Policymakers’ views on dengue fever/dengue haemorrhagic fever and the need for dengue vaccines in four southeast Asian countries

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Abstract

A survey of policymakers and other influential professionals in four southeast Asian countries (Cambodia, Indonesia, Philippines and Vietnam) was conducted to determine policymakers’ views on the public health importance of dengue fever and dengue haemorrhagic fever (DHF), the need for a vaccine and the determinants influencing its potential introduction. The survey, which involved face-to-face interviews with policymakers, health programme managers, researchers, opinion leaders and other key informants, revealed an almost uniformly high level of concern about dengue fever/DHF and a high perceived need for a dengue vaccine. Several characteristics of the disease contribute to this high sense of priority, including its geographic spread, occurrence in outbreaks, the recurrent risk of infection each dengue season, its severity and the difficulty in diagnosis and management, its urban predominance, its burden on hospitals, and its economic toll on governments and families. Research felt to be key to future decision-making regarding dengue vaccine introduction include: disease surveillance studies, in-country vaccine trials or pilot projects, and studies on the economic burden of dengue and the cost-effectiveness of dengue vaccines. The results suggest favourable conditions for public and private sector markets for dengue vaccines and the need for creative financing strategies to ensure their accessibility to poor children in dengue-endemic countries.

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1. Introduction

Dengue fever (DF) is an acute mosquito-transmitted disease, which has become an increasing public health problem [1–4]. Each year, there are an estimated 50–100 million cases of dengue fever, including 250,000–500,000 cases of dengue haemorrhagic fever and dengue shock syndrome (DHF/DSS), and 30,000 deaths [5]. Due to its rapid expansion from southeast Asia to Latin America and other tropical regions, as well as within countries, more than one-half of the world’s population now lives in areas at risk for the disease [6].

There are four dengue serotypes (DEN 1–4); infection with one serotype provides life-long immunity against that same serotype but not against the others. During a dengue infection, the presence of heterologous antibodies either maternally acquired or from a previous dengue infection has been shown to increase the risk for severe disease, that is, dengue haemorrhagic fever and dengue shock syndrome [7,8]. While fluid resuscitation and intensive care can be life-saving measures against severe disease, specific treatments are not available. The main preventive strategy, mosquito control, has entailed mosquito spraying and larviciding and/or efforts to reduce mosquito breeding areas (source reduction) through community-based activities and health education. Most of the dengue-endemic countries support Aedes aegypti control programmes. Despite some success in a few countries, widespread mosquito control efforts have been difficult to sustain [4,9].

The development of a vaccine offers the potential for effective prevention and long-term control of dengue infection. There are several promising dengue vaccines under development [10]. These include two live tetravalent vaccines conventionally attenuated by serial passage in primary dog kidney or in primary African green monkey kidney cell cultures [11–13]. Applying the technology of introducing dengue virus premembrane and envelope genes into the non-structural portion of the yellow fever or a dengue virus, several chimeric vaccines are also under development. These are also live vaccines, with attenuation achieved through...
significant deletions in the genetic structure of the dengue viruses [14–18].

The objective of this study was to survey policymakers and other influential professionals in four dengue-endemic countries in Asia (Cambodia, Indonesia, Philippines, and Vietnam) on the public health importance of dengue, the need for a vaccine, and the determinants influencing its potential introduction. In surveying the opinions of those who will actually make decisions about introducing and implementing dengue immunization, such a study can help ensure that dengue research activities, including vaccine development and testing, are in line with the needs of policymakers in dengue-endemic countries. Doing so may help reduce the often 10–20-year delay between vaccine development and its widespread use in developing countries, as has been the case with hepatitis B and other newer vaccines. This study represents the first systematic effort to understand policymakers’ views toward dengue and the potential use of future dengue vaccines in Asia.

2. Methods

2.1. Country selection

The researchers decided to limit the study to Asia, where the dengue disease burden is greatest. A convenience sample of four countries was selected on the basis of the following criteria:

- Countries widely recognized for a number of years as being endemic for dengue.
- Countries where visits were logistically feasible and where the researchers were able to identify and establish relationships with local collaborators.
- Countries with populations of 5 million or more.
- Countries where visits were logistically feasible and where the researchers were able to identify and establish relationships with local collaborators.

