of purchasing the vaccine for the list price, taking into account the mean national household income and keeping other variables in the model at their means. The median WTP was estimated by plotting the probability of purchasing the vaccine on the Y-axis and the vaccine list price on the X-axis, and drawing the trend. Then the median WTP was identified on X-axis which corresponded to a purchasing probability of 50%. The median was used instead of the mean because the WTP was not normal distributed, but skewed to the right. To estimate the total WTP for Hib vaccination per the birth cohort, the median WTP was multiplied by the size of the mid-year birth cohort of 740,109 (Fuguitt and Wileox, 1999). Thirty-six Thai Baht (THB) per US dollar was used as the exchange rate.

The theoretical validity of the WTP estimate was explored by testing the relationship between the WTP and the variables, including socioeconomic, demographic, hypothetical incidence scenarios, and vaccine list price, using alternative statistical techniques, including cross-tabulations and probit regression analyses.

Estimate reliability was determined by pseudo  $R^2$  of the valuation function (Fuguitt and Wilcox, 1999).

The kappa statistic was used to determine the agreement between the acceptance of the price during the first and the second interview.

To compare WTP between pregnant and post-partum women, only data from the Central and the South were used for analysis. The model was constructed by applying the significant variables determined by the previous model mentioned above to predict the median WTP for the vaccine of the two groups. Then, the median WTP of the two groups were compared.

## RESULTS

### Respondent characteristics

Six hundred sixty-two pregnant women were interviewed. The distribution of the numbers of respondents for each selected variable, including province, hypothetical incidence scenarios, and vaccine list prices, was nearly even (Fig 1). Of the 662 pregnant women interviewed, 97% were completely interviewed for WTP elicitation. Of the rest, 82% were interested in a free vaccine (Fig 1).

The average age of respondents was 30 years. Sixty percent were living in household size greater than three persons, which was similar to the average household size of the country (3.6 persons). Most (78%) had only one child. Forty-two percent had completed high school, and 12% had completed a university degree. Most respondents (73%) were employed, while 8% worked in agriculture, compared to 43% of the general Thai population who are farmers. The household income distribution was skewed to the right, with an

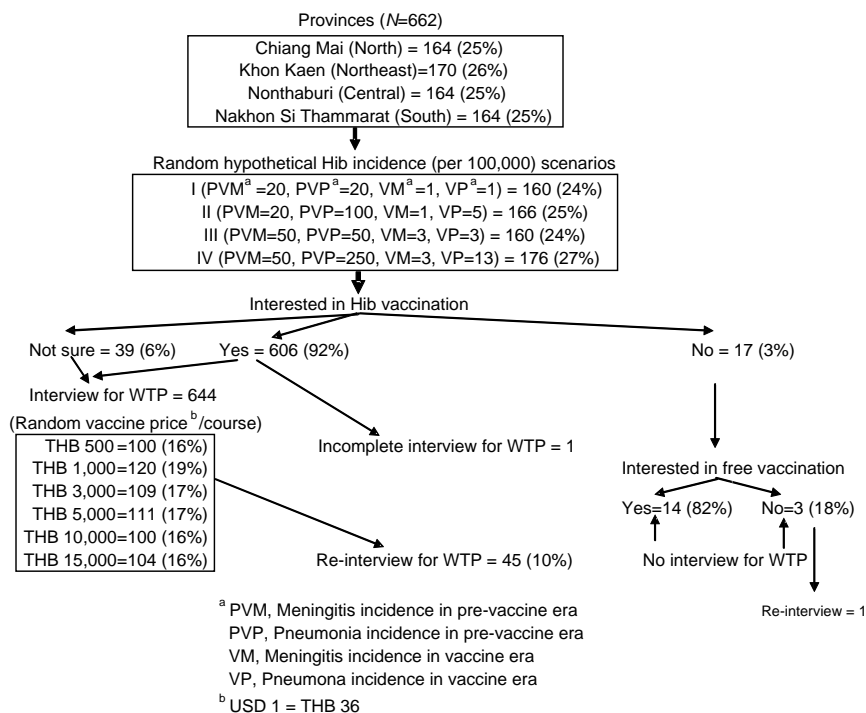


Fig 1—Flow chart of Hib vaccination willingness-to-pay survey.

