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PREVALENCE, DISTRIBUTION, & CONTROL OF DENGUE IN INDIA & THAILAND

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ABSTRACT

Dengue is the world's fastest growing viral vector-borne disease (WHO, 2015). Due to international travel and trade, demographic and climate changes, the incidence of dengue has increased during the past 50 years and it is now estimated that 50-250 million cases occur each year (WHO, 2015). Only a small percentage of cases are symptomatic and reported. The actual impact of dengue is difficult to determine due to factors including inadequate disease surveillance, misdiagnosis, and low levels of reporting. The objective of this paper is to examine the prevalence and distribution of dengue, examine current surveillance systems used to identify dengue cases, and review preventative and control measures implemented in two Southeast Asian countries, India and Thailand. Currently, Southeast Asia experiences the greatest disease burden from dengue, with 1.3 billion people at risk of contracting the disease (WHO, 2015). A total of 15 articles were reviewed that discussed the substantial economic and epidemiological burden of dengue on India and Thailand. According to the literature, improved mosquito control efforts, improved disease surveillance systems, and targeted dengue health education and outreach efforts can result in a reduction in the total number of dengue cases reported per year in both India and Thailand.

INTRODUCTION

Overview of Dengue

Dengue is an arboviral infection transmitted primarily by the female *Aedes aegypti* mosquito and on occasion by *Aedes albopictus* mosquitoes, and is considered the world's most common arthropod-borne viral disease (WHO, 2015). Currently, there are four distinct but closely related Dengue serotypes, including: DEN 1, DEN 2, DEN 3 and DEN 4, in which recovery of infection by one serotype provides lifelong immunity against only that particular serotype, but confers only partial protection against subsequent infection by another strain (WHO, 2015). Dengue is typically characterized by a fever lasting two to seven days, and symptoms may

include: headache, rash, body aches, and/or joint pain (Fullerton et al., 2014). The majority of dengue infections are asymptomatic and tend to not be reported, while a small percentage of them may progress to a more severe form of dengue (e.g., DHF, DSS) (WHO, 2015).

OVERVIEW OF DENGUE AS A GLOBAL DISEASE BURDEN

The disease is considered to be hyperendemic in tropical and sub-tropical regions, is currently endemic in more than 110 countries, and is most prevalent in Southeast Asia, the Americas, and Western Pacific regions (Fullerton et al., 2014). In fact, all of the countries located in the Southeast Asia region of the World Health Organization except Korea reports dengue cases (Amarasinghe et al., 2014). It is a serious global health concern, with 2.5 billion people at risk and an annual average of 50 million cases of infections per year, which includes dengue fever, dengue hemorrhagic fever (DHF), and dengue shock syndrome (DSS) (WHO, 2015). Five hundred thousand (1%) of these infections are cases of life-threatening, severe dengue illness, also known as DHF (WHO, 2015).

Over the years, the incidence of dengue has increased exponentially, and some of the major contributing factors related to the transition of dengue fever from a national to global health concern includes: climate change, the expansion of dengue vectors to new geographic regions, increasing travel and migration across borders, global trade, and unplanned urban overpopulation with inadequate public health systems (Shepard et al., 2014). Thailand's 26.6% and India's 5.9% growth in foreign international travel in 2013 (Office of Tourism Development & Ministry of Tourism, 2013), their role in the global economy, and their ongoing problem with Dengue underscores the importance of further examining this critical health concern (Shephard et al., 2014). The purpose of this paper is examine the prevalence and distribution of Dengue and identify current preventative and control measures implemented in two Southeast Asian countries, India and Thailand.

INCIDENCE, PREVALENCE, REPORTING AND SURVEILLANCE OF DENGUE IN INDIA & THAILAND

India's population of one billion people is twice that of Southeast Asia and the nation current reports the most dengue-related deaths (Suaya et al., 2006). The first case of dengue was reported in Calcuttta, India in 1945 (Shephard et al., 2014). India's first dengue fever epidemic was reported in 1963, when dengue gradually spread from the country's southern regions to its northern states and progressively to the whole country by 1968 (Shephard et al., 2014). The first major epidemic of DHF/DSS was identified in India in 1996 (Shephard et al., 2014). Based on trends in endemicity, India is identified as a Category B country as the country is reported to

experience cyclic epidemics, whereas Thailand has been identified as a Category A country as the nation experiences annual epidemics (Amarasinghe et al., 2014). Dengue epidemiological trends in India during recent decades indicate that larger and more frequent dengue outbreaks are occurring, cases are now identified in new states, dengue is spreading from peri-urban to rural areas, increased case morbidity and mortality, and progression to hyperendemicity in large urban areas (Amarasinghe et al., 2014; Shephard et al., 2014). Amarasinghe et al. (2014) conducted a comprehensive literature review of the changing epidemiological patterns of Dengue in India between 1961 through 2012, and identified isolated reports of dengue outbreaks throughout most of the country, some only dengue-like and others accompanied by more severe forms of the disease, ranging from DEN-1 through DEN-4 serotypes.