We excluded Asian countries where dengue endemicity is uncertain (Nepal and Bhutan) and others where the disease has only recently begun to be recognized as a public health problem (Bangladesh, India, Maldives and Sri Lanka) [19]. Logistical difficulties and limited contacts precluded Laos and Burma. The relative affluence of Singapore and Malaysia, which will have fewer problems making policy choices or being able to afford a vaccine, eliminated these two countries. The South Pacific island countries were not included because of their rather small populations. While Thailand was considered a possible country, the authors felt that, given the preponderance of dengue research conducted in the country, the high quality of its dengue surveillance and reporting system and local efforts to develop a dengue vaccine, the importance of the disease and need for a vaccine to Thai policymakers was already apparent.

2.2. Data collection

The survey used a question guide based on key issues influencing the introduction of a potential dengue vaccine, identified from a review of factors influencing the uptake of new vaccines in developing countries [20–23] and the experience from a seven-country survey of policymakers on enteric diseases and new generation vaccines against them [24]. A review of the dengue literature, including the special challenges of immunization against dengue [10,25], and the dengue clinical and research experience of one of the authors (JD) also informed the development of the question guide. The questions explored respondents’ beliefs, attitudes and opinions regarding the scope and seriousness of DF/DHF in their country, the level of priority of dengue control, the quality and accuracy of existing surveillance data, the effectiveness and importance of current preventive and treatment methods, the need for and interest in dengue vaccines, criteria and preferences regarding dengue vaccines, preferred or feasible strategies for vaccine introduction (including financing), and data requirements to inform future decision-making regarding dengue vaccine introduction and use.

The question guide consisted entirely of open-ended questions, allowing for a qualitative semi-structured interview format. The semi-structured interview approach provided an informal atmosphere, facilitating the open expression of views and ideas among respondents and allowed for the probing of key issues, identification of new issues or facts as they arose, and the clarification of responses. The authors had learned from prior experience that semi-structured interviews were most effective for the often high-elevation respondents involved, as opposed to highly-structured interviews using a close-ended questionnaire.

Data collection took place during country visits of four to five days each by one of the authors (DD) in Vietnam, Indonesia and Cambodia and by two authors (DD and JD) in the Philippines. Local collaborators, who helped arrange the interviews and served as informants, also sat in on several of the interviews, especially in Vietnam and Cambodia. Interviews were conducted on a one-to-one basis or through group meetings with two to eight participants each. Each interview or meeting lasted on average 1–2 hours. All interviews or meetings in the Philippines, Vietnam and Indonesia were conducted in English. In Cambodia, about half of the interviews were conducted by the lead author in French and in some cases, questions, and answers were translated orally into Khmer by the local collaborator for clarification.

2.3. Selection of interviewees

Individuals or groups from the public and private sector who were identified by local collaborators and by the authors as playing a decision-making or influential role in disease control, immunization, or vaccine introduction were interviewed. These included Ministry of Health (MOH) officials from the communicable disease control, preventive...
Table 1
Number of persons taking part in interviews or meetings by country and type of position

<table>
<thead>
<tr>
<th>Type of position</th>
<th>Cambodia</th>
<th>Indonesia</th>
<th>Philippines</th>
<th>Vietnam</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central Ministry of Health programme managers(a)</td>
<td>4</td>
<td>5</td>
<td>7</td>
<td>10</td>
<td>26</td>
</tr>
<tr>
<td>Senior policymakers (in MOH or national planning agency)</td>
<td>1</td>
<td>2</td>
<td>–</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Political leaders (national or local)</td>
<td>–</td>
<td>–</td>
<td>3</td>
<td>–</td>
<td>3</td>
</tr>
<tr>
<td>Public hospital directors and other representatives</td>
<td>2</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>Research institute scientists and academicians</td>
<td>4</td>
<td>4</td>
<td>13</td>
<td>3</td>
<td>24</td>
</tr>
<tr>
<td>Medical association representatives (1^b)</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>–</td>
<td>7(^b)</td>
</tr>
<tr>
<td>Local health officials</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>International agency officials (e.g. WHO)</td>
<td>2</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Total persons interviewed or who participated in meetings</td>
<td>14(^b)</td>
<td>14(^b)</td>
<td>41</td>
<td>22</td>
<td>91</td>
</tr>
<tr>
<td>Total number of interviews or meetings</td>
<td>10</td>
<td>13</td>
<td>12</td>
<td>13</td>
<td>48</td>
</tr>
</tbody>
</table>

\(^a\)include managers of national dengue control and vector control programmes, communicable disease control divisions, national immunization programmes, preventive medicine departments, disease surveillance and planning departments. 
\(^b\)The medical association officials interviewed in Cambodia and Indonesia were also counted in another category and thus not included in the total.

