THE PUBLIC DEMAND FOR A DENGUE FEVER VACCINE: A CONTINGENT VALUATION SURVEY IN PHNOM PENH, CAMBODIA

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A Thesis Submitted in Partial
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ABSTRACT

Title of Thesis	THE PUBLIC DEMAND FOR A DENGUE FEVER VACCINE: A CONTINGENT VALUATION SURVEY IN PHNOM PENH, CAMBODIA
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Our study estimates the willingness to pay (WTP) for the dengue fever vaccination program at a national level in Cambodia. A double bounded format with an open-ended question was used in this to estimate the WTP. The contingent valuation method (CVM) scenario was created as a two-year dengue fever vaccination program. Two vaccine levels were used, one with 40% and another with 80% effectiveness, neither with any side effects. Three dose were required for full protection. We used 600-split sample survey in Phnom Penh, Cambodia of those aged 20 to 60 years old and with Cambodian nationality. Subjects were asked how much they would be willing to pay for dengue fever vaccination via a one-time income tax surcharge of either 50,000, 150,000, 200,000, 350,000, 500,000, or 600,000 riel, respectively. As shown by the Tobit Model, the mean of households' willingness to pay to support the dengue fever vaccination program were 98,841 riel and 149,124 riel for the 40% and 80% levels, respectively. Income, gender, marital status, and education were the key factors influencing households' WTP to support a dengue fever vaccination program.

Keywords: Contingent Valuation Method, Dengue Fever Vaccine, Willingness to Pay (WTP)

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CHAPTER 1
INTRODUCTION

1.1 Background

The dengue virus is the main cause of an epidemic disease called “Dengue Fever” (Rodenhuis-Zybert, Wilschut, & Smit, 2010). There are five serotypes of the virus that was found in the family of Flaviviridae for dengue fever diseases (Dwivedi, Tripathi, Tripathi, Bharadwaj, & Mishra, 2017; Normile, 2013). In general, we have known that dengue virus can lead to a dengue fever for any person who have got infected to it. Dengue fever has its own common names which were known as dengue hemorrhagic fever, break-bone fever, and dandy fever. The dengue hemorrhagic fever is the serious case of dengue fever. We usually found that dengue fever is getting infected in subtropical and tropical region and mostly in the urban area where there is a high population density.

In addition, dengue fever can be infected to all-age people, not just the children anymore. There is usually a high level of dengue fever disease infection in the wet season, and it is lower in the dry season. This is because in the wet season or rainy season, there are high number of mosquitoes which are the dengue fever transmission agent. The human got infected the dengue fever virus when they were bitten by the infected mosquitos. There are 3-14 days for the period of incubation. This illness will be last for the period of 3 to 7 days. The dengue fever is not infected from a human to another since the one who get infected cannot be contagious. There are some signification symptoms such as minor hemorrhagic including a positive result of tourniquet test or hematuria, bleeding gums, petechiae, ecchymosis, purpura, epistaxix, and maculoppular or macular; bone, muscle, and joint pain; retroorbital pain; and serious headache (Palanca-Tan, 2008).

Dengue fever is considered as an epidemic disease in Cambodia, which is a nation with low health and economic indicators (Asian Development Bank, 2009). The 2008 population estimation for Cambodia was 14.6 million people (National Institute of Statistics, 1998). The first Cambodian dengue infection case was discovered in 1963, after which dengue spread across the nation. The dengue fever infection rate has been reported as fast rising over the years and has become one of the most significant public health issues. Moreover, dengue fever infections drastically increased in 2008. And since 2008 there have been about 9,000-38,000 cases (about 103 cases/100,000 population) and 3-179 deaths (about 1/100,000 population) every year. During 2008–2017, dengue fever infection cases in Cambodia peaked in 2012 with 37,675 cases and 179 deaths. In 2012, the mortality and morbidity levels were all high, at 2 and 262, respectively, per 100,000 population (Ministry of Health of Cambodia, 2017).

By 2017, there were 6,372 reported cases, while in 2016 there were 12,483 cases. A large part of the reported cases occurred among children from ages of 5 through 10 (2,434 cases or 38.2%), followed by children aged 10 to 15 (2,271 cases or 35.6%), children under 5 years of age (1,305 cases or 10.7%), and children over 15 years (362 cases or 5.6%). It should be noted that among the child cases there is not much difference between males (3,264 cases, 51.2%) and female (3,108 cases, or 48.8%) (Ministry of Health of Cambodia, 2017).

1.2 Study Research Question and Study Objectives

In this study, we intend to derive a useful insight into the public demand from Cambodian households (including both genders) as to how much they are willing to pay to support a one-year dengue fever vaccination program. Such a program aims to prevent the spread of dengue fever among the population, but to do so, individuals would have to pay a one-time income tax surcharge of 50,000, 150,000, 200,000, 350,000, 500,000, or 600,000 riels, respectively.

The double-bounded Contingent Valuation Method will be used with an open-ended question to estimate the maximum level of WTP amount to support dengue fever vaccination program. Then, this dengue fever vaccine would be provided nationwide for all citizens including both genders. The dengue fever vaccine was separated into two different level of effectiveness include 40% and 80%.

This paper examines the factors that influence individuals regarding their household's WTP for this dengue fever vaccination program. Estimating the WTP for a dengue fever vaccination program and thus a potential means of funding it can thus provide policy planners with an understanding of just how a dengue fever vaccination program can be most effective.

Our research questions are: 1) What are the key factors influencing how much a household is willing to pay to support a dengue fever vaccination program? and 2) How much would individuals be willing to pay to support such a program?

1.3 Significance of the study

Dengue fever vaccine has not been widely used to protect the household in Cambodia yet even it is a potential preventive and more effective with long-run control to protect household from dengue fever. However, if we provide the dengue fever vaccine publicly with a vaccination subsidy program, we need to know about public demand for a dengue fever vaccination program. This study intended to make an estimation on the public demand for the program. We used contingent valuation approach to do this evaluation.

1.4 The Study Scope

1.4.1 Population

In this paper, our target population was defined as the people aged 20 to 60 years old with Cambodian nationality since these people are the taxpayers and the

ones who have been living and working in Phnom Penh regardless of where they originally came from. We then randomly selected 600 people in Phnom Penh with both genders to be our sample for this study.

1.4.2 Location

This study was conducted in Phnom Penh, the capital city of Cambodia since it is the most populated city with highest population density and highest dengue fever infected cases. The population in Phnom Penh is accounted for 14% of total population in the country. Moreover, there are a vast amount of inflow of migrants from across the nation. This made Phnom Penh become the biggest city with fast economics growth. However, it simultaneously increased the social issues such as slums and sanitation problems which made Phnom Penh the city with highest dengue fever infected cases.

1.4.3 The Estimation of Willingness to Pay (WTP)

This study employed double-bounded CVM format with an open-ended question to make an estimation of mean value of WTP amount to support a two-year dengue fever vaccine program. The determinants on demand for a dengue fever vaccination program that we would like to determine whether the respondents in pubic are agreed to give away a one-time income tax surcharge payment are depending on household monthly income (I); family composition or size (F) refers to the number of family members; household characteristics (C) include age, gender, occupation, education, marital status; the dengue fever variable (D) refers to awareness of dengue fever issues, general knowledge about dengue fever, and experience with dengue fever disease infection; vaccine effectiveness understanding variables (U) refer to understanding that dengue vaccine has two levels of effectiveness (40% and 80%); and effectiveness level of the vaccine (V) refers to a vaccine whose effectiveness is either 40% or 80%, respectively.

1.4.4 Scope Test

The scope test was designed in this CVM study on the subject of two different types of vaccine effectiveness (40% and 80%) in the dengue fever vaccination program for the validity of responses to our hypothetical dengue fever vaccination program because CVM study has been highly recommended. Then this study used "spilt sample technique" to test the reliability and consistency of respondents' answer towards two different levels of vaccine effectiveness.

CHAPTER 2
LITERATURE REVIEWS

Previous research that has focused on estimating the private demand for dengue fever vaccine programs at a country level has been conducted in various countries, such as in Metro Manila, Philippines (Palanca-Tan, 2008) , Indonesia (Harapan et al., 2017) , Vietnam (Nguyen et al., 2018), Brazil (Godoi et al., 2017), and South Korea (Amarasinghe, Wichmann, Margolis, & Mahoney, 2010b). However, none of these has evaluated a nation's ability to financially subsidize a public dengue fever vaccination program nor examined how much the public is willing to pay for it. In addition, key factors influencing the number of vaccines that could be purchased for public use remain undetermined (Hecht & Suraratdecha, 2006). One study (Agmapisarn, 2009) focused on public demand for a free HIV vaccination program and used double bounded contingent valuation method (CVM) format with an open-ended question to estimate the mean WTP for the vaccination program. Our study will follow this research design.

Dengue vaccine is a potentially effective method of preventing dengue fever in the long run. Various public and private sectors have given assurances that a dengue fever vaccine was being developed and tested (DeRoeck, Deen, & Clemens, 2003). In 2007, one news report claimed that a dengue fever vaccine could be produced within the next ten years. This news raised a lot of questions regarding policy implementation, such as to whom and how dengue fever vaccine could be supplied. For example, should a dengue vaccine be provided by the private or the public sector? In the case of the vaccine being provided by the private sector, the next question that arises is how much vaccine will be demanded by the market and at what price? And who will be able to receive the injections? On the other hand, if the public sector provides the vaccine, an evaluation of the estimated benefits of such a preventive measure needs to be made. The willingness to pay (WTP) is a monetary valuation put on a vaccine by survey respondents and is derived from a contingent

valuation survey. It is derived by assessing a household's perceived benefit from preventing dengue disease. This WTP approach is more accurate and comprehensive than the cost of illness (COI) approach, comprised of treatment cost reduction and productivity gain that can occur place from illness prevention. This is the approach that is normally employed in the public health literature (Palanca-Tan, 2008).

In Vietnam, the expansion of dengue fever infected cases in the recent years and a large-scale outbreak of dengue fever in 2017 underlined the importance of dengue fever vaccine. Given the potential benefit of dengue fever vaccine and need for private sector to pay for healthcare service coverage, Nguyen et al. (2018) decided to evaluate the willingness to pay for a dengue fever vaccination program for patients in northern Vietnam. Cross-sectional data were collected from 330 inpatients and outpatients in Bach Mai Hospital. They used contingent valuation method to estimate the willingness to pay for dengue fever vaccine. Results showed that around 95% of respondents agreed to pay a mean WTP of $67.4 USD for the vaccine. Moreover, the study recommended that the government should subsidize the cost of the vaccine to improve the coverage of the population, especially the poor people, in the future. (Nguyen et al., 2018).

In December 2015, the first dengue fever vaccine, developed by Sanofi Pasteur, was approved in Brazil. However, given that dengue fever vaccine would potentially be paid for through public health system, the information regarding households' willingness to pay for the vaccine as needed in order to discuss about the possible inclusion of this vaccine into the public health system in the first place needed to take place. Godoi et al. (2017) addressed these issues using a cross-sectional data set with residents of Greater Belo Horizonte, Minas Gerals to estimate their willingness to pay for dengue fever vaccine. After interviewing 507 respondents, they found that the maximum value of median of households' willingness to pay was $33.61 USD. The study suggested that manufacturers in Brazil should find out the possible way to reduce the prices in order to reach more people (Godoi et al., 2017).

One study claimed that a dengue fever vaccine would be available in the next 3 to 5 years (Amarasinghe, Wichmann, Margolis, & Mahoney, 2010a). The authors emphasized that such a vaccine was direly needed in both public and private markets for nations experiencing widespread dengue outbreaks. These estimations were based on population projections from 2015 to 2020 in Asian and American endemic nations. Moreover, it made an expectation for specific countries' vaccination programs in the public, private, and traveler sectors. There were 54 countries that were categorized as dengue fever infectious area, comprising a total population of 2.8 billion, among which were 54 million children aged 1-2 years old. In the following five years, it was estimated that 645 million doses of dengue fever vaccine would be needed for children to strengthen their immunity against the dengue fever virus, and up to two billion doses for immunization catch-up, with 80% in the nations with dengue fever infectious area for being in the public sector. Also, it was estimated that for the traveler market, 59 to 89 million doses would be needed.

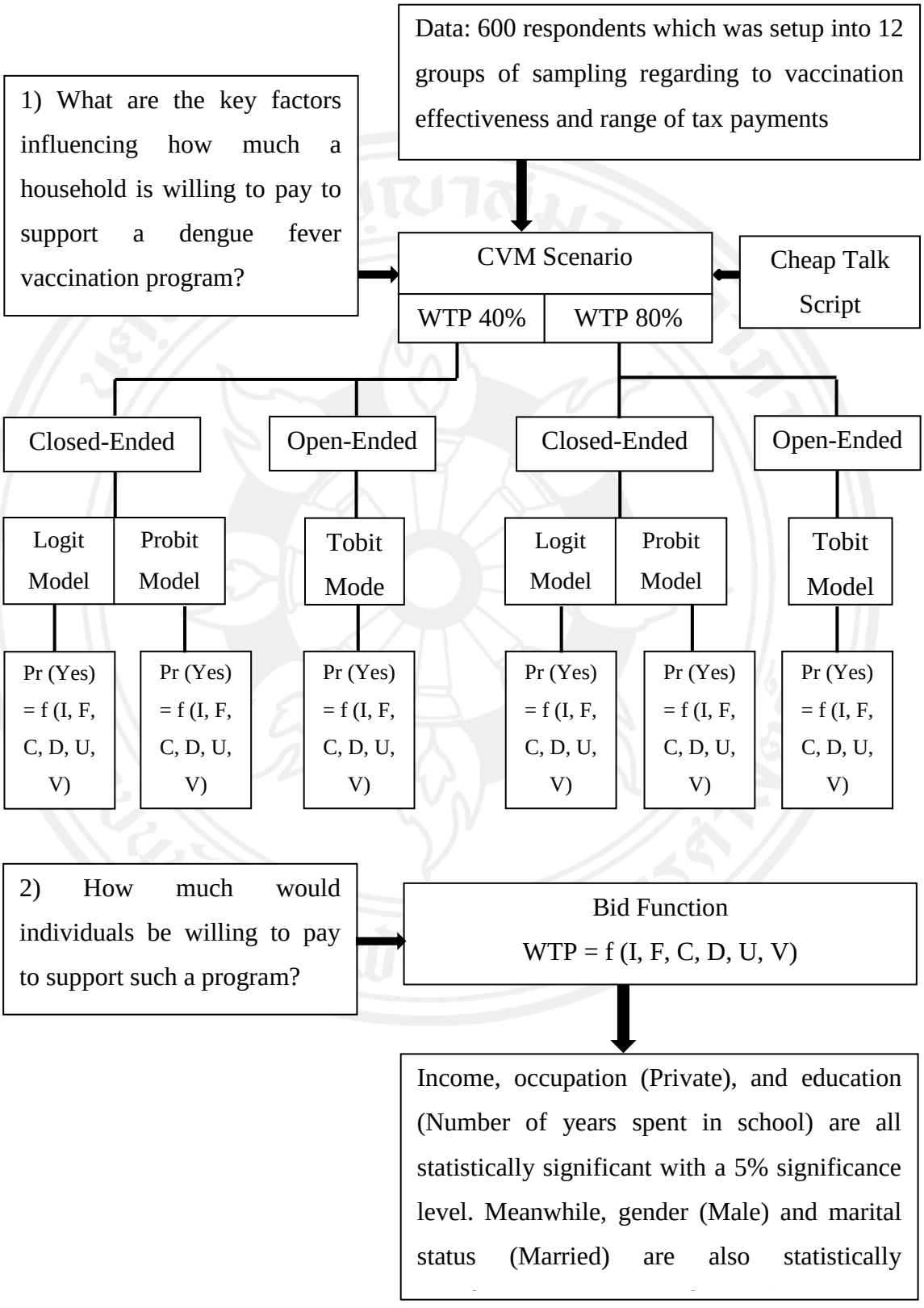
Recently, there have also been reports of dengue fever vaccine that has been produced and approved for use in some countries (Lee et al., 2015). Specifically, such vaccines have been deployed in countries in which a high risk of dengue has been reported. Nevertheless, there might be an impediment toward dengue vaccine strategic adoption in some specific areas, especially in low- and middle-income nations (Lee et al., 2015). Such nations normally encounter difficulties in making decisions about how to allocate their limited budgets to cover vaccines, which are very expensive to produce. Hence, they are faced with budget constraints (Hadisoemarto & Castro, 2013). Thus, it is very important to thoroughly understand the benefit of public dengue fever vaccination programs in terms of preventing the diseases and incurring even greater social and economic costs if vaccinations were not given. Such an understanding is crucial before bringing proposals for a vaccination program to the public sector or to private markets (Harapan et al., 2017).