average income of THB 17,600 per month and a median of THB 12,500. Regarding the household income and educational level, the respondents in this study were somewhat wealthier and more educated than the general Thai population, where the average household income is THB 11,834 per month and 81% have primary education or lower. Thirty-seven percent of respondents had at least one child previously admitted to the hospital. Most (92%) had heard about pneumonia, but only 64% had ever heard about meningitis. Thirty-four percent had previously seen pneumonia patients and 9% had previously seen meningitis patients. Nine percent had previously heard about Hib vaccine and fewer than 2% had ever had their children vaccinated against Hib (Table 1). Ninety-six percent of respondents were able to answer all four questions testing

their understanding of the hypothetical incidence scenarios previously presented to them. The cumulative percentage of respondents that answered all questions correctly for the first or the second time was 99%.

#### Factors associated with Hib vaccine demand (Bi-variate analyses)

There were statistically significant relationships ( $p < 0.05$ ) between Hib vaccine price acceptance and the following demographic variables: province, woman's occupation and household income. Demographical variables that had no relationships ( $p > 0.05$ ) with price acceptance included woman's age, household size, number of living children, woman's education and husband's occupation. However,  $p$ -values for relationships with the woman's age, woman's education and

Table 1  
 Respondent demographics, knowledge and experiences regarding meningitis,  
 pneumonia, and Hib vaccines.

Parameter	Number	Percentage
Age (years), <i>n</i> =662, mean=30, median=29, range= 17-49		
<25	112	16.9
25-29	227	34.3
30-34	191	28.8
>34	132	19.9
Size of household, <i>n</i> =660, mean=4.38, median=4, range=2-23		
2	73	11.1
3	193	29.2
4	104	15.8
5	123	18.6
6	98	14.8
7	43	6.5
>7	26	3.9
Number of children, <i>n</i> =662, mean=1.27, median=1, range =1-5		
1	519	78.4
2	114	17.2
3	23	3.5
4	5	0.7
5	1	0.1
Highest level of education, <i>n</i> =660		
No school	12	1.8
Elementary school (grades 1-6)	200	30.3
Secondary school (grades 7-9)	170	25.8
Secondary school (grades 10-12)	105	15.9
Trade/Technical college (grades 10-12)	54	8.2
Trade/Technical college (grades 13-14)	40	6.1
University degree	71	10.8
Post-graduate	8	1.2
Occupation, <i>n</i> =661		
House worker	178	26.9
Agricultural worker	51	7.7
Owner of a business without workers	124	18.8
Owner of a business with worker(s)	40	6.0
Government employee	38	5.7
Enterprise employee	13	2.0
Private employee	188	28.4
Other	29	4.4
Monthly household income (THB), <i>n</i> = 655, mean=17,622, median=12,500 range=0-300,000		
<6,000	64	9.8
6,000-9,999	144	22.0
10,000-14,999	177	27.0
15,000-19,999	84	12.8
20,000-29,999	94	14.3
>29,999	92	14.0
Children admitted to a hospital, <i>n</i> =643	238	37.0
Heard about meningitis, <i>n</i> =660	422	63.9
Seen meningitis cases, <i>n</i> =654	24	3.7
Ever heard pneumonia, <i>n</i> =662	610	92.1
Ever seen pneumonia cases, <i>n</i> =661	223	33.7
Ever heard Hib vaccine, <i>n</i> =662	60	9.1
Children ever received Hib vaccine, <i>n</i> =662	11	1.7

USD 1 ≈ THB 36

Table 2  
Percentages of pregnant women purchasing Hib vaccine, classified by suspected influential factors.