2.4. Data analysis

The results were analyzed separately for each country. Following each country visit, a complete set of notes from the interviews was transcribed by topic area and then by person or group interviewed, including salient quotations. From these transcripts, the lead author analyzed the types of responses and patterns of responses by the type and level of the informants. Country-specific summaries of the responses were then prepared, grouped by topic area (e.g. seriousness of the problem, reasons for concern, ranking of dengue among disease priorities). The country summaries were sent to the local collaborators and to each person or group interviewed, although little feedback was received.

3. Results

3.1. Concern for and fear of dengue among policymakers and practitioners

A striking finding from the survey is the high degree of consensus both within and across countries that dengue, specifically DHF, is a cause of great concern and a growing priority. The importance of DHF was highlighted by nearly all informants, including national and local government officials and hospital directors who deal with the whole spectrum of diseases. Among the reasons given for the importance of DHF were:

- **There is a high and growing incidence:** One paediatrician from the Philippines, for instance, quoted Department of Health data showing an increase in reported incidence of clinically diagnosed DF/DHF from 1.5/100,000 in the 1970s to 12.1/100,000 by the early 1990s—an increase of more than 700%. The increase in incidence over time and the increasing occurrence of annual outbreaks was also mentioned as a concern by respondents in Cambodia, Indonesia and Vietnam.

- **DHF has become nation-wide in scope and is no longer just an urban disease:** Unlike diseases that are more limited geographically, informants in all countries expressed concern about the broad and growing spread of DHF. While the disease was first recognized in 2 cities in Indonesia in 1968, by 2001, it was reported in all of the nation’s provinces and in 93% of its 310 districts. The spread outside cities is a particular concern to policymakers and practitioners, given the often poorer diagnosis and management of the diseases and higher case fatality in rural areas. A pilot intensive reporting system in southern Vietnam is finding that 70% of dengue-related deaths occur in rural areas. One informant in Cambodia estimates that the case fatality from DHF can be more than 20% in remote rural areas, as compared to 3–10% in provincial capitals and around 1% in Phnom Penh.

- **DHF is a major cause of hospital admissions and mortality:** According to hospital directors, DHF is the second highest cause of paediatric admissions at Jakarta’s largest public hospital (after acute respiratory infections) and the fifth highest cause of all admissions at the city’s infectious disease hospital (after diarrhoea, acute respiratory infections (ARI), typhoid fever and tuberculosis). It is “one of three killer diseases” at Cambodia’s National
There is an increasing occurrence of DHF throughout the year. While there are still peak dengue seasons, informants expressed concern that the disease is increasingly occurring throughout the year. Incidence data from a local city government in the Philippines showed clinically diagnosed cases occurring for only 4–6 months of the year from 1998 to 2000, while in 2001, cases were reported for all but 2 months of the year. The occurrence of the disease throughout the year was also mentioned as a concern by respondents in Indonesia and Vietnam.

- There are major epidemics every 3 or 4 years: Unlike several other main causes of child morbidity and mortality, such as diarrhoea, ARI and malaria, there are major epidemics of DF/DHF around every 3 or 4 years in southeast Asian countries. According to informants, the epidemics can cause the population to panic and can overwhelm hospitals.

- The disease places a large burden on hospitals: Across countries, informants talked of the enormous strain that DHF cases place on hospital staffs, facilities and finances, especially but not only, during peak seasons and epidemic years. During the 1998 pandemic, hospital chapels in the Philippines were turned into dengue wards for overflowing patients. That same year, the main paediatric hospital treating DHF patients in Phnom Penh, Cambodia had to open a new ward and hire additional nurses away from other hospitals. There are usually two children to a bed in the Phnom Penh hospital—to which DHF cases make a significant contribution.

- DHF is difficult to diagnose and manage: According to several physicians interviewed in the Philippines and Indonesia, the difficulty of accurately diagnosing dengue in its early stage and the high risk of death if DHF is not recognized and managed has led practitioners to greatly fear potentially misdiagnosing DHF cases and consequently to view almost every patient as a dengue suspect during epidemics. One Filipino paediatrician called it “the most feared [by providers] among clinical conditions”.