Among all five of the studies cited above, not one evaluates a nation's ability to financially subsidize a public dengue vaccination program. Nor do any examine how much the public would be willing to pay for the program. However, there is a

study of public demand of a free HIV vaccination program that used the double bounded CVM format followed by an open-ended question to find an estimation of the mean willingness to pay (WTP) for a HIV vaccine program (Agmapisarn, 2009). A 600-split sample survey was conducted by asking respondents aged 20-60 years old living and working in Bangkok whether they were willing to pay (WTP) to support an HIV vaccination program using either a 30% or 70% effectiveness vaccine with an initial tax payment of either 500, 1,500, 2,000, 3,500, 5,000, or 6,000 baht. The mean WTP values that were found were 2,050 baht and 1,746 baht for 70% and 30% effectiveness, respectively. The author recommended that, in addition to people using condoms to prevent HIV infection in the meantime, when a vaccine becomes available the Thai government should use a progressive tax to fund such a program.

As we have described above, most research so far has estimated private demand for a dengue fever vaccine at country level. However, none has evaluated a nation's ability to subsidize a public dengue fever vaccination program nor examined how much the public is willing to pay for it. Our objective here is to derive a useful insight into the demand among Cambodian households (including both genders) as to how much they are willing to pay to support a two-year public dengue fever vaccination program.

2.1 Conceptual Framework



CHAPTER 3
METHODOLOGY

3.1 The CVM Approach

We employed a double-bounded approach with an open-ended question to derive an estimation of how much people surveyed would be willing to pay for a dengue fever vaccine coverage. Initial payment amount levels were 50,000, 150,000, 200,000, 350,000, 500,000, and 600,000 riels, respectively. When respondents gave a Yes answer to the initial rate, we followed up by posing further questions for the respondents to answer, presenting them with a higher rate (HR) equal to one and a half times of initial rate. However, when respondents answered "No" to the initial rate (R), we gave them another question, offering them a lower rate (LR), equal to two-thirds of the initial rate.

Table 3.1: The WTP Rate Structure for Respondent's Bid

	Initial Rate (R)	Higher Rate (HR)	Lower Rate (LR)
1	50,000	75,000	30,000
2	150,000	225,000	100,000
3	200,000	300,000	130,000
4	350,000	525,000	230,000
5	500,000	750,000	330000
6	600,000	900,000	400000

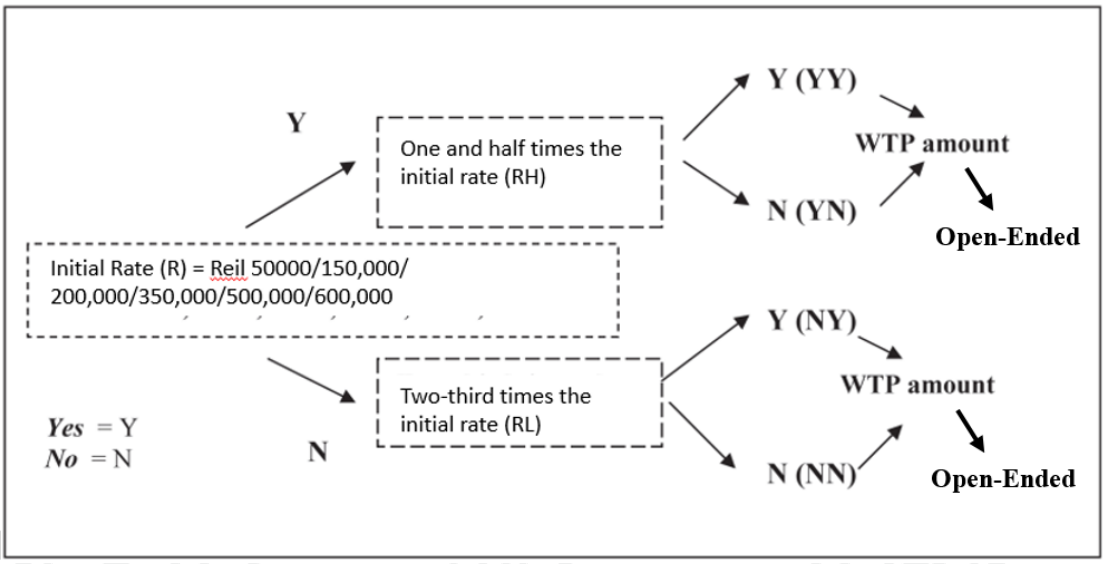


Figure 3.1: The Double-Bounded Format with Open-Ended Following Questions Diagram

Notice: Y Y = Yes/Yes, Y N = Yes/No, N Y = No/Yes, N N = No/No

In the last stage, we asked respondents to state the maximum amount that they would be willing to pay to support a dengue fever vaccination program. If respondents stated that their maximum level of WTP was not zero, then we continued asking them more questions to identify the reason that they gave this amount for the program. Moreover, if the respondents gave a zero amount for WTP for the program, then we asked them again the questions to find the reason why they were willing to give nothing at all for the program. This is a confirmation question to truly identify whether a zero amount of WTP for the program is valid or biased. If we found that respondents who gave a zero WTP for the program were biased, then the answers of those respondents were categorized as "Non-Response." In addition, all respondents were advised to consider their budget constraints, and we also informed them that there were no right or wrong answers for this interview. Moreover, in order to make sure that they told us the truth, we have talked with them using a cheap talk script before starting the interview to encourage them to answer truthfully.

3.2 Sample of the study

In this study, we randomly selected 600 samples and conducted interviews in Phnom Penh, the capital city of Cambodia. The population in Phnom Penh accounts for 14% of the total population of the country. Moreover, there is a vast inflow of migrants from across the nation. This has made Phnom Penh the nation's largest city and one with fast economic growth. At the same time, this has increased social pressures and has aggravated problems such as slums and sanitation, resulting in Phnom Penh having the greatest number of dengue fever cases in the country. We used multistage sampling since a sampling frame was not needed in this method. Moreover, multistage sampling is easier and less expensive than a single-stage random sampling when we use a CVM to survey a huge population (Bateman et al., 2002). The defined targeted population was people aged 20 to 60 years old with Cambodian nationality since these people are the taxpayers and the ones who have been living and working in Phnom Penh regardless of where they originally came from. We then used a multistage random sampling with three-stage sampling.

First, we randomly selected a sample from 6 of the 12 districts or "Khan" in Phnom Penh. After that we set a quota that took into account population density in order to select sample units in the second stage within each sample district. As a result, we selected the sample within a district by its proportion to the population density of each district. Hence, we finished with a total sample of 600 units. With regard to the sampling of 600 respondents, we randomly selected any person aged 20 to 60 years old in each sampling quota to form a final stage sample choice, as shown in Table II. Randomly selected individuals had to be Cambodian nationals and taxpayers who had a job in Phnom Penh, regardless of where they originally came from.

Table 3.2: Multistage Area Sampling of 6 Sampled Districts Conducted on the Survey

Sampled District	Area (Km2)	Population	Population Density	Sampled Quota
Chamkar Mon	10.56	182,004.00	17,235	98
Doun Penh	7.44	126,550.00	17,009	96
Prampir Makara	2.21	91,895.00	41,581	235
Tuol Kork	7.99	171,200.00	21,427	121
Dangkao	197.89	257,724.00	1,302	7
Mean Chey	43.79	327,801.00	7,486	42
Total	**269.88**	**1,157,174.00**	**106,040.98**	**600**

Source: (Municipality of Phnom Penh, 2004)

3.3 State of Work

3.3.1 Focus Group

Before the questionnaire was created, we conducted 12 focus groups including pre and post-questionnaire focus groups (See Appendix B and C). Each focus group normally had 5-11 participants, selected to be homogenous on sex, age, education, and occupation. Six pre-questionnaire focus groups were conducted with the purpose to construct a questionnaire structure including the CVM scenario, questions, and range of payment rate. Prior to constructing our CVM draft questionnaire, we asked these six focus groups whether they choose to pay either for a dengue fever vaccination program or for research on dengue fever vaccination. Most of the participants would like to pay for dengue fever vaccination program rather than the research.

We have interviewed with many focus groups. As a result, we were recommended to choose people aged 20-60 years old to be our target group in our dengue fever vaccination program and children aged under 9 years to be the high-risk group. After the drafted questionnaire had been written, we had conducted another six post-questionnaires focus groups and we were recommended about the wordings,

contents, questionnaire structure, and range of payment rate. This was very useful and helpful for us to write the drafted questionnaire.

3.3.2 Pre-Testing

After our CVM drafted questionnaire was tested by focus groups and we got many recommendations from many respondents, we then conducted a pre-test to carry out a pilot survey. Our pilot survey was done during the period from December 20-31, 2018. We asked 200 respondents aged 20-60 years old patients with Cambodian nationality who came for healthcare service in Thailand.

The responses in the pilot survey were also addressed and analyzed to ensure the adequacy of data collection. It reminded us about a few issues regarding the design of questionnaire that need to be adjusted before the survey in Phnom Penh. In addition, those 200 questionnaire-pilot surveys also assist us in making the decision on the range of tax payment rate that household need to pay to support the dengue fever vaccination program. Then, we had created the range of tax payment rate in Cambodian currency (Riel) as follow: 50,000, 150,000, 200,000, 350,000, 500,000, and 600,000 Riel, respectively.

3.4 The Design of the study

The dengue fever vaccine program will be a one-year program and it will be free to the public. The dengue fever vaccine itself will be separated into two different levels in terms of its effectiveness, namely, 40% and 80%, to protect our target group of Cambodian citizens aged 20-60 years old. We also created different levels of one-time income tax surcharge from which respondents were to choose: 50,000, 150,000, 200,000, 350,000, 500,000, 600,000 riels, respectively. This range of one-time income tax surcharge payment was to be matched with the two different levels of effectiveness of the dengue fever vaccine. Hence, there were 12 possible outcomes from combinations of tax payment rates and of dengue vaccine effectiveness (See Table 3.3).

The sample size of 600 will be significantly depending on the sample of the fifty interviewed respondents per sampling point in every dengue fever vaccine effectiveness and range of tax payment rate combination. We also use the split sample approach to make an estimation on the WTP of respondents and testify the respondents' answer consistency and reliability (Whittington, 1998, 2004). Consequently, each sample in the survey was randomly given the question on their WTP for dengue fever vaccine program regarding to its level of effectiveness as well as the range of tax payment rate from 12 combinations (See in Table 3.3).

Table 3.3: Sampling of Respondents Distribution with Regarding to Different Vaccination Effectiveness and Range of Tax Payments

	Total Sample = 600	
Target	(n=600)	
Vaccine Effectiveness	40% (n=300)	80% (n=300)
Tax Payment = R 50000	50	50
Tax Payment = R 1,50000	50	50
Tax Payment = R 2,00000	50	50
Tax Payment = R 3,50000	50	50
Tax Payment = R 5,00000	50	50
Tax Payment = R 6,00000	50	50

3.5 The Study CVM Scenario

To make our respondents understand our scenario, we used illustrations to create a clear understanding about dengue fever vaccine's effectiveness in the context of a contingent valuation scenario approach.