Variable	N	% of purchasing	p-value
Woman age (years)			
<25	110	63.64	0.078
25-29	219	52.51	
30-34	187	54.55	
≥35	128	64.06	
Province			
Chiang Mai	158	60.13	0.000 <sup>a</sup>
Khon Kaen	166	42.77	
Nonthaburi	159	68.55	
Nakhon Si Thammarat	161	58.39	
Household size			
<4	258	58.53	0.528
4	101	61.39	
5	121	52.07	
>5	162	56.79	
Number of children			
1	505	56.04	0.218
>1	139	61.87	
Child admitted			
Ever	235	61.28	0.120
Never	395	54.94	
Heard about meningitis			
Ever	413	60.29	0.053
Never	229	52.4	
Seen meningitis cases			
Ever	23	78.26	0.040 <sup>a</sup>
Never	619	56.7	
Heard about pneumonia			
Ever	595	56.97	0.563
Never	49	61.22	
Vaccine list price (THB)			
500	100	98	0.000 <sup>a</sup>
1,000	120	82.5	
3,000	109	66.97	
5,000	111	44.14	
10,000	100	28	
15,000	104	21.15	
Woman education			
Primary school or lower	204	51.47	0.063
Lower secondary	167	55.69	
Upper secondary to vocational	157	60.51	
University	115	66.09	



Table 2 (continued).

Variable	N	% of purchasing	p-value
Woman occupation			
Housekeeping or agricultural worker	224	51.8	0.047 <sup>a</sup>
Business	160	64.4	
Employee	234	58.1	
Husband's occupation			
Housekeeping or agricultural worker	51	56.9	0.052
Business	178	66.3	
Employee	347	55.3	
Household income (THB)			
<10,000	199	44.7	0.000 <sup>a</sup>
10,000-19,999	257	56.0	
20,000-29,999	92	73.9	
30,000+	91	71.4	
Seen pneumonia cases			
Ever	218	60.1	0.305
Never	426	55.9	
Heard about Hib vaccine			
Ever	59	72.9	0.011 <sup>a</sup>
Never	585	55.7	
Child received Hib vaccine			
Ever	11	72.7	0.297
Never	633	57.0	
Hypothetical incidence			
1	154	55.2	0.768
2	163	60.7	
3	157	56.7	
4	170	56.5	

<sup>a</sup>Statistically significant ( $p < 0.05$ )

husband's occupation were close to significant level, ranging from 0.052 to 0.078. When looking at provinces compared to three other provinces, Khon Khaen had the lowest proportion of the acceptance. Regarding the women's educational level, the highest proportion of the acceptance was among women with "university level" education (66%) and lowest (51%) among women with "primary school or lower" education. Regarding women's occupation, those who reported they were in a "business" had the highest proportion

of the acceptance (64%); those who had the lowest acceptance (52%) were housekeeping or agricultural workers. This was similar for the husband's occupation. Regardless of vaccine price, the proportion of respondents accepting vaccine price tended to increase with increasing income. Forty-five percent of those in the lowest household income group of lower than THB 10,000 were willing-to-pay for the vaccine; it increased to 71% in those with an income THB 30,000 (Table 2).

The acceptance of vaccine price was

Table 3  
Probit regression of Hib vaccine demands among pregnant women.