- DF/DHF is difficult to prevent and poses a risk across socio-economic classes: Dengue was viewed by most informants in all countries as extremely difficult or impossible to prevent, given the difficulty in avoiding mosquito bites, especially in crowded cities. The widespread perception in all countries involved in the study was that “anyone can get dengue”, “from the Minister’s son to the very poor”. This perceived risk to the classes to which policymakers and other influential professionals belong undoubtedly heightens their awareness and concern about the disease.

- The population is highly aware of and fears DHF: The generally high awareness of and concern for DF/DHF among the public in these countries contributes to the sense of importance policymakers place in the disease. In Indonesia, for instance, a knowledge, attitudes and practice survey conducted in seven cities in 1997 found that 53% of the population were knowledgeable about dengue and its prevention methods [26], and population awareness of dengue is considered higher than it is for typhoid fever or tuberculosis—two other prevalent diseases in the country. This relatively high awareness is noted in all four countries but is considered greatest in urban areas and during epidemics. It is attributed to promotional campaigns, media attention during peak periods, and the fact that, according to one Filipino informant, “everyone knows someone who’s died from DHF”. Across countries, informants described the anxiety and even panic that the disease engenders among parents, especially once a family member gets the disease, an outbreak is suspected or, once a child gets his or her first infection. This causes many people to come to the hospital during the dengue season suspecting they have the disease, further overwhelming health facilities.

3.2. A top national health priority

In all four countries, DF/DHF is a declared health priority. It is one of four priority infectious diseases recently declared by the Philippines Secretary of Health, along with tuberculosis, malaria and rabies. DHF has been added to Cambodia’s declared health priorities, which now number six, and is one of four diseases (along with measles, cholera and acute flaccid paralysis) included in an early warning system requiring weekly reports from all hospitals. In both Vietnam and Indonesia, DHF control is 1 of the 10 national priority health programmes, although it is below priorities, such as malaria, tuberculosis, HIV/AIDS and ARI. Being declared a national priority usually means additional and more protected funding for prevention and treatment programmes.

In addition to the disease’s growing incidence, spread, and other reasons outlined earlier, several socio-economic factors were also cited by informants as contributing to its priority status. These include: the considerable media attention given to DF/DHF outbreaks; the fact that the disease strikes urban areas, which are centres of political power and the media; and the fact that the public and the media—predominantly in the Philippines and Indonesia—view DHF as a government problem and responsibility and often blame national and local governments for not doing enough to prevent the disease, thus turning it into a political issue.

3.3. Consensus on the urgent need for dengue vaccines

The study found near universal agreement among policymakers and other informants in all countries concerning the importance of and urgent need for a dengue vaccine.
Most informants were doubtful of the potential impact that source reduction through community participation—the prevention method now most espoused by WHO and several governments—will have on disease incidence in their countries. The reasons cited included the large amounts of financial and human resources required on a sustained basis, the inadequacy of current funding, and the perceived difficulty in changing people’s behaviour. As one Indonesian informant argued, community participation is “almost impossible”, since we’re asking [poor] people to think about this disease, when they’re worrying about what to eat today. Given the perceived problems with source reduction and the expense and short-term impact of mosquito spraying, informants called vaccines the “ultimate weapon” and the “ideal solution” in controlling DF/DHF. Typical was the response of one Vietnamese official, who ranked vaccines as the most important means of controlling dengue, followed by vector control and early diagnosis and improved treatment.

A number of informants across countries felt that a dengue vaccine—once available—should be the next vaccine priority for their national immunization programme, that is, once nation-wide hepatitis B introduction is achieved. In all countries, most persons interviewed considered a vaccine against dengue a higher priority than a Haemophilus influenzae type B (Hib) vaccine. Local government officials in the Philippines and Indonesia claimed they would buy a dengue vaccine on their own for their populations, provided it was affordable. Given the political dimensions of dengue described above, Filipino informants talked of the potential political benefits to the government and to individual politicians of dengue vaccine introduction. According to a leading paediatrician, “any politician who brought a dengue vaccine to the Philippines [through the national immunization programme] could become President.”