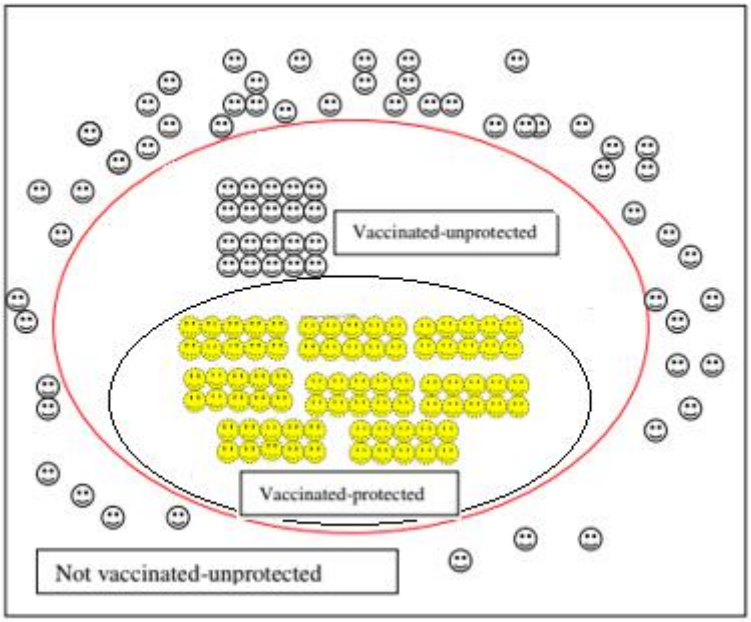


Figure 3.2: Dengue Fever Vaccine with 80% Level of Effectiveness

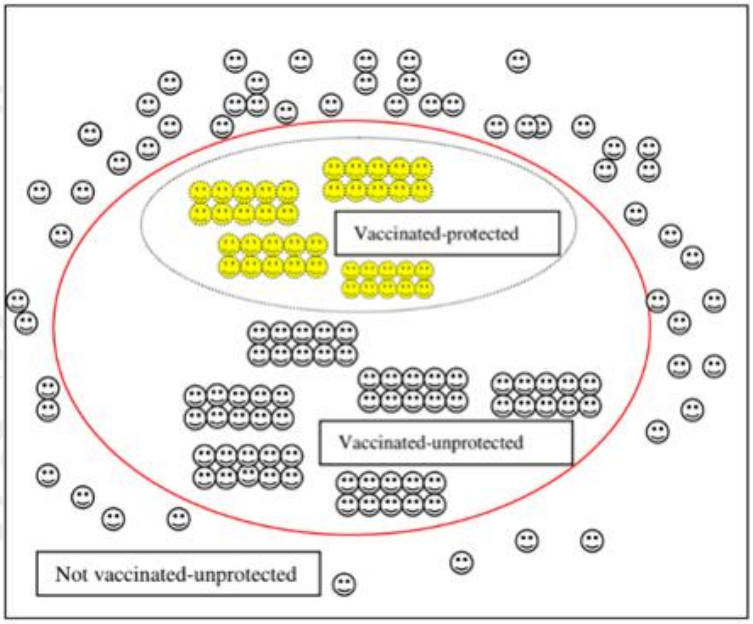


Figure 3.3: Dengue Fever Vaccine with 40% Level of Effectiveness
Source: (Do et al., 2006)

The CV scenario is as follows: dengue fever is an epidemic disease caused by a mosquito-borne flavivirus that can spread to most tropical and subtropical regions. Dengue fever viruses 1-4 are the main viruses that cause the illness. Dengue fever vaccine is a protective method to prevent and control the spread of dengue fever

infection, especially in Cambodia. As mentioned previously, dengue fever vaccine in this study paper consists of two different levels of effectiveness (40% and 80%) and has no side effects on recipients. Moreover, its effectiveness will last for five years or more, which can protect a household from getting infected by the four types of dengue fever virus. Household members need to be injected with three doses of dengue fever vaccine six months apart. After receiving all three doses, recipients will be protected from dengue fever infection.

In addition, Figures 2 and 3 will also verify the precision and consistency of the explanation of our dengue fever vaccination program among the enumerators, who are the persons employed for taking a census of the population, when they explain and show the scenario illustration to the respondents.

Hence, this scenario will not just make things easier to understand for respondents. Moreover, if respondents give a wrong response to the scenario or if that they do not understand our dengue fever vaccination program scenario, we will use the illustration in the study to prevent scenario misspecification problems.

3.6 The Characteristic of Dengue Fever Vaccine in this Program

In this study, the characteristic of our vaccine was primarily depending on the comments and advice of several respondents in our focus group. Our focus group respondents mostly recommended that dengue vaccine should at least have 40% effectiveness to protect the people from dengue fever. Moreover, they express their positive perspectives toward the dengue fever vaccine which it should be able to protect more people by higher effectiveness level with 80% effectiveness. Therefore, our hypothetical dengue fever vaccine was set as 40% and 80% effectiveness with no side-effects, five years protection, and can protect from all types of dengue fever with three doses injection 6 months apart.

The meaning of our dengue fever vaccine refers to the probability of a person getting infected to dengue fever virus. In case of 40% effectiveness, if 100 people

were vaccinated with dengue fever vaccine, only 40 people were vaccinated-protected. While 80% effectiveness, if 100 people were vaccinated with dengue fever vaccine, 80 people were vaccinated-protected. Therefore, vaccine with 80% effectiveness gave higher probability that a person was vaccinated-protected.

3.7 The Dengue Fever Vaccination Demand Model

Our study aims to determine the public demand for dengue fever vaccination. The public demand for a dengue fever vaccine regarding both vaccine effectiveness levels (40% effectiveness and 80% effectiveness) are as follows:

$$\Pr(\text{Yes}) = f(I, F, C, D, U, V)$$

I= household monthly income
F= family composition or size
C= household characteristics
D= the dengue fever variable
U= vaccine effectiveness understanding variables
V= effectiveness level of the vaccine

We wanted to determine whether respondents in public agreed to pay a one-time income tax surcharge by using their annual income tax liability according to household monthly income (I); family composition or size (F) refers to the number of family members; household characteristics (C) include age, gender, occupation, education, marital status; the dengue fever variable (D) refers to awareness of dengue fever issues, general knowledge about dengue fever, and experience with dengue fever disease infection; vaccine effectiveness understanding variables (U) refer to understanding that dengue vaccine has two levels of effectiveness (40% and 80%); and effectiveness level of the vaccine (V) refers to a vaccine whose effectiveness is either 40% or 80%, respectively.

Table 3.4: The Variables Description in the Public Demand for Dengue Fever Vaccination Program with Coefficients Expected Sign

Variables	Descriptions	Expected Sign
Independent Variables		
Tax Payment Rate	Tax Payment Rate (As in logarithm form, in Riel): 50,000/150,000/200,000/350,000/500,000/600,000	Negative
Household Income		
Monthly income	Household monthly income (Continuous in logarithm form, Riel)	Positive
Socioeconomic and Demographic variables		
Gender	Male = 1, 0 if otherwise (Female gender as a base)	N/A
Age	Respondents' age (Continuous, number of years)	Negative
Marital Status	Married = 1, 0 if otherwise (Single/Divorce/Widow/Separated as a base)	N/A
Schooling	The number of years in school of the respondents (continuous, years)	Positive
Private	Occupation status = 1 if private, 0 otherwise (Public as a base)	N/A
Household	Number of household members (continuous, persons)	Negative
Children	1 if respondent has children aged less than 9 years living in the same household, 0 otherwise	Positive
Knowledge, Experience and Awareness		
Knowledge	Dengue fever knowledge = 1 if respondent answered all 5 questions correctly, 0 otherwise	Positive
Known	1 if respondent has any family member has had dengue fever, 0 otherwise	Positive
Curable	1 if respondent has heard that Dengue Fever is now curable, 0 otherwise	Positive

Variables	Descriptions	Expected Sign
Independent Variables		
Understanding of vaccine effectiveness		
Understanding	1 if respondent passed all three questions on the understanding of vaccine effectiveness, 0 otherwise	Positive
Vaccine characteristic and program		
80% effectiveness	1 = vaccine is 80% effectiveness, 0 otherwise (40% vaccine effectiveness is a base)	Positive

CHAPTER 4
EMPIRAL RESULT

4.1 Profile of Respondent

A total of 600 people aged 20 to 60 years were successfully interviewed during the period July 2019–February 2020. The response rate for interviewees was 95%. We compensated for this by conducting more survey interviews to get a total number of 600 survey interviews. We profiled respondents in terms of (1) sociodemographic characteristics, (2) knowledge, experiences, and awareness of dengue fever, and (3) understanding of vaccine effectiveness.

4.1.1 Sociodemographic Characteristics

Of the 600-people interviewed in the survey in Phnom Penh, 57% were female with an average age of 31, and 60% were single. Almost two-thirds (65.7%) had completed at least a bachelor's degree, and 78.7% had a job in the private sector. The average household size was 4.5 persons, and those with household members aged less than 9 years old living in the same household accounted for 51.2% (Table 4.1).

Table 4.1: Sociodemographic Characteristics of Respondents

Variable	Descriptive	Mean	S.D
Tax Payment Rate	Tax Payment Rate	308,333.33	194,705.95
Monthly income	Household monthly income (Continuous in logarithm form, Riel)	14.255	0.431
	Household monthly income (Continuous form, Riel)	1,705,900.000	792,826.471
Male	Gender = 1 if male, 0 if otherwise (Female as a base)	0.432	0.496
Age	Age of respondents (continuous, years)	30.793	7.648

Variable	Descriptive	Mean	S.D
Married	Marital status = 1 if married, 0 otherwise	0.595	0.491
Schooling	The number of years in school of the respondents (continuous, years)	15.402	2.458
Private	Occupation status = 1 if private, 0 otherwise (Public as a base)	0.787	0.410
Household	Number of household members (continuous, persons)	4.532	1.322
Children	1 if respondent has children aged less than 9 years living in the same household, 0 otherwise	0.512	0.500

4.1.2 Knowledge, Experience, and Awareness of Dengue Fever

Of the 600 respondents in the survey, only 89.5% answered correctly all 5 questions regarding knowledge, experience, and awareness of dengue fever. As for the knowledge of dengue fever (Table 4.3), more than 90% believed that the risk of dengue fever transmission would be reduced by reducing areas where mosquito shelter and breed and by sleeping under a mosquito net. They also believed that a healthy-looking person can get infected by dengue fever. More than 90% of respondents knew that a person can get infected by dengue from mosquito bites. Surprisingly, almost 8.8 % of respondents believed that a person cannot die from getting infected.

Regarding the experiences of dengue fever, 97.7% of respondents had known someone who had dengue fever, and almost 99% of the respondents believed that dengue fever is now curable. On the other hand, 2.03% of respondents had never known anyone who had contracted dengue fever, and 1% did not believe that dengue fever was currently curable. (Table4.4).

In terms of dengue fever awareness, more than 90% of respondents believed that mosquitos are the major cause of dengue fever spreading and that children are

tended to get infected. In addition, 90.8% of respondents thought that the government should prioritize children and vaccinate them first if a dengue fever vaccine becomes available, and 91% of respondents believed that dengue fever vaccine is the most advanced method to prevent dengue fever diseases.

Table 4.2: Knowledge, Experience and Awareness of Dengue Fever

Variable	Descriptive	Mean	S.D
Mosquitohome	1 If respondent believe that risk of dengue fever transmission has been reduced by having reducing mosquito's shelter, 0 otherwise.	0.910	0.286
Sleepingnet	1 if respondent believe that we reduce the risk of getting dengue fever infection by sleeping in the net, 0 otherwise.	0.895	0.307
Healthylook	1 if respondent believe that a healthy-looking person can get infected to dengue fever, 0 otherwise.	0.902	0.298
Mosquitobite	1 if respondent believe that a person can get dengue fever infection by mosquito's bites, 0 otherwise.	0.905	0.293
Death	1 if respondent believe that a person can die by getting infected the dengue fever virus, 0 otherwise.	0.900	0.300
Known	1 if respondent knows anyone who had got infected by dengue fever virus, 0 otherwise.	0.977	0.151
Curable	1 if respondent have heard that dengue fever is now curable, 0 otherwise.	0.990	0.100
Transmission	1 if respondent believe that mosquito is the major causes the dengue fever spreading, 0 otherwise.	0.922	0.269
Children-Infect	1 if respondent believe that children are tended to get infected the dengue fever, 0 otherwise.	0.952	0.215
Kidpriority	1 if respondent believe that the government should prioritize children as the first vaccinated group, 0 otherwise.	0.908	0.289
Prevention	1 if respondent believe that dengue fever vaccine is the most advance method to prevent dengue fever diseases, 0 otherwise.	0.910	0.286

Table 4.3: Knowledge of Dengue Fever

Knowledge of Dengue Fever	Yes	No	Do not know
1. Can we reduce the risk of dengue fever transmission by having reducing mosquito's shelter?	91.0%	8.3%	0.8%
2. Can we reduce the risk of getting dengue fever infection by sleeping in the net?	89.5%	8.5%	2.0%
3. Can a healthy looking person get infected to dengue fever?	90.2%	8.5%	1.3%
4. Can a person get dengue fever infection by mosquito's bites?	90.5%	8.5%	1.2%
5. Can a person die by getting infected the dengue fever virus?	90.0%	8.8%	1.2%

Table 4.4: Experience f Dengue Fever

Experience of Dengue Fever	Yes	No	Do not know
1. Have you or your family member got infected by dengue fever virus?	97.7%	2.0%	0.3%
2. Have you heard that dengue fever is now curable?	99.0%	1.0%	0.0%

Table 4.5: Awareness on Dengue Fever

Awareness on Dengue Fever	Yes	No	Do not know
1. Mosquito is the major cause the dengue fever spreading.	92.2%	7.7%	0.2%
2. Children are tend to get infected the dengue fever.	95.2%	2.8%	2.0%
3. If there is a dengue fever vaccine, the government should prioritize children as the first vaccinated group.	90.8%	8.3%	0.8%
4. The dengue fever vaccine is the most advance method to prevent dengue fever diseases.	91.0%	8.7%	0.3%

4.1.3 Understanding of Dengue Fever Vaccine Effectiveness

Almost 100% of respondents demonstrated that they fully understand vaccine effectiveness of either the 40% or 80% variety by correctly answering all three questions regarding vaccine effectiveness. With the aid of our visual card, respondents had a better grasp of vaccine effectiveness during our explanation of either 40% or 80% effectiveness (Table 4.6).

Table 4.6: Understanding of Vaccine Effectiveness

Variable	Descriptive	Mean	S.D
Understanding	1 If respondent passed all three questions on the understanding of vaccine effectiveness, 0 otherwise.	0.992	0.091

4.2 The Public Demand for a Free Dengue Fever Vaccination Program

From our split sample contingent valuation method (CVM) survey with randomization of the two levels of vaccine effectiveness (40% and 80%) and six different rate of tax payment, Table 4.7 showed the number and percentage of respondents who were willing and able to support our Dengue Fever vaccination program. Figure 4.1 showed that the public demand for a Dengue Fever vaccination program has been rapidly diminishing from more than 90% at payment rate of 50,000 Riel to 2% at payment rate of 600,000 Riel. It showed that the demand was reducing with respect to an increase on payment rate. The demand also was lower for the 40% effectiveness of the vaccine at any given payment rate.

Table 4.7 : Number of Respondents Willing and Able to Support for a Dengue Fever Vaccination Program, by the Tax Payment Rate and Vaccine Effectiveness

Tax payment (Riel)	40% Effectiveness		80% Effectiveness	
	Number	Percentage	Number	Percentage
50,000.00	38	76.0%	43	86.0%
150,000.00	22	44.0%	32	64.0%
200,000.00	19	38.0%	25	50.0%
350,000.00	12	24.0%	13	26.0%
500,000.00	5	10.0%	6	12.0%
600,000.00	1	2.0%	1	2.0%

Note: Total number of respondents per rate of tax payment and effectiveness equals to 50 persons.