Variables	Model 1		Model 2	
	dp/dx	<i>p</i> -value	dp/dx	<i>p</i> -value
Vaccine cost per course (THB)				
1,000	-0.549	0.003 <sup>a</sup>	-0.483	0.000 <sup>a</sup>
3,000	-0.714	0.000 <sup>a</sup>	-0.642	0.000 <sup>a</sup>
5,000	-0.824	0.000 <sup>a</sup>	-0.771	0.000 <sup>a</sup>
10,000	-0.850	0.000 <sup>a</sup>	-0.778	0.000 <sup>a</sup>
15,000	-0.860	0.000 <sup>a</sup>	-0.821	0.000 <sup>a</sup>
Province				
Khon Kaen	-0.251	0.001 <sup>a</sup>	-0.248	0.000 <sup>a</sup>
Nonthaburi	0.069	0.334	0.054	0.417
Nakhon Si Thammarat	0.040	0.570	0.051	0.434
Woman's age				
25-29	-0.177	0.022 <sup>a</sup>	-0.175	0.016 <sup>a</sup>
30-34	-0.210	0.016 <sup>a</sup>	-0.221	0.005 <sup>a</sup>
>34	-0.151	0.096	-0.152	0.065
Woman's education				
Lower secondary	0.072	0.288		
Upper secondary to vocational	0.004	0.957		
University	0.065	0.431		
Woman's occupation				
Business	-0.007	0.917		
Employee	0.012	0.842		
Husband's occupation				
Business	-0.038	0.715		
Employee	-0.108	0.235		
Log household income (THB 1,000)	0.226	0.000 <sup>a</sup>	0.272	0.000 <sup>a</sup>
Heard about meningitis				
Ever	0.077	0.170		
Seen meningitis cases				
Ever	0.134	0.256		
Heard about the Hib vaccine				
Ever	0.077	0.363		
Log likelihood	-224.77717		-267.89505	
Sample size	559		637	
LR chi <sup>2</sup>	307.03		334.23	
<i>p</i> -value	0.000		0.000	
Pseudo R <sup>2</sup>	0.4058		0.384	
Observed <i>p</i>	0.590		0.571	
Predicted <i>p</i>	0.696		0.648	

\* Statistically significant ( $p < 0.05$ )

Table 4  
Vaccine price acceptance between the first and the second interviews.

First interview Vaccine price acceptance	Second interview Vaccine price acceptance		Total
	Yes	No	
Yes	14	1	15
No	4	25	29
Total	18	26	44

Overall agreement 88.6%; Positive agreement 84.8%; Negative agreement 90.9%; Expected agreement 52.9%; Kappa 0.7588; Standard error 0.1492; Z 5.09; Prob>Z 0.000

also significantly associated ( $p < 0.05$ ) with experience with or knowledge about meningitis or pneumonia. Seventy-eight percent of respondents who had seen meningitis cases before were willing-to-pay for the vaccine, while fifty-seven percent of those who had never seen meningitis were. This was similar to having heard about Hib vaccine or having a child admitted to the hospital. However, having heard about meningitis or pneumonia, having seen pneumonia and having a child receiving Hib vaccination were not significantly associated with the acceptance ( $p > 0.05$ ). However,  $p$ -value of the relationship of having heard about meningitis was close to 0.05 (Table 2).

Vaccine list price also had significant, negative relationship with the vaccine acceptance ( $p = 0.000$  for chi-square for linear trend). Ninety-eight percent of respondents were willing-to-pay THB 500 per course; the acceptance decreased to 21% for THB 15,000 per course. The hypothetical incidence scenarios were not associated with the acceptance. The acceptance of each scenario ranged from 24% to 27% (Table 2).

#### Predicted Hib vaccine demand and reliability

After controlling for other variables,

province household income, and vaccine list price were still significantly associated with WTP, while woman's occupation, having seen meningitis case and having heard about Hib vaccine were not. Woman's age became significantly associated with WTP. Using the parsimonious model, WTP decreased when vaccine price increased. When keeping other variables constant and comparing a price of THB 500, to a price of THB 1,000, WTP decreased 48% and for a price of THB 15,000, WTP decreased 86%. WTP increased 27% for every THB 1,313 increase in household monthly income. WTP in Khon Khaen Province was 24.8% lower than that in Chiang Mai. WTP by women younger than 25 years old was 17% and 22% higher than women 25-29 and 30-34 years old, respectively. Thirty-eight percent of price acceptance of respondents can be explained by variables included in the model (Pseudo  $R^2 = 0.384$ ). We used this model to predict demand for Hib vaccine at the country level. At the country level, Fig 2 shows demand curves for three doses of Hib vaccine in population with different household incomes. By looking at these curves, the median demands (percentage of purchasing = 50%) of the population who had monthly household income of THB 5,000 was THB 2,300; for THB 11,834