Besides the difficulty in preventing and managing the disease, reasons given for the high priority respondents placed on dengue vaccines included: the occurrence of epidemics, the potential lives saved from vaccination, the expected relief to overburdened health facilities and the growing incidence and spread of the disease. Economic arguments for vaccination were also common, especially in Vietnam and Cambodia. Vaccination was viewed as saving costs now spent on prevention and treatment.

3.4. Perceived population demand for dengue vaccines

Informants in all countries believed that there would be high population demand for a dengue vaccine. Paediatricians in the Philippines and Indonesia reported that patients coming to health facilities now ask for dengue vaccine, while, according to one Filipino informant, they do not ask for pneumonia or dysentery vaccines. According to some informants in Indonesia and Vietnam, population demand for a dengue vaccine would be greater than for hepatitis B vaccine, given the more frightening clinical manifestations of DHF and their rapid onset, as compared to hepatitis B, which does not lead to serious complications until well into adulthood. The main reasons why informants believed population demand would be high were: the high population awareness of and concern about dengue (“people live in fear”), the severity of its symptoms (e.g. bleeding), the difficulty in treating the disease, and the strong acceptance of and demand for vaccines in general among their populations. The heavy financial burden of DHF on families was another reason frequently given. It had been estimated in Jakarta, Indonesia that the average medical costs for a DHF grade II or III case and for an ICU admission were the equivalent of 43 and 188% of the average monthly family income, respectively. Medical costs of simple dengue fever (not DHF) were estimated in Cambodia to be around US$ 20—the equivalent of a public sector physician’s monthly salary. These estimates do not take into account the economic costs to families from missing work.

While no formal market demand or willingness-to-pay studies have been carried out on dengue vaccines in these countries, many informants believed that if the vaccine is not provided free through the government sector, there would be a large potential dengue vaccine market. This market would be in the private sector in the Philippines and Indonesia and in the public sector in Vietnam, where “non-EPI” vaccines are sold at low cost through government health facilities. Informants in these countries believed that this market would extend beyond the relatively small middle and upper classes to reach the working classes, unless the vaccine price was prohibitive. The private sector market was considered most limited in Cambodia, a country with a gross national income per capita of US$ 270, although a key ministry of health official felt that even the poor would be willing to pay for a dengue vaccine.

3.5. Major concerns, criteria and preferences regarding dengue vaccines

When asked which criteria for a dengue vaccine were critical to government acceptance or to their promoting its use in the private sector, safety was the most frequently mentioned in all four countries. There was considerable concern, especially in the Philippines and Indonesia, that use of the vaccine may increase the risk for severe disease, as it could mimic a primary or secondary infection. An acceptable level of efficacy and length of protection were also top criteria—with 80% efficacy against all four serotypes and 3–5 years length of protection commonly given across countries as the minimum acceptable levels. Low vaccine cost was also considered a key factor—the most important to some—to government uptake of a dengue vaccine. Suggested maximum prices that governments would pay were US$ 0.50 per dose to US$ 2–3 per series in Indonesia, US$ 0.50–1.00 per dose in Cambodia, and around US$ 0.50 per dose in Vietnam. In the Philippines, given its recent experience with hepatitis B vaccine, where government procurement was halted for 2 years due to budget constraints and competing priorities,
there was a general consensus that the price of a dengue vaccine to the government must be less than the current price of their plasma-derived hepatitis B vaccine (around US$ 0.33 per dose or US$ 1.00 per series).

There was also a general preference for a dengue vaccine requiring as few doses as possible—ideally one. This was due to the concern about dropouts after the first dose (which is especially a problem in Cambodia where 80% of EPI vaccines are delivered through outreach services) and to the fear that partial protection from incomplete immunization may lead to severe disease. Some informants also expressed interest in vaccines that would place a minimal burden on their immunization programmes, such as those with minimal cold chain requirements and oral vaccines.

Informants across countries showed a preference for the chimeric dengue vaccine candidates over the conventionally attenuated live vaccines. This was due in part to a fear among several informants that the live vaccines could lead to secondary infections or could convert to virulent strains—a fear that was most pronounced in Indonesia. Another reason for the preference for chimeric vaccines in Indonesia stems from the use of dog organs in passaging one of the live vaccines and the fact that dogs are not considered clean (halal) in the Moslem faith. This would make any vaccine using dogs in processing unacceptable in Indonesia, where Moslems make up 90% of the population, and in other countries with sizeable Moslem populations.