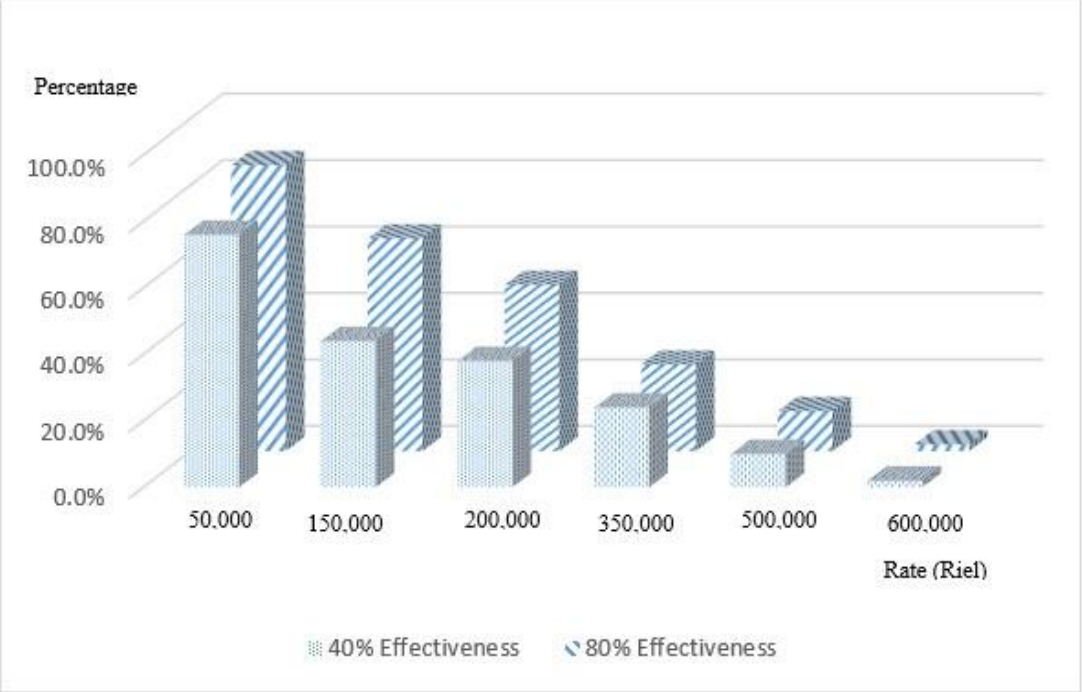


Figure 4.1: Percentage of Respondents Willing and Able to Support for a Dengue Fever Vaccination Program, by Tax Payment Rate and Vaccine Effectiveness

Regarding the demand analysis, our study has divided it into two sections: (1) the result of analysis on factors influencing a household's willingness to pay a certain amount to support a dengue fever vaccination program, and (2) the estimation of mean willingness to pay (WTP). Our analysis of the demand for a free dengue fever vaccination program is discussed below.

4.2.1 The Factors Influencing a Household's Willingness to Pay Amount to Support Dengue Fever Vaccination Program

The study result shows that the factors influencing a household's willingness to pay a certain amount to support dengue fever vaccination program are income, gender (Male), occupation (Private), marital status (Married), and education (Number of years spent in school). As shown in the Table 4.8, income, occupation (Private), and education (Number of years spent in school) are all statistically significant with a 5% significance level. Meanwhile, gender (Male) and marital status (Married) are also statistically significant, at a 10% significance level. Moreover, based on results

presented Table 4.8, income, and education (Number of years spent in school) have positive coefficients. The results also showed that male respondents tend to pay more compare to the base group which was female respondents, and this might because of the culture of Cambodian people which male are the family leader and have higher power in decision making. Our study results also found that respondents who were married tend to pay higher WTP compared to the base group which were single/divorce/widow/separate, and this might because of married respondents tend think more about others, especially family members. In addition, our study results showed that people work in the public sector (Base group) tend to pay higher WTP compared to people working in the private sectors. This might because of our respondents in the private sector that we randomly selected were mostly junior employees with low salary and small income, while respondents working in the public sector that we randomly selected were mostly senior officials with higher income lever.

Table 4.8: The Factors Influencing a Household's Willingness to Pay Amount to Support Dengue Fever Vaccination Program

Independent Variable	Coefficient	Standard Error	P Value	Mean
Constant	-238689.056	69518.760	0.001	
Income	0.074***	0.005	0.000	1705900.000
Number of Family Member	5451.413	5451.413	0.076	4.532
Number of Kid	-13706.251	10738.729	0.202	0.512
Age	840.281	631.211	0.183	30.793
Male	17748.043*	7647.557	0.020	0.432
Private	-36492.592***	9780.155	0.000	0.787
Married	30898.091*	13207.687	0.019	0.595
Education	12703.760***	1789.196	0.000	15.402
Curable	-21959.155	12659.904	0.083	0.910
Known	-33305.952	23952.136	0.164	0.977
Knowledge	15061.254	35935.189	0.675	0.990

Independent Variable	Coefficient	Standard Error	P Value	Mean
Vaccine Understanding	37121.323	39091.814	0.342	0.992
Vaccine Effectiveness	-3806.640	7772.036	0.624	0.500

Remark: * p<0.05; **p<0.01; ***p<0.001

4.2.2 The estimation of the Tobit Model

Our study was based on double-bounded format with the following open-ended question to make an estimation on households' willingness to pay for a dengue fever vaccination program. Therefore, in the open-ended question, we can use the Tobit model to estimate the mean of households' willingness to pay to support the dengue fever vaccination program by using the formula as below:

$$E(WTP) = \Phi(\frac{Z}{\sigma}\beta)Z\,\beta + \sigma\phi(\frac{-Z}{\sigma}\beta)$$

- E(WTP): is the mean of households' willingness to pay to support the dengue fever vaccination program
- Φ: is the CDF of Standard Normal
- ϕ : is the PDF of Standard Normal
- Z : is the mean of economic variables
- β : is the coefficient of variable
- σ : is the sigma value

Table 4.8 presents results showing that the factors influencing a household's willingness to pay to support dengue fever vaccination program are income, gender (Male), occupation (Private), marital status (Married), and education (Number of years spent in school). Income, occupation (Private), and education (Number of years spent in school) are all statistically significant, at a 5% significance level. Meanwhile, gender (Male), and marital status (Married) are all statistically significant at a 10% significance level.

Thus, we will take only these statistically significant independent variables to run in the Tobit model to calculate the estimation of E(WTP) for both levels of vaccine effectiveness by using the Limdep program.

Table 4.9: Significant Variables in the Tobit Model for Vaccine with 40% Effectiveness level

Independent Variables	Coefficient	Standard Error	P Value	Mean
Primary Index Equation for Model				
Constant	-108077.267	36150.085	0.003	
Male	11560.152	9904.934	0.243	0.350
Private	-38478.587	17217.118	0.025	0.920
Number of Schooling	6763.750	2044.935	0.001	14.957
Income	0.079	0.007	0.000	1529000.000
Married	23302.743	9114.046	0.011	0.537
Disturbance standard deviation				
Sigma |	78061.8827	3186.86302	0.000	

Table 4.10: Significant Variables in the Tobit Model for Vaccine with 80% Effectiveness level

Independent Variables	Coefficient	Standard Error	P Value	Mean
Primary Index Equation for Model				
Constant	-225741.823	46824.792	0.000	
Male	33621.401	11205.478	0.003	0.513
Private	-35920.446	13061.816	0.006	0.653
Number of Schooling	14270.850	2696.050	0.000	15.847
Income	0.074	0.007	0.000	1882800.000
Married	19820.906	12388.565	0.110	0.653
Disturbance standard deviation				
Sigma |	94789.9157	3869.78211	0.000	

From the calculation in the Tobit model using the formula above, we found that the mean of households' willingness to pay to support the dengue fever

vaccination program is 98,841 riel and 149,124 riel for the 40% and 80% levels, respectively.

4.2.3 The estimation of Logit Model

Regarding our contingent valuation method (CVM), our study was based on a double-bounded format along with the following open-ended question to make an estimation of households' willingness to pay for a dengue fever vaccination program. We used the Logit and Probit Model to estimate the mean willing to pay for a dengue fever vaccination program by using the formula $E(WTP) = \alpha/\beta$. From our calculation, we found an estimation of E(WTP) of dengue fever vaccination program for both models (Table 4.9).

Table 4.11: The Result of Mean Willingness to Pay for Dengue Fever Vaccination Program by using Logit and Probit Model

Model	**Vaccine Effectiveness**			
	40%		**80%**	
	WTP	**Log likelihood function**	**WTP**	**Log likelihood function**
Logit Model	392,429	506.2477	315,482	490.0306
Probit Model	392,046	506.2299	320,772	489.8935

Since the Logit Model has the higher Log likelihood function than in the Probit Model, our study will take the households' mean willingness to pay to support the dengue fever vaccination program from the Logit Model, thus, 392,429 riel and 315,482 riel for the vaccine with 40% and 80% effectiveness, respectively.

4.2.4 Mean Willingness to Pay

Regarding the split sample survey on two types vaccine effectiveness (40% and 80%), our results (Table 4.12) show that respondents with 80% vaccine effectiveness were willing to pay more, compared to what they were willing to pay for 40%

(Lower) vaccine effectiveness. For instance, the Yes/Yes response to an initial tax payment of 50,000 riel, 50% of respondents supported the dengue fever vaccination program, whereas only 34% were willing to pay for the 40% effective vaccine.

Table 4.12: Distribution of Responses by Various Initial Rate of Tax Payment in Double Bounded Format

Vaccine Effectiveness	**Y/Y**		**Y/N**		**N/Y**		**N/N**	
	40%	80%	40%	80%	40%	80%	40%	80%
	n/%	n/%	n/%	n/%	n/%	n/%	n/%	n/%
Initial Rate = 50000	17/34%	25/50%	21/42%	18/36%	7/14%	7/14%	6/12%	0/0%
Initial Rate = 150000	0/0%	6/12%	22/44%	26/52%	2/4%	8/16%	26/52%	11/22%
Initial Rate = 200000	0/0%	0/0%	19/38%	25/50%	0/0%	0/0%	31/62%	25/50%
Initial Rate = 350000	0/0%	0/0%	12/24%	13/26%	4/8%	4/8%	34/68%	33/66%
Initial Rate = 500000	0/0%	0/0%	5/10%	6/12%	1/2%	15/30%	44/88%	29/58%
Initial Rate = 600000	0/0%	0/0%	1/2%	1/2%	0/0%	2/4%	50/100%	47/94%

Note: n = number of respondents; % = percentage of respondents willing and able to pay for our dengue fever vaccination program with different rate of tax payment (in riel) and vaccine effectiveness (in percent); Y/Y = Yes/Yes; Y/N = Yes/No; N/Y = No/Yes; N/N = No/No; and total number of respondents per rate of tax payment and each vaccine effectiveness equal to 50 persons.

Table 4.13 shows that the result from Tobit Model, the E(WTP) of the vaccine with 80% effectiveness is 149,124 higher than the E(WTP) of the vaccine with 40% effectiveness, which is 98,841. This makes sense because households were willing to pay more for a vaccine with greater effectiveness. While for the Logit Model it does not make sense because the E(WTP) of the vaccine with 40% effectiveness is higher than the E(WTP) of the vaccine with 80% effectiveness. Therefore, our study chose the mean WTP from the Tobit model to be the household's mean willingness to pay for supporting the dengue fever vaccination program.

Compare our result to other research studies in a few countries such as Vietnam (US$ 67.4 for three doses), Indonesia (US$ 16.16 for three doses), Philippines (US$ 81.3–96.9 for three doses), Brazil (US$ 33.6 for three doses), and our study in Cambodian (98,841-149,124 Riel or US$24 – US$36 for three doses; Cambodian Exchange Rate US$1=4,106 Riel).

Table 4.13: The Mean WTP for Dengue Fever Vaccination Program of Logit and Tobit Model for Both Effectiveness Level

	E(WTP)	
Vaccine Effectiveness	40%	80%
Logit Model	392,429	315,482
Tobit Model	98,841	149,124

4.3 Cost-Benefit Analysis of Dengue Fever Vaccination Program

The cost of illness of dengue fever includes direct medical cost and indirect cost. The direct cost of dengue fever are the cost of drug and the cost of hospitalization. Meanwhile, the indirect cost of dengue fever is the productivity loss from being ill. From a study research in Yogyakarta found that the direct cost of dengue fever in average was US$ 350 and indirect cost of dengue fever in average was US$ 142. Therefore, the cost of illness of dengue fever in average was US$ 492 (Supadmi, Izzah, Suwantika, Perwitasari, & Abdulah, 2019). The cost of dengue fever vaccine was around US$20–US$25 per dose. Moreover, we need to inject three doses of dengue fever vaccine 6 months apart to get the full protection from dengue fever virus. Therefore, the total cost of dengue fever vaccine for the full protection is around US$60–US$75. Thus, the social cost of dengue fever vaccine is US$75 (Pang & Loh, 2017). Our study result shows that household's WTP for dengue fever vaccination program is 98,841-149,124 Riel or US$24 – US$36 (Cambodian Exchange Rate US$1=4,106 Riel). Thus, the social benefit that we can get from the dengue fever vaccination program is US$36. Therefore, we found that this dengue fever vaccination program's social benefit is less than its social cost. Then, it is not worth to launch this dengue fever vaccination program.

CHAPTER 5
CONCLUSION AND RECOMMENDATION

5.1 The Public Demand for a Free Dengue Fever Vaccination Program

The purpose of this study was to obtain in-depth information from the public including both genders, about the degree of financial support for a dengue fever vaccination program. By using CVM, our study was aimed to analyze how much each person would be willing to pay for the program with a one-time income tax surcharge payment and what were the key factors influencing them to finance this program.

The study showed that the factors influencing a household's willingness to pay amount to support dengue fever vaccination program are income, gender (Male), occupation (Private), marital status (Married) and education (Number of year spent in school). As shown in the Table 4.8, income, and education (Number of years spent in school) have positive coefficients. The results also showed that male respondents tend to pay more compare to the base group which was female respondents, and this might because of the culture of Cambodian people which male are the family leader and have higher power in decision making.

Our study results also found that respondents who were married tend to pay higher WTP compared to the base group which were single/divorce/widow/separate, and this might because of married respondents tend think more about others, especially family members. In addition, our study results showed that people work in the public sector (Base group) tend to pay higher WTP compared to people working in the private sectors. This might because of our respondents in the private sector that we randomly selected were mostly junior employees with low salary and small income, while respondents working in the public sector that we randomly selected were mostly senior officials with higher income lever.

The result showed that there was a potential-demand for dengue fever vaccination program. Our study used Logit, Probit, and Tobit model to calculate the mean WTP for dengue fever vaccination program, and we found that the result from Tobit model is more reliable and makes sense accordance to household's behavior. From Tobit Model, the mean of households' willingness to pay to support the dengue fever vaccination program were 98,841 Riel and 149,124 Riel for 40% and 80% level, respectively.

5.2 Methodological Issues

Our study had two limitations. First, this study concluded survey of Cambodian residents only in Phnom Penh metropolitan area which does not represent the whole country of Cambodia.