Shepard et al. (2014) reported that between 2006 and 2012, India experienced an annual average of 20,474 Dengue cases. However, it is interesting to note that the actual incidence of dengue cases maybe 282 times higher than reported (Shepard et al., 2014). For example, adjustment for underreporting from a case study in Madurai district of India an expert Delphi panel yielded an annual average of 5,778,406 clinically diagnosed dengue cases between 2006 and 2012 (Shepard et al., 2014). Shephard et al. (2014) concluded that the economic and disease burden of dengue in India is substantially more than identified in official case reports, and increased control efforts are necessary to halt the spread of Dengue. Amarasinghe et al. (2014) also found that over the last few decades, reporting of dengue cases have increased substantially, spreading to almost all regions of India, yet the disease burden remains severely underestimated with the current surveillance system.

National dengue surveillance, initiated in India in 1996, is passive and consists of over 347 hospitals linked to 14 referral laboratories that implements laboratory supported fever surveillance and maintaining line-listing of positive dengue cases (Amarasinghe et al., 2014).

These sentinel sites cover only 17 out of 35 states in the country and illnesses reported are a combination of hospitalized and non-hospitalized cases (Amarasinghe et al., 2014). Cases reported through the national surveillance system in India are limited only to laboratory confirmed cases, and given a database with clinically suspected cases there would be a much greater probability of higher dengue morbidity rates (Amarasinghe et al., 2014). In addition, a recent study on the epidemic of Dengue in Chennai in 2001 suggested that the surveillance system may not have generated proper information on the epidemiology of the disease (Suaya et al., 2006). Since 2004, a WHO initiative was developed to improve dengue surveillance as part of the Integrated Disease Surveillance Programme in India, by strengthening laboratory networking and quality assurance, and reviewing case definitions (Suaya et al., 2006).

The first case of dengue was reported in Thailand in 1949, sporadic cases continued to be reported through the 1950's and the first major outbreak of DHF was reported in Bangkok in 1958 (Limkittikul et al., 2014). There were 2,158 cases and 300 deaths in this outbreak (Limkittikul et al., 2014). Similar to India, in Thailand there has also been an increasing trend in the incidence of DHF since the time of the first reported outbreak in 1958 and has now became the leading cause of hospitalization and death among children in Thailand (Barbazan et al., 2002; Limkittikul et al., 2014). Two large outbreaks were reported in 1997 and 1998, with 101,689 and 126,348 cases reported (Limkittikul et al., 2014). Prior to 2004, Thailand reported the highest number of annual dengue cases in Southeast Asia, with an average of almost 69,000 cases per year reported between 1985 and 1999 (Limkittikul et al., 2014). The highest mortality rate associated with DHF occurred in 2001 in Thailand (245 deaths, 0.39 deaths/100,000 population) (Limkittikul et al., 2014). Thailand initiated a reporting system for dengue surveillance in 1958, and in 1972 the national surveillance system for DHF was implemented by the Thai Ministry of Public Health's Bureau of Epidemiology (Limkittikul et al., 2014). The surveillance system becoming fully operational in 1974 (Limkittikul et al., 2014).

According to Amarasinghe et al., (2014), even in Southeast Asian dengue endemic countries such as Thailand, equipped with well-functioning disease surveillance systems, considerable underreporting was observed. For instance, data obtained from community based cohort studies in Thailand have indicated an underreporting level ('Expansion factor') of the national surveillance system in this country of 8.37 (Amarasinghe et al., 2014). Using this expansion factor, Amarasinghe et al., (2014), estimated the crude incidence of dengue in India based on the annual numbers selected in 10 states and it is 53/100,000 to 58.8/100,000. This study utilized the incidences calculated for the 10 states to estimate an annual dengue case load for India in 2012 of approximately 600,000- 700,000 cases (Amarasinghe et al., 2014).

EPIDEMIOLOGICAL RISK FACTORS ASSOCIATED WITH DENGUE INCIDENCE IN INDIA AND THAILAND

The ability of dengue to progress to a more severe form of the illness in individual cases depends on several risk factors including: previous infection with dengue, age, ethnicity, gender, and/or diagnosis with a chronic disease (e.g., diabetes mellitus) (Tantawichien 2012; WHO 2009). Although infection with one specific dengue serotype has been reported to create immunity for that particular serotype, it is not considered a cross-protective immunity (WHO 2009). The secondary infection may increase the likelihood of developing a more severe form of the disease (WHO 2009).

Dengue fever has generally been considered a childhood disease typically affecting children aged 5 to 9

years old (Tantawichien 2012). However, over the last few years a shift in the age trend has been observed in Thailand (Cummings et al. 2009; Kongsomboon et al. 2014; Tantawichien 2012). These studies provide evidence of a shift in dengue incidence towards older age groups in Thailand, particularly DHF. According to Tantawichien (2012), in Thailand 30-40% of dengue cases currently affects adults over 15 years of age. On the contrary, in India, the age group with the greatest incidence of dengue is 15-45 years and over the last decade, dengue incidence has increased in younger children (including infants) in seven different regions of India (Amarasinghe et al., 2014). In addition, according to Suaya et al. (2006), dengue is considered to be the leading cause of hospitalization and death among children in India. It is important to note that symptoms and risk factors for DHF vary among children and adults, as increased co-morbidities and mortality has been identified in elderly patients, thus influencing clinical guidelines and treatment for the illness (Tantawichien 2012).