3.6. Most feasible or preferred strategies for financing dengue vaccines

Most informants in the four countries believed that ways of financing a dengue vaccine—unless prohibitively expensive—would be found, if not through traditional financing mechanisms. While most informants preferred that the central government finance the vaccine and provide it free to all children through their EPI, many did not view this as realistic, at least initially. It was commonly believed in the Philippines and Indonesia—both countries with decentralized health systems—that the funding of dengue and other new vaccines will now be the responsibility of local governments—with central or provincial governments covering the costs for poorer localities. Local governments would finance the vaccine with local tax revenues, through income-generating schemes or, as mentioned in Indonesia, by charging a reasonable fee to patients, while exempting the poor.

In Vietnam, the overall assumption among informants was that, as is currently the case with Japanese encephalitis immunization, there would be a parallel programme of free vaccination through the EPI for certain groups (e.g. children, people in rural areas, children in high-incidence areas) and sale of the vaccine at a reasonable price at public sector facilities to others (e.g. adults, urban residents, people in lower incidence areas, etc.). Local production of the vaccine was also viewed as a key strategy in Vietnam to reduce vaccine costs to a level where such a scheme could be successful. The majority of interviewees in Cambodia believed that the vaccine would have to be provided free through the EPI and be financed with donor funding, which currently covers the majority of EPI programme costs.

3.7. Research and data needs to inform decision-making

The types of data or studies mentioned most frequently by informants as necessary for decision-making regarding dengue control, including future immunization, were: (1) laboratory-confirmed data on disease incidence and disease burden; (2) vaccine trials or demonstration projects; and (3) data on the economic burden of dengue and the cost-effectiveness of dengue vaccines.

3.7.1. Laboratory-confirmed data on disease burden

The interest across countries in collecting credible incidence data stems largely from the perceived inaccuracy of official reports on DF/DHF due to the lack of laboratory confirmation, the difficulty in diagnosing DF/DHF, and the lack of distinction in these countries between DF and DHF in official reports. Both under-reporting and over-reporting were believed to occur. Informants in the Philippines, Indonesia and Vietnam cited instances where re-examination of suspected DF/DHF cases revealed that only a fraction—10% in one study in the Philippines and one in 20 cases in a study in Vietnam—turned out to actually have DHF.

Another key reason given for the need to conduct dengue disease burden studies was the increasing need of government decision makers for scientific data (“real numbers”) on which to base decisions regarding priorities and resource allocation. Even though DF/DHF is a stated priority of health ministries in all four countries, credible evidence of the nation-wide spread and growing incidence of DHF would “open eyes” and help convince decision-makers outside of the ministry (e.g. senators in the Philippines) of the extent of the problem. Another reason given for the need for disease burden data was to identify age groups and geographic areas for targeting immunization.

3.7.2. In-country vaccine studies

The majority of informants in all four countries believed dengue vaccine trials or demonstration projects conducted in their countries would be necessary before decisions could be made regarding public use of a vaccine. Given the potential differences between populations in their immune response to vaccination, the documented differences in the endemicity of the disease, as well as ecological and other factors, policymakers increasingly require country-specific data on safety, efficacy of and the immunological response to new vaccines. Informants also believed trials could provide key information concerning programme feasibility, population acceptance of the vaccine, and cost-effectiveness of vaccination.
3.7.3. Data on the economic burden of dengue and the cost-effectiveness of dengue vaccines

Economic data, including cost-of-illness from DHF and the cost-effectiveness of vaccination compared to treatment and to other preventive measures, were frequently cited as critical to inform decision-making regarding dengue control and future vaccination. This was especially true in the Philippines and in Indonesia, where nearly all informants mentioned the need for such data to assist the government in setting priorities, to counter potential opposition to vaccine introduction in national or local legislatures, and to market the vaccine to local governments.

4. Discussion

There are several limitations of this study that should be considered when interpreting the findings. As with all qualitative studies, there is the possibility of misunderstanding or biased interpretation of informants’ responses. The structure of the interviews, which allowed for probing and clarification of responses, was designed to minimize misinterpretation. Secondly, the sample of policymakers and other informants in each country was relatively small, could potentially have a bias or particular interest in dengue, or may not have been representative of all key decision-makers in the country. This latter point could especially be true in Indonesia and the Philippines, where we were able to meet with only a limited number of local officials but where local governments are increasingly becoming decision-makers regarding health interventions. However, the fact that we met with several top policymakers and others dealing with an array of health concerns, coupled with the relative uniformity of responses within each country, lead us to believe that we tapped the prevailing opinions and beliefs among policymakers and other key stakeholders regarding dengue and dengue vaccines.