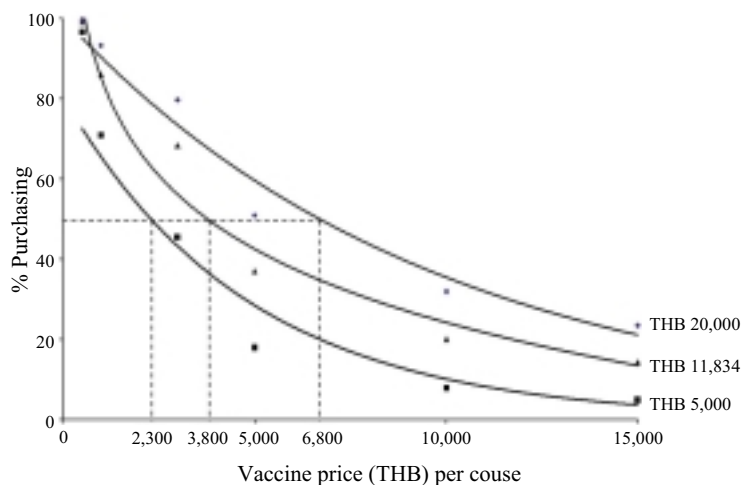


Fig 2—Predicted Hib vaccine demand curves of pregnant women at the country level, classified by monthly household income.

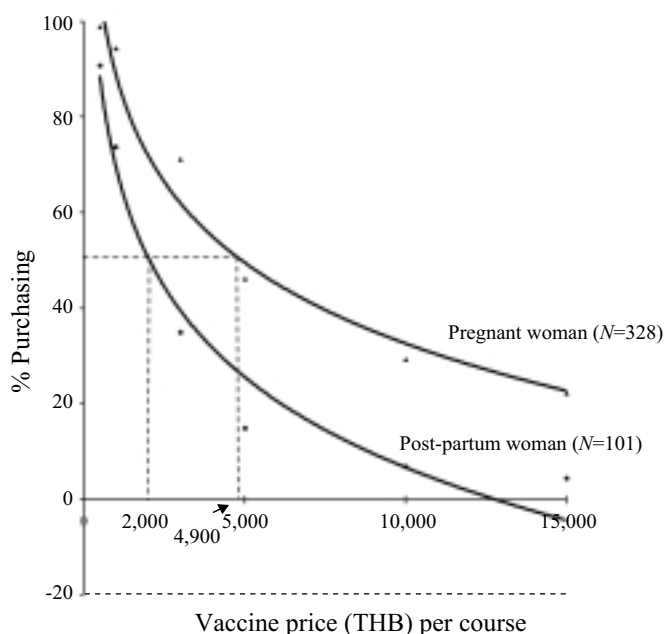


Fig 3—Predicted Hib vaccine demand curves, compared between pregnant and post-partum women.

(the national average household income), the demand increased to THB 3,800; and for THB 20,000 the demand increased to THB 6,800. Then, by the method mentioned earlier and by the average national household income (THB 11,834), the total demand for Hib vaccine of the country was estimated at THB 2,812 million (USD 78 million) per birth cohort.

Fig 3 shows a comparison between the predicted demands of pregnant and post-partum women. For every point increase in list price, the demands of pregnant women were all higher than that of post-partum women and the difference in median demands between the two curves was approximately 59%; the median demand of pregnant women was about THB 2,900 higher than that of post-partum women. The median demand of pregnant women was THB 4,900 and of post-partum women was THB 2,000 per course per child (Fig 3).

Among 46 pregnant women who were re-interviewed, 44 were interested in Hib vaccination at both interviews, one was not interested at either interview and one became interested at the second interview. Table 4 shows agreement between the vaccine price at

the first and the second interviews in the 44 pregnant women who were interested in Hib vaccination at both interviews. The overall agreement was high (89%) with positive and negative agreement of 85% and 91%, respectively. The agreement expected by chance was 53%. Therefore, it was significant agreement (Kappa=75.88%,  $p$ -value =0.000).