Second, the question in our questionnaire might be too easy to answer since it was general questions about the knowledge, experience, and awareness of dengue fever. That might be the reasons that almost all respondents answer correctly for all questions which made no difference for our result.

5.3 Policy Implication of Results and Suggestions

The study results would suggest some policy implications as follow. First, it recommends that policymakers should not provide a dengue fever vaccination program because this dengue fever vaccination program's social benefit is less than its social cost. Then, it is not worth to launch this dengue fever vaccination program.

Second, the government should use a combination of strategies to prevent dengue fever infection. Cleaning up and treating areas where mosquitos proliferate and providing mosquito nets would be the most indispensable parts of this combined prevention strategy. The Cambodian government should also launch a dengue fever prevention campaign along with access to information about dengue fever, especially for kids.

Last, the government should provide knowledge, skills, and promote the dengue fever awareness for behavior change nationwide, for example, by knowing how to detect one's own dengue fever status, knowing about risks, knowing how to protect oneself from dengue fever, being careful about one's health in general, and living in a clean environment. The government should employ a combination of all the above strategies to halt dengue fever.

APPENDIX A

Questionnaire

No……

Interview……Date……. Supervisor……

Time:…….....

Khan/Venue…….

[*Interviewer: Please read the following sentences to interviewees*] This survey is in the purpose to fulfil the research of Mr. Seyhak Khon, a Master Degree candidate in Economic at School of Development Economics, NIDA. We will strictly keep your information as confidential and use only for this study objectives. We will not disclose your answers to other people in any form that others can identify you. You have an entire right to stop the interview or not answer to any questions. The interview time normally takes around 30 minutes. **[*Please sign your signature to verify your acknowledgment after interviewer finish reading for you*]**

Signature:……...

A PUBLIC DEMAND FOR A DENGUE FEVER VACCINATION PROGRAM

[*Interviewer: Please read the statement below and strictly follow the conditions*]

1. The interviewees in this survey have to be a taxpayers ages between 20 to 60 years old. This survey will be done in Phnom Penh only. Cambodian language will be used in the survey interview. The targeted groups are people living and working in Phnom Penh regardless to where they originally came from.

2. Interviewees are not allowed to see the questionnaire. Interviewees have to be explained about questions, story, visual card, and scenario by the interviewer. Interviewees have to fill the information by themselves in the Section A: Self-response. Moreover, all the information from the interviewees will be filled in by the interviewer in the Section B: Interview section.

Section A: Self-response

Part 1: Personal Information

Please make the sign of (□) in the questionnaire boxes and fill the blank.

1.1 Gender

☐ Male

☐ Female

1.2 Age: …….. Years

1.3 Marital Status

☐ Single

☐ Married

☐ Widowed/Divorced/Separated

1.4 Education Level

☐ No schooling

☐ Elementary (6 years at school)

☐ Primary (9 years at school)

☐ Secondary (12 years at school)

☐ Technical (14 years at school)

☐ Undergraduate (16 years at school)

☐ Postgraduate (18 years up at school)

1.5 Occupations

☐ Self-employees

☐ Entrepreneur/Businessman

☐ Private sector employees

☐ Government official

☐ Others……...

1.6 Number of Family members…….person(s)

Number of family members age less than 9 years old…….person(s)

1.7 Monthly income (on average)…….Riel

Part 2: Knowledge, Experience, and Awareness of the dengue fever

[*Interviewer: we will ask the interviewees the questions related to dengue fever to test their knowledge, experience, and awareness about the diseases. There are 11 questions with only three possible answers such "Yes", "No", and "Do not know".*]

The interviewees need to mark the □ in the column for the correct answer only.

Knowledge of Dengue Fever	**Yes**	**No**	**Do not know**
1. Can we reduce the risk of dengue fever transmission n by having reducing mosquito's shelter?			
2. Can we reduce the risk of getting dengue fever infection by sleeping in the net?			
3. Can a healthy-looking person get infected to dengue fever?			
4. Can a person get dengue fever infection by mosquito's bites?			
5. Can a person die by getting infected the dengue fever virus?			
Experience of Dengue Fever	**Yes**	**No**	**Do not know**
1. Have you or your family member got infected by dengue fever virus?			
2. Have you heard that dengue fever is now curable?			
Awareness on Dengue Fever	**Yes**	**No**	**Do not know**
1. Mosquito is the major cause the dengue fever spreading.			
2. Children are tended to get infected the dengue fever.			
3. If there is a dengue fever vaccine, the government should prioritize children as the first vaccinated group.			
4. The dengue fever vaccine is the most advance method to prevent dengue fever diseases.			

Section B: Interview section

Part 1: The Dengue Fever Vaccine Effectiveness Understanding

[*Interviewer will need to present the illustrations and explain the interviewees about dengue fever vaccine effectiveness clearly before you ask them the following questions*]

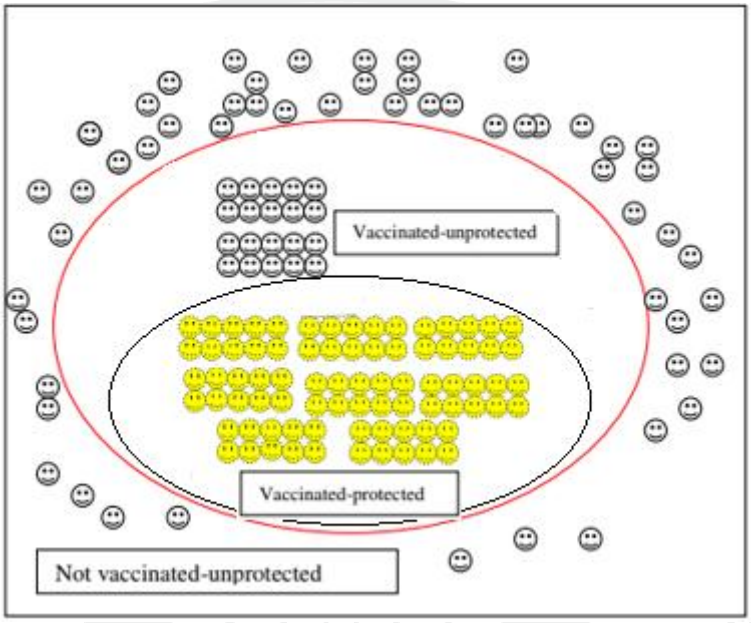


Illustration 1: Dengue Fever Vaccine with 80% Level of Effectiveness

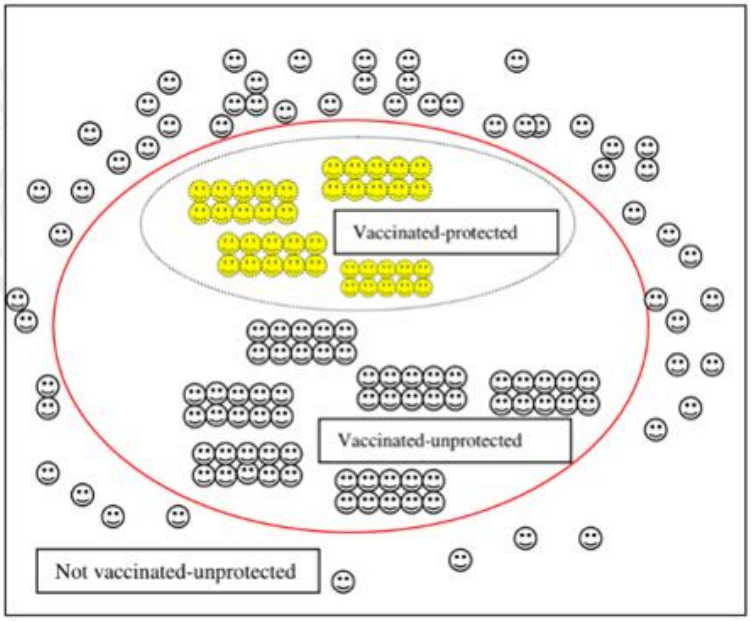


Illustration 2: Dengue fever Vaccine with 40% Level of Effectiveness

Source: (Do et al., 2006)

[*Then, interviewer will ask the question about the vaccine effectiveness "I would like to make a confirmation that you have understood about dengue fever vaccine effectiveness"*]

1. Please identify the vaccine recipient who was vaccinated by dengue fever vaccine. [If the interviewees already gave the answer, interviewer need to mark down in the box based on the given answer by using (☐)]

☐ Right

☐ Wrong

2. Please identify the people who will be protected by the vaccine and will not get the dengue fever disease. [If the interviewees already gave the answer, interviewer need to mark down in the box based on the given answer by using (☐)]

☐ Right

☐ Wrong

3. Please identify the number of people who are vaccinated to dengue fever vaccine, but not being protected by the vaccine which mean that they still can get the dengue fever disease. [If the interviewees already gave the answer, interviewer need to mark down in the box based on the given answer by using (☐)]

☐ Right

☐ Wrong

Then, interviewers need to collect all the answers of interviewees about dengue fever vaccine effectiveness whether they can answer all three questions correctly or not by mark (☐) in the boxes below.

☐ Yes (Go on to dengue vaccine scenario)

☐ No (Explain and ask them again, then evaluation the result and continues to dengue vaccine scenario)

Part 2: Dengue fever vaccine scenario

1. [*In this part, interviewer will have to present the storyboard during explanation about dengue fever with the scenario to the interviewees to ensure that they understand well.*]

Present Card A: Read the background information for Cambodian dengue disease situation

Show Figure 4: Cambodian mapping for dengue fever cases rates

Present Card B: Read the general knowledge about dengue fever and its transmission

Show Figure 5: Dengue Fever Virus Transmission

Present Card C: Read the dengue fever disease prevention by dengue fever vaccine

Show Figure 6: Dengue Fever Disease Prevention by Dengue Fever Vaccine Respect to Its Both Effectiveness Level (40%, 80%)

Present Card D: Read the cheap talk script

Choose one of the Initial Rate of Tax Payment among Card E1-E6 and use double-bounded techniques to ask interviewees to state their WTP.

2. What is maximum amount of your willing to pay for supporting the dengue fever vaccination program?.....Riel.

[If the interviewees give a response with Zero value, then go to **Reason 2**, otherwise go to **Reason 1**]

Reason 1: Could you please give us the reason why you are willing to pay to support this dengue fever vaccination program? [Interviewer do not have to read the following options, but please mark (□) on the options that you think it match the interviewees' answer.]

☐ It gives me and my family the benefit if dengue fever is protected.

☐ It will give more positive externality to our society

☐ The tax payment rate is affordable.

☐ It will give more benefit to next generation

☐ Others, please specify……

Reason 2: Could you please give us the reason why you give a zero amount of your willing to pay for the dengue fever vaccination program? [Interviewer do not have to read the following options, but please mark (☐) on the options that you think it match the interviewees' answer.]

☐ I am not affordable for the program.

☐ I do not think that it gives me and my family the benefit.

☐ My family are living in a good condition and I do not think we will not get infected with dengue fever.

☐ I do not think that it is an effective program to protect people from dengue fever.

☐ Others, please specify……

Part 3: Cards and Figures

Card A: The Background Information for Cambodian Dengue Disease Situation

Cambodia is considered as a nation with a low health and economic indicator with the total population around 14.6 million. Since there is a low health indicator with sanitation problem causes a lot of diseases to spread across the countries. The dengue fever infection reported as fast rising over the years. It is becoming as one of the most significant issues for the public health problems. Moreover, it was reported that the infected cases of dengue fever were drastically increased in 2008. Since 2008 there have been about 9,000 – 38,000 cases (About 103 case/100,000 population) and 3-179 deaths (About 1/100,000 population) in every year. During 2008-2017, dengue fever infection cases in Cambodia increased to the peak in 2012 with 37,675 cases as total and death 179 case. In 2012, dengue fever level, mortality and morbidity level were all at the high level of 2 and 262, respectively per 100,000 population (Ministry of Health of Cambodia, 2017).

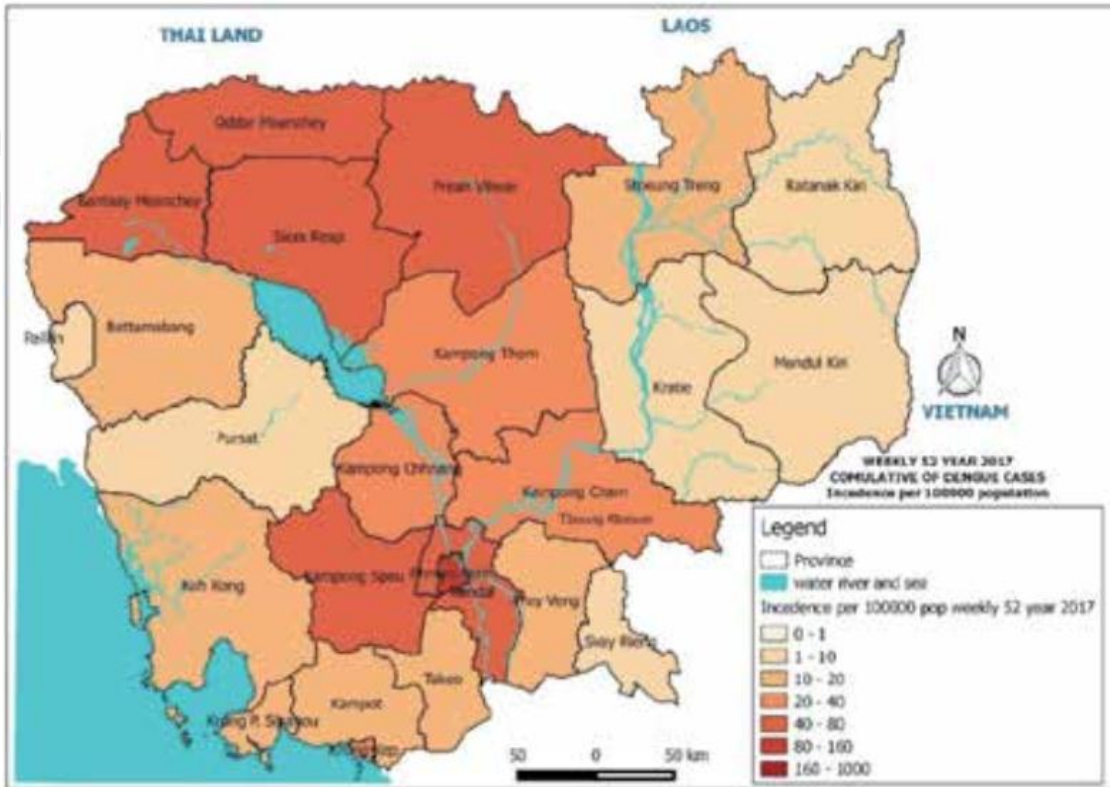


Figure 1: Cambodian mapping for dengue fever cases rates
Source: (Ministry of Health of Cambodia, 2017)

Card B: The General Knowledge about Dengue Fever and Its Transmission

The dengue virus is the main cause of an epidemic diseases that we called "Dengue Fever" (Rodenhuis-Zybert et al., 2010). There are five serotypes of the virus that was found in the family of Flaviviridae for dengue fever diseases (Dwivedi et al., 2017). We usually found that dengue fever is getting infected in subtropical and tropical region and mostly in the urban area where there is a high population density. In addition, dengue fever can be infected to all-age people, not just the children anymore. There is usually a high level of dengue fever diseases infection in the wet season, and it is lower in the dry season. This is because in the wet season or rainy season, there are high number for mosquitoes who is the one to transmit dengue fever virus. The human will be infected the dengue fever virus when they were bitten by the infected mosquitos (Palanca-Tan, 2008).