Given the considerably larger number of informants in the Philippines (41) than in the other three countries (between 14 and 22), one could also argue that the findings were overly influenced or driven by the informants from this country. However, we analyzed the findings separately for each country and have tried to describe the various countries’ results under each topic, where there were differences among countries. Furthermore, many of the informants in the Philippines took part in group meetings, in which participants were interviewed as a group and not individually, and not all responded to all of the questions during these meetings. The number of meetings or interviews held per country was, in fact, quite similar across countries (between 10 and 13).

The results of this four-country survey indicate a high degree of consensus within and between countries on the relative importance of DHF and the urgent need for dengue vaccines. The level of concern and priority that policymakers and other influential professionals place on DHF appears higher than the mortality that it causes would seem to warrant. The estimated 30,000 annual deaths world-wide from DHF compare to, for example, an estimated 600,000 annual deaths from typhoid fever and 1.1 million deaths from Shigella [27,28]. These findings demonstrate that many more factors, besides morality and morbidity rates, influence the perceived relative importance of a disease among policymakers, the public and the media. In the case of DHF, these factors include its frightening symptoms and the possibility of sudden death; the frequent difficulty in diagnosing and managing the disease; the absence of a specific treatment; its occurrence in epidemics; the recurrent risk for the disease during each dengue season, particularly among children; the growth and geographic spread of the disease; the perceived difficulty in preventing infection; the burden DHF places on already financially-strapped and understaffed hospitals, and its economic impact on both governments and families.

A number of social and economic factors may also contribute to the high sense of priority of DHF. The risk to all socio-economic classes of getting the disease, including middle and upper classes; its prevalence in cities; and the media attention that it receives during epidemics all may act to increase its prominence among policymakers and the public—as compared to non-epidemic diseases that primarily affect rural dwellers and the poor. The fact that the public and the media tend to blame local or national governments for dengue outbreaks also undoubtedly contributes to policymakers’ and politicians’ level of concern about the disease.

The high degree of concern about DHF among policymakers and, according to informants, among the public indicate a large potential demand for a dengue vaccine both in the government and private sectors. The study found a high level of interest among government officials in the use of future dengue vaccines. This was particularly true among local government officials and politicians in the Philippines and Indonesia, since, especially with decentralization, local governments in these countries most directly feel public pressure to address key health problems. Given the level of interest and the perceived high population demand, it appears likely that creative, alternative financing mechanisms will need to be devised to provide dengue vaccines through the public sector. These mechanisms may include local government or shared central and local government financing; charging user fees at or below costs in public health facilities to the non-poor; or targeting public sector vaccines to the poor or to high-risk groups or areas, while promoting private sector immunization for wealthier or lower-risk groups. Low vaccine cost will be critical to government uptake of dengue vaccines, as will proof of vaccine safety and efficacy. These findings also suggest favourable conditions for strong private sector markets for dengue vaccines, especially in the Philippines and Indonesia, which have sizeable middle and high income classes—but which may extend beyond these elites. Once candidate vaccines are closer to licensing, market demand and willingness-to-pay surveys...
would be useful in these countries to assist in predicting demand and in determining prices that will make the vaccine financially accessible to working or lower classes. In Vietnam, a demand for “free market” dengue vaccine sold at reasonable prices at public health facilities could also be built.

Several research activities can help accelerate the actual introduction and use of dengue vaccines, once they are more developed. As these findings and those from a poliovirus survey on new generation enteric vaccines [24] indicate, proven high disease burden is a key criterion to decision-makers in setting health priorities and making budgetary decisions. Credible, laboratory-confirmed incidence and mortality data on DHF will likely be required in many countries before governments are willing to invest in a dengue vaccine. Dengue vaccine trials or pilot projects to prove safety, efficacy and programme feasibility will also be a requirement in many places. This is especially true since, unlike many other vaccines, there will not be a rich body of evidence from its use in industrialized countries. Economic studies may also be critical, according to the findings, in estimating the true costs of the disease to society and to governments, in estimating cost savings from vaccination, and in comparing cost-effectiveness of vaccination with that of current treatment and prevention measures.

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