## DISCUSSION

Fifty percent of women would be willing and able to pay for Hib vaccine costing THB 3,800 per course per child. However, WTP was 59% higher among pregnant women than post-partum women. The monetary value expressed by both pregnant women and post-partum women for WTP for their children to be vaccinated with Hib vaccine was high compared to their income. For pregnant women of the national average household income, median WTP for Hib vaccine per course per child was about 2.7% of their average annual household income, and among post-partum women was 1.1% (National Statistical Office, 2005). The estimated total demand of Hib vaccination of pregnant women was approximately 8.5 times as much as the cost of the vaccination program and 19 times as much as the cost of Hib disease burden. Another study looked at WTP for an AIDS vaccine in Thailand. Even though the incidence and severity of HIV/AIDS is higher than Hib disease, WTP for Hib vaccination per child (THB 3,800) was higher than for AIDS vaccination, since 50% of Thai adults aged 18-60 years would purchase AIDS vaccine, with 95% vaccine efficacy, at an approximate cost of THB 900 (Suraratdecha *et al*, 2005).

Even though Hib disease incidence in Thailand is probably low, the high mon-

etary value of WTP expression for Hib vaccine probably reflects the significant concern of Thais about severity of the disease and good perceptions about safety and efficacy of the vaccine. After the respondents had been educated by the interviewers in this study, 99% thought that Hib meningitis was severe and 93% for Hib pneumonia. A very high proportion (93-96%) of respondents thought that Hib vaccine had moderate to high efficacy and safety. And, less than half (43-44%) thought that their newborns had moderate to high risk of developing Hib disease.

It is difficult for respondents to include or exclude specific benefits from their WTP elicitation (Drummond *et al*, 1997). Therefore, the vaccine market scenarios presented to the respondents did not remind or ask them to include or exclude any specific type of benefit in their WTP elicitation. We believe WTP for the vaccine expressed by the women in this study reflects more intangible than tangible benefit. When asking about their reasons of their WTP or non-WTP for the vaccine, almost none of them included non-health effects or cost of disease treatment. Most answered that "I want my child to be as healthy as possible" and "I would like to prevent him/her from contracting the disease". When asking further questions, most answered that "I cannot think of another reason right now". These may be due to several reasons, such as: 1) the interview did not mention non-health effects of the disease in any part of interview process, 2) we did not remind or ask them to include any specific type of benefit in their WTP and 3) the respondents valued their children relatively very high comparing to tangible benefit.

WTP in this study is theoretically reliable. In this study, we do not worry about

whether the respondents could understand the abstract nature of the survey idea of "the maximum amount you are willing-to-pay", because we simply asked respondents to buy the immunization products at an offered price. We did not use, for example, open-ended, payment scales that are more likely to result in this problem. The discrete choice questions used for asking about the respondent's WTP prevents starting bias and in the hypothetical Hib vaccine market scenario we also prevented "yeah" saying as mentioned earlier. The reliability and validity are probably reflected by the following: 1) there is substantial agreement between the two interviews in their WTP (Table 4), 2) the pseudo  $R^2$  of the probit model shows the WTP in this study can be explained by the variables included in the model for 38%, and 3) the WTP for the vaccine in this study was in line with the price and income effect of the demand, where the specific price had a positive relationship with household income and a negative relationship with the vaccine price (Table 4).

Based on socio-economical characteristics, including education level, occupation, and income, the study respondents are probably not good representatives of Thai population. The respondents of this study more likely represents population with higher education and greater wealth and living in urban or sub-urban areas. Only 8% of the participants were in agricultural work compared to 43% of Thai population in general (2005) (Table 1). However, of these variables only income had significant effect on the WTP, therefore we adjusted the estimated demand by taking into account household income representing the country on multiple regression analysis. The adjustment would make the estimated WTP more represent the WTP of Thai population or pregnancy in general.