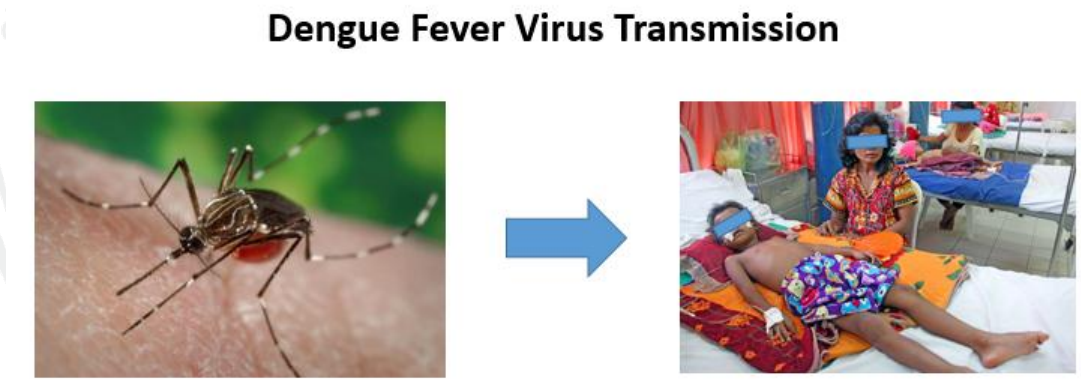


Figure 2: Dengue Fever Virus Transmission

Card C: The Dengue Fever Disease Prevention by Dengue Fever Vaccine

In the current time there is a dengue fever vaccine which represent a major advance in the control of the disease of dengue fever. It is the long-term method to protect the people from being infected to dengue fever diseases. As we have mentioned previously that dengue fever vaccine in this study paper will consist of two different levels of effectiveness such as 40% and 80% and it has no side effect to the

recipients. Moreover, its effectiveness will last for five years up which can protect the household from getting infected by four types of dengue fever virus. The household need to inject three dose of dengue fever vaccine continuously within 6 months for each dose respectively. After getting the injection for all three-dose dengue vaccine, the recipients will be protected from dengue fever infection.

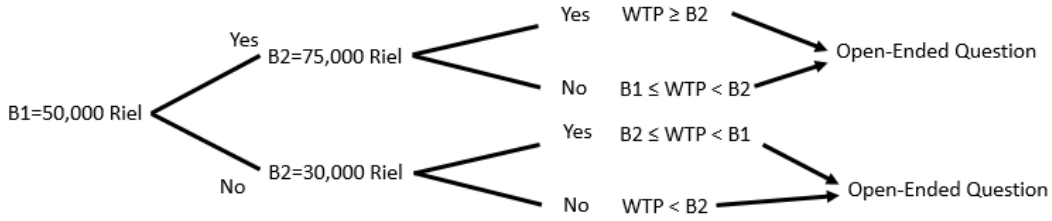
Card D: Cheap Talk Script

Let me tell you a story of a current study before we continue to the next step for the voting process to specify whether you agree to support this vaccination program or not. In the recent time, there is a survey about a program to preserve the wildlife. It is similar to you are being interview for this vaccination program now. The payment for the program was supposed to be paid by the group of interviewees if the program is passed while they actually paid nothing even the program is passed since it is just a hypothetical payment. Consequently, the result showed that there are 55% of the interviewees responded "Yes" to the program. However, within the same program but they interviewed with another similar group of people. This time the payment was real, and the people actually have to pay their money to support the program if it was passed. At this time, the result is quite different because there was only 35% of interviewees responded "Yes".

Therefore, if I were you I will imagine that this is a real program that I have to consider about my real situation regarding to my budget constraint and other circumstance to evaluate the program and give an accurate response since it will create an unbiased result which will be more efficient for the program. We do not want any undesirable consequence happened after the program is passed even though it is real or just a hypothetical one. Hence, please imagine that this is a real program and you will give away a proportion of your yearly income to support the program.

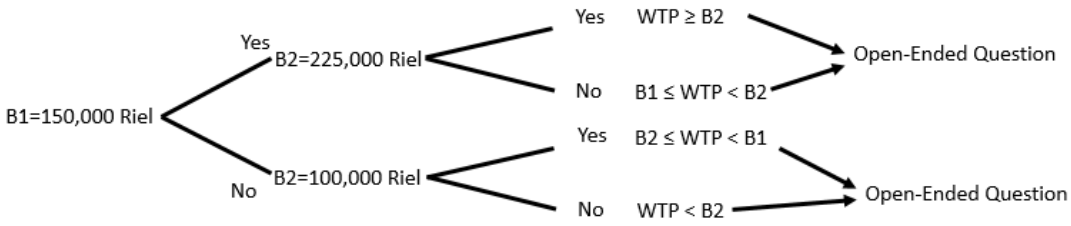
Card E1

Suppose that the government would collect an annually income tax payment of 50,000 Riel which was a single-shot payment to subsidize this dengue fever vaccination program. Are you willing to pay?



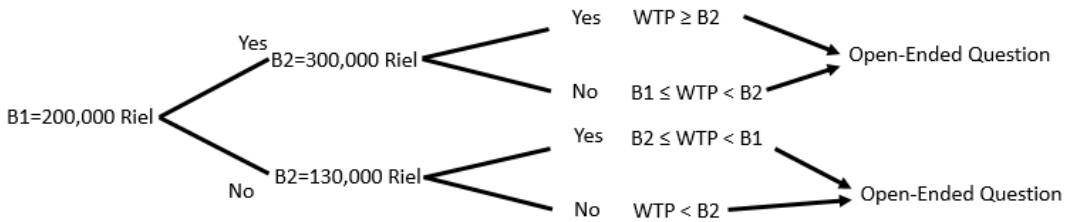
Card E2

Suppose that the government would collect an annually income tax payment of 150,000 Riel which was a single-shot payment to subsidize this dengue fever vaccination program. Are you willing to pay?



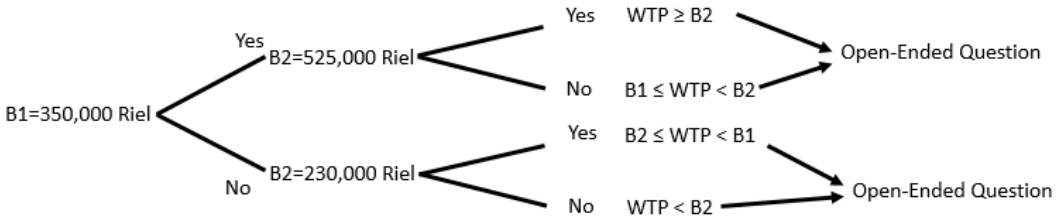
Card E3

Suppose that the government would collect an annually income tax payment of 200,000 Riel which was a single-shot payment to subsidize this dengue fever vaccination program. Are you willing to pay?



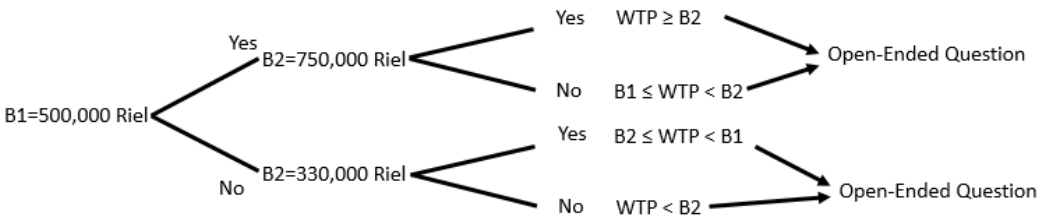
Card E4

Suppose that the government would collect an annually income tax payment of 350,000 Riel which was a single-shot payment to subsidize this dengue fever vaccination program. Are you willing to pay?



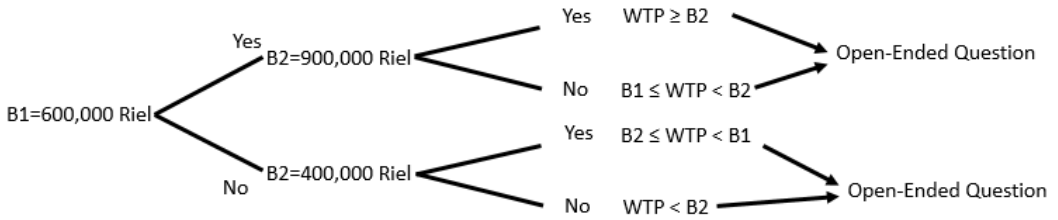
Card E5

Suppose that the government would collect an annually income tax payment of 500,000 Riel which was a single-shot payment to subsidize this dengue fever vaccination program. Are you willing to pay?



Card E6

Suppose that the government would collect an annually income tax payment of 600,000 Riel which was a single-shot payment to subsidize this dengue fever vaccination program. Are you willing to pay?



APPENDIX B

Pre-Questionnaire Focus Group

First focus group: (Male) at Vejthani Hospital November 16, 2018

This focus group of male participants was Cambodian patients who came to get the medical service at Vejthani Hospital, aged between 25-35 years old with education background at least Bachelor's degree. The summary for the raising issues about the dengue fever vaccination program from those 11 people in the first focus group:

- Most participants preferred to pay for the Dengue fever vaccination program rather than the research on the vaccine because it was more practical and useful.
- Most of them recommended that dengue vaccine should at least have 40% effectiveness to protect the people from dengue fever. Moreover, they express their positive perspectives toward the dengue fever vaccine which it should be able to protect more people by higher effectiveness level with 80% effectiveness with no side-effects, five years protection, and can protect from all types of dengue fever.
- Any side-effect on after being vaccinated? Someone asked as question that if there was a side-effect, people can be afraid to take the vaccine and they might not want to support the vaccination program.
- They would like to know more detail about the vaccine, they are afraid that they might become the person for vaccination testing.
- They want to more about the effectiveness and how long the vaccine can stay effective.
- Someone wants to know how long they have to pay for this vaccination program.
- However, they mostly preferred to vaccination program to protect their kids and family members who might be in risk of infections.

Second focus group at Vejthani Hospital (Female) November 17, 2018

This focus group of female participants was Cambodian patients who came to get the medical service at Vejthani Hospital, aged between 25-35 years old with education background at least Bachelor's degree. The summary for the raising issues about the dengue fever vaccination program from those 11 people in the second focus group:

- Most of them preferred to pay for the vaccine rather than the research on the vaccine
- Someone suggests that Government should buy the license to produce the vaccine in the country to make it cheaper.
- Most of them recommended that dengue vaccine should at least have 40% effectiveness to protect the people from dengue fever. Moreover, they express their positive perspectives toward the dengue fever vaccine which it should be able to protect more people by higher effectiveness level with 80% effectiveness with no side-effects, five years protection, and can protect from all types of dengue fever.
- Someone said that the price for dengue fever is too expensive and must inject three doses which take times and more money, then government should support in some funds.
- They want more wide use of dengue fever vaccine to protects people, especial kids, and elderly people
- But someone also said that dengue can protect by some other method that is less expensive but need sanitation and participation from society

Third focus group (Female) at Vejthani Hospital November 18, 2018

This focus group of female participants was international staff in the International Marketing Department who work at Vejthani Hospital, aged between 25-35 years old with education background at least Bachelor's degree. The summary for the raising issues about the dengue fever vaccination program from those 5 people in the third focus group:

- They agree to support the vaccine rather than the research on the vaccine

- They think that there should be any organization produce the vaccine in the country and make it cheaper.
- Most of them recommended that dengue vaccine should at least have 40% effectiveness to protect the people from dengue fever. Moreover, they express their positive perspectives toward the dengue fever vaccine which it should be able to protect more people by higher effectiveness level with 80% effectiveness with no side-effects, five years protection, and can protect from all types of dengue fever.
- Some participants in the focus group suggested that tax did not cover all people like sellers, and people who are working outside the system or informal worker.
- Some participants said that we can protect dengue by other methods beside of vaccine. It's less cost and everyone can do it.

Forth focus group (Male) at Vejthani Hospital November 19, 2018

This focus group of male participants was international staff in the International Marketing Department who work at Vejthani Hospital, aged between 25-35 years old with education background at least Bachelor's degree. The summary for the raising issues about the dengue fever vaccination program from those 5 people in the third focus group:

- More than 75% of participants in the focus group would pay for the dengue fever vaccination program
- They think that kids and elderly people should be the prior group of people that this dengue vaccination program will benefit the most, and if the program will be implemented, they should be the first group who get the vaccine.
- Most of them recommended that dengue vaccine should at least have 40% effectiveness to protect the people from dengue fever. Moreover, they express their positive perspectives toward the dengue fever vaccine which it should be able to protect more people by higher effectiveness level with 80% effectiveness with no side-effects, five years protection, and can protect from all types of dengue fever.

- All of them said that if there is this program in real, they will participate and go to get the vaccine.
- They also mentioned that even though now there is a dengue fever vaccine, but people still not aware about it and the vaccine is quite expensive which people cannot afford for it.

Fifth focus group (Male) at Payathai Hospital November 20, 2018

This focus group of male participants was Cambodian patients who came to get the medical service at Payathai Hospital, aged between 25-35 years old with education background at least Bachelor's degree. The summary for the raising issues about the dengue fever vaccination program from those 11 people in the first focus group:

- 85% of participants would like to pay for the Dengue fever vaccination program rather than the research on the vaccine because it was more practical and useful.
- Most of them recommended that dengue vaccine should at least have 40% effectiveness to protect the people from dengue fever. Moreover, they express their positive perspectives toward the dengue fever vaccine which it should be able to protect more people by higher effectiveness level with 80% effectiveness with no side-effects, five years protection, and can protect from all types of dengue fever.
- Most of them worry about the side-effect of vaccine. They asked some questions related with side-effect of vaccine. They showed the worry about the side-effect.
- They want to know about vaccine efficacy and vaccine life span how many years it can be protect the dengue fever infection.