Typically, increased cases of DF and DHF have been primarily reported in urban areas due to factors including population density and the short flying distance for the vector creates the ideal conditions for transmission (Guha-Sapir & Schimmer, 2005; Suaya et al., 2006). However, today Thailand has an incidence rate of DF and DHF that is higher in rural (102.2 per 100,000) than urban areas (95.4 per 100,000) (Guha-Sapir & Schimmer, 2005). Similarly, in India dengue outbreaks are increasingly being reported in rural areas, including states in the Northeast which had never previously reported dengue cases (Suaya et al., 2006). However, this may be due to improved diagnostic tests and increased surveillance efforts, since a serological survey conducted in 1963 and the nineties revealed dengue activity in two districts of Northern India (Khan et al., 2013). In both Thailand and India, DHF incidence generally reaches its peak during its' hot and rainy season between the months of May through October (Barbazan et al., 2002).

The end of the rainy season leads to decreased reporting and incidence of dengue cases (Barbazan et al., 2002). Climatic factors, including temperature and rainfall are important for dengue surveillance because they are strongly correlated with entomological factors (Barbazan et al., 2002).

The World Health Organization (WHO) guidelines in place for the diagnosis, prevention, and control of dengue discuss advocacy efforts including social mobilization, administrative and media advocacy as successful strategies for Dengue prevention. Advocacy along with leadership, information systems, financing, technologies, human resources, and delivery systems are part of a total health systems approach that is needed to successfully manage the global dengue epidemic. According to WHO (2009), vector management is the most critical link in halting the chain of disease transmission. Current prevention measures used in Thailand and India includes: elimination or management of larval habitats, larviciding with insecticides, the use of biological agents and the

application of adulticides (WHO, 2009). According to Khamim et al. (2015), current dengue prevention efforts including vaccines and sustainable vector control measures are critical to achieving the World Health Organization's target goal of 25% reduction in dengue morbidity and 50% reduction in dengue mortality by 2020 in dengue-endemic areas such as Thailand and India.

DISCUSSION & RECOMMENDATIONS

Countries should implement the World Health Organization's Global Strategy for DF/DHF prevention and control by implementing integrated vector management techniques (e.g., personal protective measures), development of an active disease surveillance system, emergency preparedness, capacity building and training of health-care personnel, and vector control research (Fullerton et al., 2014). Due to the fact that vulnerability and susceptibility levels remain high for health service workers, and dengue is often misdiagnosed as influenza or the common cold, it is increasingly imperative to educate and train public health care personnel, physicians, and nurses in best practices for dengue management and control. The lack of reliable epidemiological and entomological data in India, makes accurate estimates of dengue disease incidence extremely challenging, and since surveillance is passive this makes coverage of the sentinel system extremely limited. Community participation and collaboration should also be an important component in dengue disease prevention. Increased awareness of the disease via educational efforts delivered by government and non-profit dengue prevention programs will serve as a critical measure in the dengue preventative and control efforts in India and Thailand.

In Thailand and in most countries in Southeast Asia, it is difficult to maintain the required infrastructure for the whole country (Barbazan et al., 2002). The literature reports that in order for control activities to be effective, it is important to focus on epidemic periods and to intervene as early as possible (Barbazan et al., 2002). In addition, both Thailand and India serve as major tourist destinations from travellers across the world, and this can pose serious implications in the transmission and spread of imported dengue cases to other countries, and may possible lead to outbreaks.

CONCLUSION

Dengue is a continuing growing global health concern with cases reported as early as the 19th century in both India and Thailand. In the past two decades, both India and Thailand have reported a rapid increase in new cases, experienced some of the most severe outbreaks in history including Thailand's most recent epidemic of dengue fever in 2013 with a total of 136,000 confirmed cases and India's epidemic in 2013, in which

approximately 55,063 residents became ill from dengue fever (Dhawan, H., 2013; Lefevre, A., 2013). In addition, both countries are experiencing epidemiological trends in reporting of dengue, as new cases are increasingly being identified in rural areas and regions where dengue was never previously seen. Dengue cases are expected to increase due to several factors including: climate change, globalization, international travel & trade, socioeconomics, and viral evolution (Murray et al., 2013). According to the literature, the following methods can substantially reduce the spread of dengue: 1) prompt case detection and clinical management, 2) improved environmental monitoring (e.g., mosquito trapping & geographic information systems mapping to detect the spread of dengue vector species), 3) improved mosquito control (e.g., removing stagnant water sources) and, 4) support improved disease surveillance (Amarasinghe et al., 2014; Barbazan et al., 2002; Guha-Sapir et al., 2005; Murray et al., 2013; WHO 2009; WHO 2015). Improved surveillance and reporting of dengue cases is important to understand the true impact of the problem in both India and Thailand. Improved surveillance efforts will help guide prioritization for research and health policy efforts and help understand the projected economic impact of preventing and controlling this disease and result in reduced hospitalizations, illnesses, and deaths for many residents, visitors, and tourists to both India and Thailand.

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