However, we could not adjust the demand for other factors not included in the model, which could explain about 60% of the total demand. The WTP was dependant on the character or status of the respondents, for example, pregnant versus post-partum women. Pregnant women were 59% more WTP for the vaccine compared to post-partum women (Fig 3). Some pregnant women explained the reason for having their children vaccinated with Hib vaccine was dependant on health status of their child. Some said they followed the suggestions of physicians and health workers during the antenatal period and believed their children would be healthy. When they gave birth, most found their newborns were healthy, thus the demand for the Hib vaccine decreased compared to that during the antenatal period. Therefore, to estimate private demand for the vaccine by applying the WTP survey, appropriate selection of the study population is crucial. However, in this study, we did not interview guardians or parents who brought their children for vaccination to the well baby clinics, mainly because of the long duration of the interviews might be interfered by their children. Group of parents or guardians, who are responsible for the cost of vaccination would be more relevant groups to interview to determine the private demand for Hib vaccine.

Khon Khaen Province, in the northeast, is the only province that had a significantly lower WTP compared to Chiang Mai Province in the north. The reason is not clearly known. We checked for an interviewer effect, but we did not find any significant differences. Women in the youngest group tended to be WTP more than the other groups. The reason is not known.

The following are limitations of this study and could be issues for further re-

search (Smith *et al*, 1999; Bayoumi 2004; Yeung, 2006): 1) WTP seems to depend on the context of the respondents, therefore, more relevant study population would be households with 2-month-old children, who are ready to be vaccinated with Hib vaccine; 2) the WTP was not compared with actual purchasing; 3) the response rate was not recorded, but from our observations there were few women who refused to participate in the survey. The most common reason was that they were in a "hurry" and had to do something else. Therefore, there may be less selection bias among pregnant women meeting the enrollment criteria. We also excluded the group that was not interested in the vaccine, but was interested only in a free vaccine. This probably over-estimates the WTP. However, this group was small in number, therefore, they would have only small effect on the overall WTP; 4) there was no relationship between the hypothetical incidence scenarios and demand for Hib vaccine, even though most of the respondents seemed to understand the scenarios (Table 2). This is probably because none of the scenarios had significantly different incidences; meningitis incidence varies from 20 to 50 per 100,000 over five years. Therefore, the respondents valued them as having the same level of risk or could not differentiate the risk of this range. Therefore, the sensitivity of the WTP may not be accurate.

In conclusion, even though the incidence of Hib disease in Thailand is probably low, some Thai women are concerned about the severity of Hib disease and highly accept Hib vaccine, which is expressed by WTP or the demand for the vaccine in monetary value. Therefore, in performing economic analyses and policy making for Hib vaccination program, the private demand should be included in the model of the

analysis and policy consideration. However, the study suggests user fees could create a barrier to use of the vaccine, and miss the risk group for the disease. Those at high risk are those with a low socio-economical status where their ability to pay for Hib vaccine is relatively low.

#### ACKNOWLEDGEMENTS

We are deeply grateful to many people: Dr Damian Walker, Dr Mark Steinhoff, Dr Joanne Katz, Ms Porpit Warinsatian, Dr Piyanit Thammapornpilas, Dr Sirisak Warintarawat, Dr Supamit Chunsuttiwat, Dr Prayura Kunasol, Dr Sujitra Nimanitaya, Ms Ariya Klomklinsook, Dr Pornsak Yoocharoen, Ms Sirirat Techatawat, Ms Aimorn Rachjumroensook, Ms Prangtong Rachjumroensook, Mr Thammanoon Donthong, Mr Surapon Sukkasaem, Dr Wiroj Tangcharoensatian. Dr Chutima Suraratdecha, Dr Paisarn Dumkhum, Dr Kittichai Kaew-dee, Mr Adulsak Wijit, Ms Ratchanekorn Kumlah, Mr Sompoth Bowornsin, Mr Suntorn Konyai, Ms Wattana Yotayai, Mr Boonjun Junmaha, Ms Haruethai Tobwongsri, Mr Kumtud Toemyanghyai, Mr Sawas Boonpun, Ms Kannatcha Sroypechr, Ms Rawiwan Siwapradit, Ms Somrudee Klomnoi, Mr Wirat Ponlears, Ms Ladda Jirattikul and Mr Panchai Kongtrub.

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