Sixth focus group (Female) at Payathai Hospital November 21, 2018

This focus group of female participants was Cambodian patients who came to get the medical service at Payathai Hospital, aged between 25-35 years old with education background at least Bachelor's degree. The summary for the raising issues

about the dengue fever vaccination program from those 11 people in the first focus group:

- More than half of participants choose to pay for this dengue fever vaccination program while only one person chooses to pay for the research for dengue vaccine to produce in the country to make it cheaper.
- They mostly preferred to vaccination program to protect their kids and family members who might be in risk of infections.
- They think that there should be any organization produce the vaccine in the country and make it cheaper.
- Most of them recommended that dengue vaccine should at least have 40% effectiveness to protect the people from dengue fever. Moreover, they express their positive perspectives toward the dengue fever vaccine which it should be able to protect more people by higher effectiveness level with 80% effectiveness with no side-effects, five years protection, and can protect from all types of dengue fever.
- Some participants in the focus group suggested that tax did not cover all people like sellers, and people who are working outside the system or informal worker.
- According to the discussion with all the participants, we found that there are many kids and elderly people living in Phnom Penh surrounding by low sanitation environment which consist a high risk of dengue fever infection.
- Most of the participant agree to pay for the dengue fever vaccination program, but they also want the government to support for this program as well. They want to see this program is implemented for real.

List of participants for all six focus groups:

First Focus Group Name List:

1. Mr. SAMNANG TOCH
2. Mr. KHEMANORA HOR
3. Mr. PEK SENG
4. Mr. KIMYAN CHETH

5. Mr. BONA BET
6. Mr. SAMO UNG
7. Mr. SOPHA KHORN
8. Mr. SENG KEANG
9. Mr. IENG TONG HOUT
10. Mr. SAVORN VAING
11. Mr. SAVIN BORN

Second Focus Group Name List:

1. Mrs DAVAN CHENG
2. Mrs SREY LY
3. Mrs SIMON TEK
4. Mrs CHENDA CHHANG
5. Miss CHANSOLINA SOK
6. Mrs KHOM KHAT
7. Mrs NARY SIM
8. Mrs VISAL TIT
9. Mrs MOM YI
10. Mrs SOKHA BUN
11. Mrs MANISETHA SATHARIN

Third Focus Group Name List:

1. Miss SU SU WAI
2. Mrs. NI NI MINT
3. Miss YINLE WAI
4. Miss JONI JAVZ
5. Mrs JOLLY PEARL

Forth Focus Group Name List:

1. Mr. TIM PHUOK
2. Mr. KOUN HENG
3. Dr. KAUNG SACKRY
4. Mr. KI KI SAW
5. Mr. KHEMRETH VANN

Fifth Focus Group Name List:

1. Mr. SELAVITH CHOURN
2. Mr. CHANRITHY SOK
3. Mr. CHANKOSAL CHHIM
4. Mr. SOKUN SEN
5. Mr. SOK HAK AP
6. Mr. CHANDOEUNG CHEA
7. Mr. YAN MEAS
8. Mr. CHREA LIM
9. Mr. PISETH OUEN
10. Mr. KUNTHOEURN OUM
11. Mr. DARAPISEY KUNTHOEURN

Sixth Focus Group Name List:

1. Mrs SIN MAO
2. Mrs CHENDA KEO
3. Mrs HUY NEANG
4. Miss SOKTHY SOU
5. Mrs SOKSAY THY
6. Mrs LEANG SIM ROS
7. Mrs SIMON TUY
8. Mrs SYLENG AN
9. Mrs SYTHAN HOK
10. Mrs REAKSMEY TOCH
11. Mrs KIMHUON LY

APPENDIX C

Post-Questionnaire Focus Group

Post-Questionnaire on the First (female) focus-group: December 10, 2018

This focus group are the participants of 5 female aged between 25-35 years old who are the patients from Cambodia and come to get the treatment at Vejthani Hospital.

- Five Question regarding Dengue Fever: most of them gave the correct answers, only some of them still confused and cannot answer correctly
- For the experience part of Dengue Fever: most of them know someone who have infected the dengue fever. Some of them also have their own family member who experience with dengue fever.
- Dengue Fever Awareness: All of them answer correctly for all questions and they strongly agree that vaccine is the best way to protect them from dengue fever infection.
- For the vaccine effectiveness, most of the participants understand well about vaccine effectiveness and answer correctly for our three question regarding the scenarios.
- Most of them both female and male are willing to pay 50,000 Riel but some can pay up to 100,000 Riel, but if only one-time payment, they can pay up to 500,000 Riel.
- The reason that they agree to pay this dengue fever vaccination program were mostly for social benefit and for their family protection.
- Most of them said that kids are still in the high risk for this disease since they do not know well about how to protect themselves from infection.

Post-Questionnaire on the Second (Male) focus-group: December 10, 2018

This focus group are the participants of 5 male aged between 25-35 years old who are the patients from Cambodia and come to get the treatment at Vejthani Hospital.

- Five Question regarding Dengue Fever: 90% of them gave the correct answers, only some of them still confused and cannot answer correctly
- For the experience part of Dengue Fever: All of them know someone who have infected the dengue fever. Some of them also have their own family member who experience with dengue fever.
- Dengue Fever Awareness: More than half of them answer correctly for all questions and they strongly agree that vaccine is the best way to protect them from dengue fever infection.
- For the vaccine effectiveness: All participants understand well about vaccine effectiveness and answer correctly for our three question regarding the scenarios.
- Most of them both female and male are willing to pay 200,000 Riel but some can pay up to 35,000 Riel, but if only one-time payment, they can pay up to 600,000 Riel.
- The reason that they agree to pay this dengue fever vaccination program were mostly because it gives them and their family the benefit if dengue fever is protected.

Post-Questionnaire on the Third (female) focus-group: December 11, 2018

This focus group are the participants of 5 female aged between 25-35 years old who are the patients from Cambodia and come to get the treatment at Payathai Hospital.

- Five Question regarding Dengue Fever: Most of them gave the correct answers, only some of them still confused and cannot answer correctly
- For the experience part of Dengue Fever: More than half of them know someone who have infected the dengue fever. Some of them also have their own family member who experience with dengue fever. And there is one participant used to get infected the dengue fever and be curable.
- Dengue Fever Awareness: More than half of them answer correctly for all questions and they strongly agree that vaccine is the best way to protect them from dengue fever infection.

- For the vaccine effectiveness: All participants understand well about vaccine effectiveness and answer correctly for our three question regarding the scenarios.
- Most of them both female and male are willing to pay 100,000 Riel but some can pay up to 200,000 Riel, but if only one-time payment, they can pay up to 300,000 Riel.
- The reason that they agree to pay this dengue fever vaccination program were mostly because it will give more positive externality to our society and next generation.

Post-Questionnaire on the Fourth (male) focus-group: December 11, 2018

This focus group are the participants of 5 male aged between 25-35 years old who are the patients from Cambodia and come to get the treatment at Payathai Hospital.

- Five Question regarding Dengue Fever: There are four of them gave the correct answers, but one of them said that he has no idea about the question, or he does not know.
- For the experience part of Dengue Fever: All of them said they know someone who get dengue fever infection.
- Dengue Fever Awareness: They all answer correctly for all questions.
- For the vaccine effectiveness: They all answer understand and answer correctly.
- Most of them both female and male are willing to pay 100,000 Riel but some can pay up to 200,000 Riel, but if only one-time payment, they can pay up to 300,000 Riel.
- The reason that they agree to pay this dengue fever vaccination program were mostly because it will give more positive externality to our society and next generation.

Post-Questionnaire on the Fifth (female) focus-group: December 11, 2018

This focus group are the participants of 5 female aged between 25-35 years old who are the patients from Cambodia and come to get the treatment at Paolo Hospital.

- Five Question regarding Dengue Fever: All of them answer correctly.
- For the experience part of Dengue Fever: Most of them know about dengue fever.
- Dengue Fever Awareness: All of them answer correctly.
- For the vaccine effectiveness: All of them understand well about vaccine effectiveness.
- Most of them both female and male are willing to pay 50,000 Riel but some can pay up to 100,000 Riel, but if only one-time payment, they can pay up to 200,000 Riel. However, most of them also suggest that government should give some subsidy.
- The reason that they agree to pay this dengue fever vaccination program because they think that it is the best way to protect the people from dengue fever infection.

Post-Questionnaire on the Sixth (male) focus-group: December 11, 2018

This focus group are the participants of 5 male aged between 25-35 years old who are the patients from Cambodia and come to get the treatment at Paolo Hospital.

- Five Question regarding Dengue Fever: All of them answer correctly.
- For the experience part of Dengue Fever: All of them know about dengue fever.
- Dengue Fever Awareness: All of them answer correctly.
- For the vaccine effectiveness: All of them understand well about vaccine effectiveness.
- Most of them both female and male are willing to pay 50,000 Riel, only one of them are willing to pay 80,000 Reil.
- Participants give higher WTP when we ask them for the higher level of vaccine effectiveness.

- The reason that they agree to pay this dengue fever vaccination program because they want their family member such as kids and elderly people safe from dengue fever infection.

List of Participants for All Six Focus Group:

First Focus Group Name List:

1. Mrs TANN VORN
2. Mrs CHHENGLY PHAN
3. Mrs SREY PHAN
4. Mrs RATHA SOK
5. Mrs LY PANG

Second Focus Group Name List:

1. Mr. SOK HOUR PHEANG
2. Mr. HOU KE
3. Mr. MAN LEAP
4. Mr. KOSAL SEREI
5. Mr. KOSAL CHHAY

Third Focus Group Name List:

1. Mrs PRUMVATEY PRANG
2. Mrs NUON SREAN
3. Mrs LUN SAR
4. Mrs SOCHENDA SUM
5. Mrs SORN SAR

Fourth Focus Group Name List:

1. Mr. ROMNEA SEM
2. Mr. YOUDA KANG
3. Mr. HENG SIM
4. Mr. SOKAN KOAM
5. Mr. CHANTOLA NAT

Fifth Focus Group Name List:

1. Mrs PHALLY SOME

2. Miss SREY CARE MAK
3. Mrs SOKHA KORNG
4. Mrs SAMNANG YIN
5. Mrs SINUON YOU

Sixth Focus Group Name List:

1. Mr. LEAKANAK KANG
2. Mr. LY TOEUNG
3. Mr. NALEANG HENG
4. Mr. SONA LAB
5. Mr. BUNSATH TITH

APPENDIX D

Estimation Result and Method

1. Socio-Demographic Characteristics of the Respondents (Descriptive Statistics)

Descriptive Statistics
All results based on nonmissing observations.

Variable	Mean	Std.Dev.	Minimum	Maximum	Cases	Missing
All observations in current sample						
NBID	308.333	194.706	50.0000	600.000	600	0
INCOME	.170590E+07	792826.	400000.	.800000E+07	600	0
NMEMBER	4.53167	1.32234	.000000	10.0000	600	0
NKID	.511667	.500281	.000000	1.00000	600	0
AGE	30.7933	7.64841	20.0000	71.0000	600	0
MALE	.431667	.495722	.000000	1.00000	600	0
PRIVATE	.786667	.410003	.000000	1.00000	600	0
MARRIED	.595000	.491302	.000000	1.00000	600	0
SCHOOL	15.4017	2.45772	6.00000	20.0000	600	0
CURABLE	.910000	.286421	.000000	1.00000	600	0
KNOWN	.976667	.151086	.000000	1.00000	600	0
AWARE	.990000	.995818E-01	.000000	1.00000	600	0
UNDER	.991667	.909818E-01	.000000	1.00000	600	0
VEFFECT	.500000	.500417	.000000	1.00000	600	0

2. The Factors Influencing a Household's Willingness to Pay Amount to Support Dengue Fever Vaccination Program

```
--> Tobit; Lhs = WTP ; Rhs = one,income,nmember,nkid,age,male,private,married...
Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Limited Dependent Variable Model - CENSORED |
| Maximum Likelihood Estimates                |
| Model estimated: Jun 23, 2020 at 01:12:14AM.|
| Dependent variable                   WTP    |
| Weighting variable                  None    |
| Number of observations               600    |
| Iterations completed                   3    |
| Log likelihood function       -7671.222     |
| Number of parameters                  15     |
| Info. Criterion: AIC =          25.62074    |
|   Finite Sample: AIC =          25.62211    |
| Info. Criterion: BIC =          25.73066    |
| Info. Criterion:HQIC =          25.66353    |
| Threshold values for the model:             |
| Lower=      .0000     Upper=+infinity       |
| LM test [df] for tobit=    307.594[ 14]     |
| Normality Test, LM     =   115.060[  2]     |
| ANOVA  based fit measure =     .360397      |
| DECOMP based fit measure =     .433889      |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|   -238689.056       69518.7598    -3.433    .0006
 INCOME  |      .07351831       .00519285    14.158    .0000   .170590D+07
 NMEMBER |    5451.41305      3071.96205     1.775    .0760   4.53166667
 NKID    |   -13706.2510      10738.7285     -1.276    .2018    .51166667
 AGE     |    840.280594      631.210893     1.331    .1831   30.7933333
 MALE    |    17748.0428      7647.55718     2.321    .0203    .43166667
 PRIVATE |   -36492.5915      9780.15504     -3.731    .0002    .78666667
 MARRIED |    30898.0908      13207.6866     2.339    .0193    .59500000
 SCHOOL  |    12703.7603      1789.19603     7.100    .0000   15.4016667
 CURABLE |   -21959.1551      12659.9036     -1.735    .0828    .91000000
 KNOWN   |   -33305.9520      23952.1355     -1.391    .1644    .97666667
 AWARE   |    15061.2544      35935.1891      .419    .6751    .99000000
 UNDER   |    37121.3230      39091.8141      .950    .3423    .99166667
 VEFFECT |   -3806.63951      7772.03617     -.490    .6243    .50000000
---------+Disturbance standard deviation
 Sigma   |    86373.1598      2493.37836    34.641    .0000
```

3. The Result of E(WTP) using the Logit Model

- Vaccine with 40% Effectiveness Level:

```
--> maximize ; labels=alpha,bta
      ;start=0.01,0.01
      ;fcn=yy*log(1-lgp(-alpha+bta*nbidhi))+
         yn*log(lgp(-alpha+bta*nbidhi))-(lgp(-alpha+bta*nbid))+
         ny*log(lgp(-alpha+bta*nbid))-(lgp(-alpha+bta*nbidlow))+
         nn*log(lgp(-alpha+bta*nbidlow))$
Normal exit from iterations. Exit status=0.
```

```
+---------------------------------------------+
| User Defined Optimization                   |
| Maximum Likelihood Estimates                |
| Model estimated: Jun 23, 2020 at 01:22:02AM.|
| Dependent variable            Function      |
| Weighting variable                None      |
| Number of observations             300      |
| Iterations completed                 6      |
| Log likelihood function         506.2477    |
| Number of parameters                 0      |
| Info. Criterion: AIC =          -3.37498    |
|   Finite Sample: AIC =          -3.37498    |
| Info. Criterion: BIC =          -3.37498    |
| Info. Criterion:HQIC =          -3.37498    |
| Restricted log likelihood        .0000000   |
| Chi squared                     1012.495    |
| Degrees of freedom                   2      |
| Prob[ChiSqd > value] =           .0000000   |
+---------------------------------------------+
```

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
ALPHA	.49271847	.27882994	1.767	.0772
BTA	.00125556	.00127771	.983	.3258

In the Logit Model, we calculate the mean WTP as in the formula below:

E(WTP) = $\left(\frac{\alpha}{\beta}\right) * 1000 = \left(\frac{0.49271847}{0.00125556}\right) * 1000 =$ 392,429 Riel

We multiply E(WTP) by 1000 because we create the new variable nbid = $\frac{bid}{1000}$, nbidh = $\frac{bidh}{1000}$, nbidl = $\frac{bidl}{1000}$ (Because our bid, bidh, and bidl are in Cambodian Riel and it has many digits.

Note:

- Bid = Payment Rate
- Bidh (Bid High) = Higher Payment Rate
- Bidl (Bid Low) = Lower Payment Rate

- Vaccine with 80% EffectivenessLevel:

```
--> maximize ; labels=alpha,bta
      ;start=0.01,0.01
      ;fcn=yy*log(1-lgp(-alpha+bta*nbidhi))+
         yn*log(lgp(-alpha+bta*nbidhi))-(lgp(-alpha+bta*nbid))+
         ny*log(lgp(-alpha+bta*nbid))-(lgp(-alpha+bta*nbidlow))+
         nn*log(lgp(-alpha+bta*nbidlow))$
Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| User Defined Optimization                   |
| Maximum Likelihood Estimates                |
| Model estimated: Jun 23, 2020 at 01:38:57AM.|
| Dependent variable              Function    |
| Weighting variable                  None    |
| Number of observations               300    |
| Iterations completed                   7    |
| Log likelihood function         490.0306    |
| Number of parameters                   0    |
| Info. Criterion: AIC =          -3.26687    |
|   Finite Sample: AIC =          -3.26687    |
| Info. Criterion: BIC =          -3.26687    |
| Info. Criterion:HQIC =          -3.26687    |
| Restricted log likelihood       .0000000    |
| Chi squared                     980.0612    |
| Degrees of freedom                     2    |
| Prob[ChiSqd > value] =          .0000000    |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]|
+--------+--------------+----------------+--------+--------+
 ALPHA   |    1.27562331       .26442532     4.824    .0000
 BTA     |     .00404341       .00149382     2.707    .0068
```

In the Logit Model, we calculate the mean WTP as in the formula below:

E(WTP) = $\left(\frac{\alpha}{\beta}\right) * 1000 = \left(\frac{1.27562331}{0.00404341}\right) * 1000 =$ 315,482 Riel

We multiply E(WTP) by 1000 because we create the new variable nbid = $\frac{bid}{1000}$, nbidh = $\frac{bidh}{1000}$, nbidl = $\frac{bidl}{1000}$ (Because our bid, bidh, and bidl are in Cambodian Riel and it has many digits.

Note:

- Bid = Payment Rate
- Bidh (Bid High) = Higher Payment Rate
- Bidl (Bid Low) = Lower Payment Rate

4. The Result of E (WTP) using the Probit Model

- Vaccine with 40% Effectiveness Level:

```
--> maximize ; labels=alpha,bta
      ;start=0.01,0.01
      ;fcn=yy*log(1-phi(-alpha+bta*nbidhi))+
         yn*log(phi(-alpha+bta*nbidhi))-(phi(-alpha+bta*nbid))+
         ny*log(phi(-alpha+bta*nbid))-(phi(-alpha+bta*nbidlow))+
         nn*log(phi(-alpha+bta*nbidlow))$
Normal exit from iterations. Exit status=0.
```

User Defined Optimization	
Maximum Likelihood Estimates	
Model estimated: Jun 23, 2020 at 01:22:09AM.	
Dependent variable	Function
Weighting variable	None
Number of observations	300
Iterations completed	7
Log likelihood function	506.2299
Number of parameters	0
Info. Criterion: AIC =	-3.37487
Finite Sample: AIC =	-3.37487
Info. Criterion: BIC =	-3.37487
Info. Criterion:HQIC =	-3.37487
Restricted log likelihood	.0000000
Chi squared	1012.460
Degrees of freedom	2
Prob[ChiSqd > value] =	.0000000

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
ALPHA	.31056283	.17326853	1.792	.0731
BTA	.00079216	.00079658	.994	.3200

In the Probit Model, we calculate the mean WTP as in the formula below:

E(WTP) = $\left(\frac{\alpha}{\beta}\right) * 1000 = \left(\frac{0.31056283}{0.00079216}\right) * 1000 =$ 392,046 Riel

We multiply E(WTP) by 1000 because we create the new variable nbid = $\frac{bid}{1000}$, nbidh = $\frac{bidh}{1000}$, nbidl = $\frac{bidl}{1000}$ (Because our bid, bidh, and bidl are in Cambodian Riel and it has many digits.

Note:

- Bid = Payment Rate
- Bidh (Bid High) = Higher Payment Rate
- Bidl (Bid Low) = Lower Payment Rate

- Vaccine with 80% Effectiveness Level:

```
--> maximize ; labels=alpha,bta
      ;start=0.01,0.01
      ;fcn=yy*log(1-phi(-alpha+bta*nbidhi))+
         yn*log(phi(-alpha+bta*nbidhi))-(phi(-alpha+bta*nbid))+
         ny*log(phi(-alpha+bta*nbid))-(phi(-alpha+bta*nbidlow))+
         nn*log(phi(-alpha+bta*nbidlow))$
Normal exit from iterations. Exit status=0.
```

User Defined Optimization	
Maximum Likelihood Estimates	
Model estimated: Jun 23, 2020 at 01:39:06AM.	
Dependent variable	Function
Weighting variable	None
Number of observations	300
Iterations completed	7
Log likelihood function	489.8935
Number of parameters	0
Info. Criterion: AIC =	-3.26596
Finite Sample: AIC =	-3.26596
Info. Criterion: BIC =	-3.26596
Info. Criterion:HQIC =	-3.26596
Restricted log likelihood	.0000000
Chi squared	979.7871
Degrees of freedom	2
Prob[ChiSqd > value] =	.0000000

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]
ALPHA	.78844870	.15771992	4.999	.0000
BTA	.00245797	.00090351	2.720	.0065

In the Probit Model, we calculate the mean WTP as in the formula below:

E(WTP) = $\left(\frac{\alpha}{\beta}\right) * 1000 = \left(\frac{0.7884487}{0.00245797}\right) * 1000$= 320,772 Riel

We multiply E(WTP) by 1000 because we create the new variable nbid = $\frac{bid}{1000}$, nbidh = $\frac{bidh}{1000}$, nbidl = $\frac{bidl}{1000}$ (Because our bid, bidh, and bidl are in Cambodian Riel and it has many digits.

Note:

- Bid = Payment Rate
- Bidh (Bid High) = Higher Payment Rate
- Bidl (Bid Low) = Lower Payment Rate

5. The Result of E (WTP) using the Tobit Model

Since our study was based on double bounded format with the following opened ended question to make an estimation on households' willingness to pay for dengue fever vaccination program. Therefore, in the opened ended question, we can use the Tobit model to estimate the mean of households' willingness to pay to support the dengue fever vaccination program by using the formula as below:

$$E(WTP) = \Phi(\frac{Z}{\sigma}\beta)Z\,\beta + \sigma\phi(\frac{-Z}{\sigma}\beta)$$

- E(WTP): is the mean of households' willingness to pay to support the dengue fever vaccination program
- Φ: is the CDF of Standard Normal
- ϕ : is the PDF of Standard Normal
- Z : is the mean of economic variables
- β : is the coefficient of variable
- σ : is the sigma value

From the Table 4-8, the study result shows that the factors influencing a household's willingness to pay amount to support dengue fever vaccination program are Income, Gender (Male), Occupation (Private), Marital Status (Married) and Education (Number of Schooling). Income, Occupation (Private), and Education (Number of Schooling) are all statistically significant with 5% significant level. Meanwhile, Gender (Male), and Marital Status (Married) are all statistically significant with 10% significant level.

Then we will take only these independents that are statistically significant to run in the Tobit model to calculate the estimation of E (WTP) by using Limdep program.

- **Vaccine with 40% Effectiveness Level:**

```
--> Tobit; Lhs = WTP ; Rhs = one,male,private,school,income,married$
Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Limited Dependent Variable Model - CENSORED |
| Maximum Likelihood Estimates                |
| Model estimated: Jun 23, 2020 at 01:22:31AM.|
| Dependent variable                    WTP   |
| Weighting variable                   None   |
| Number of observations                300   |
| Iterations completed                    3   |
| Log likelihood function          -3805.259  |
| Number of parameters                    7   |
| Info. Criterion: AIC =           25.41506   |
|   Finite Sample: AIC =           25.41634   |
| Info. Criterion: BIC =           25.50148   |
| Info. Criterion:HQIC =           25.44964   |
| Threshold values for the model:             |
| Lower=       .0000     Upper=+infinity      |
| LM test [df] for tobit=      173.495[  6]   |
| Normality Test, LM     =     110.441[  2]   |
| ANOVA  based fit measure =      .257263     |
| DECOMP based fit measure =      .320453     |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|   -108077.267      36150.0851    -2.990   .0028
 MALE    |    11560.1519      9904.93422     1.167   .2432     .35000000
 PRIVATE |   -38478.5865      17217.1183    -2.235   .0254     .92000000
 SCHOOL  |    6763.75000      2044.93528     3.308   .0009    14.9566667
 INCOME  |     .07869581       .00706028    11.146   .0000   .152900D+07
 MARRIED |    23302.7432      9114.04620     2.557   .0106     .53666667
---------+Disturbance standard deviation
 Sigma   |    78061.8827      3186.86302    24.495   .0000
```

Independent Variable	β= coefficient	Z= Mean	Z * β
C	-108077.267		-108077.267
Male	11560.1519	0.35	4046.053165
Private	-38478.5865	0.92	-35400.29958
Edu	6763.75	14.9566667	101163.1544
Income	0.07869581	1529000	120325.8935
Married	23302.7432	0.53666667	12505.8056
		Zβ =	94563.34006

Note: Zβ is the sum of coefficient of constant (c) and the product of mean and coefficient of each independent variable that are significant.

- σ (sigma) = 78061.88
- Zβ = 94563.34
- $(\frac{Z}{\sigma}\beta) = (\frac{78061.8827}{94563.34006}) = 1.21138$
- $A = \Phi(\frac{Z}{\sigma}\beta)$ = Phi(1.21138)
- $C = \phi(\frac{-Z}{\sigma}\beta)$ = N01(-1.21138)

Then, we can run the equation in Limdep to find the value of A and C and get the result as below:

```
--> calc;list; A=Phi( 1.21138)$
+-------------------------------------+
| Listed Calculator Results           |
+-------------------------------------+
 A        =        .887125
--> calc;list; C=N01(- 1.21138)$
+-------------------------------------+
| Listed Calculator Results           |
+-------------------------------------+
 C        =        .191540
```

Then, we can get the value of A and C

- A = 0.887125
- C = 0.19154

Therefore, now we can estimate the E(WTP)

E(WTP) = [(94563.34)*(0.887125)] + [(78061.88)*(0.19154)]

= 98,841.48 Riel

- **Vaccine with 80% Effectiveness Level:**

```
--> Tobit; Lhs = WTP ; Rhs = one,male,private,school,income,married$
Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Limited Dependent Variable Model - CENSORED |
| Maximum Likelihood Estimates                |
| Model estimated: Jun 23, 2020 at 01:39:36AM.|
| Dependent variable                    WTP   |
| Weighting variable                   None   |
| Number of observations                300   |
| Iterations completed                    3   |
| Log likelihood function         -3863.507   |
| Number of parameters                    7   |
| Info. Criterion: AIC =           25.80338   |
|   Finite Sample: AIC =           25.80466   |
| Info. Criterion: BIC =           25.88980   |
| Info. Criterion:HQIC =           25.83797   |
| Threshold values for the model:             |
| Lower=      .0000     Upper=+infinity       |
| LM test [df] for tobit=     132.648[  6]    |
| Normality Test, LM    =      79.825[  2]    |
| ANOVA  based fit measure =      .381345     |
| DECOMP based fit measure =      .446517     |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Primary Index Equation for Model
 Constant|| -225741.823      46824.7922    -4.821    .0000
 MALE    |   33621.4011      11205.4778     3.000    .0027     .51333333
 PRIVATE |  -35920.4461      13061.8162    -2.750    .0060     .65333333
 SCHOOL  |   14270.8503      2696.04975     5.293    .0000    15.8466667
 INCOME  |    .07408423       .00743759     9.961    .0000   .188280D+07
 MARRIED |   19820.9063      12388.5649     1.600    .1096     .65333333
---------+Disturbance standard deviation
 Sigma   |   94789.9157      3869.78211    24.495    .0000
```

Independent Variable	β= coefficient	Z= Mean	Z * β
C	-225741.823		-225741.823
Male	33621.4011	0.51333333	17258.98579
Private	-35920.4461	0.65333333	-23468.02467
Edu	14270.8503	15.8466667	226145.4082
Income	0.07408423	1882800	139485.7882
Married	19820.9063	0.65333333	12949.65872
		Zβ =	146629.9933

Note: Zβ is the sum of coefficient of constant (c) and the product of mean and coefficient of each independent variable that are significant.

- σ (sigma) = 94789.91
- Zβ = 146629.99

- $(\frac{Z}{\sigma}\beta) = (\frac{146629.99}{94789.91}) = 1.54689$
- $A = \Phi(\frac{Z}{\sigma}\beta)$ = Phi(1.54689)
- $C = \phi(\frac{-Z}{\sigma}\beta)$ = N01(-1.54689)

Then, we can run the equation in Limdep to find the value of A and C and get the result as below:

```
--> calc;list; A=Phi( 1.54689)$
+-------------------------------------+
| Listed Calculator Results           |
+-------------------------------------+
 A        =        .939055
--> calc;list; C=N01(- 1.54689)$
+-------------------------------------+
| Listed Calculator Results           |
+-------------------------------------+
 C        =        .120588
|
```

Then, we can get the value of A and C

- A = 0.939055
- C = 0.120588

Therefore, now we can estimate the E(WTP)

E(WTP) = [(146629.99)*(0.939055)] + [(94789.91)*(0.120588)]

= 149,124.15 Riel

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BIOGRAPHY

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