Chapter 5

Indonesia Dengue Fever: Status, Vulnerability, and Challenges

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Additional information is available at the end of the chapter

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Abstract

In Indonesia, the incidence rate (IR) of dengue fever reported increase almost in every year since the first cases were found in 1968, from 0.05 to ~35–40 per 100,000 population in 2013, with superimposed epidemics demonstrating a similar increasing trend with the highest epidemic occurring in 2010 (IR 85.7). Most currently, about 80% of regencies/cities had been infected and posed as very high vulnerability of spreading the disease. Increased incidence of dengue fever is associated with the increase of rainfall and temperature in particular years. Up to the year of 2038, a climate model of Meteorological, Climatological, and Geophysical Agency shows increasing trend of rainfall and temperature. Along with its unsuccessful of Indonesia dengue fever control program will lead challenges to reduce dengue fever endemic in the future. Revitalization of dengue disease control program in every single stage with close monitoring implementation is urgently needed. Socialization, community capacity building, and participation could also be a joint sectoral action to enhance the dengue fever control program.

Keywords: Indonesia dengue fever, climate vulnerability, eradication challenges

1. Introduction

Dengue fever is a mosquito-borne disease caused by any one of four closely related dengue viruses (DenV-1, DenV-2, DenV-3, and DenV-4). Dengue fever is transmitted by the bite of an *Aedes* mosquito infected with a dengue virus. The female mosquito becomes infected when it bites a person with dengue virus in their blood both indoors and outdoors during the daytime (from dawn to dusk). *Aedes aegypti* is particularly involved, as it prefers to lay its eggs in artificial water containers, to live in close proximity to humans, and to feed on people rather than other vertebrates.

Dengue infection is the most rapidly spreading mosquito-borne viral disease in the world. Infections are most commonly acquired in the urban environment. In recent decades, the expansion of villages, towns, and cities in the areas in which it is common and the increased mobility of people have increased the number of epidemics and circulating viruses. Dengue fever, which was once confined to Southeast Asia, has now spread to Southern China, countries in the Pacific Ocean and America, and might pose a threat to Europe. In the last 50 years, dengue virus infections had expanded to many other countries with significant increasing cases [1] up to 2.5 billion people living in endemic countries where about 1.8 billion (more than 70%) in Southeast Asia and the Western Pacific Region [1–4]. About 50 million dengue infections occur every year [2, 3], and approximately 500,000 patients are hospitalized of whom dominated by children [2–7]. The increasing incidence and geographical spread of dengue virus were more likely driven by demographic and societal changes such as population growth, urbanization, and modern transportation [8]. The traveler movement also contributed to the risk of contracting dengue disease from nonendemic countries to endemic dengue areas to nonendemic regions where competent mosquito vectors are currently found [9–12].

Indonesia, with 257.5 million inhabitants and 17,500 islands spread across the equator, poses as the largest archipelago country in the world [13], comprising 3.1 million km^2 of ocean (62% of the total area) with a coastline of 81,000 km and approximately 2 million km^2 of land (38% of the total area). Its tropical climate and subsequent relative high humidity makes Indonesia favorable conditions for vector-borne disease transmission. The increasing trend of dengue infections over the current decades putting Indonesia as one of endemic area for dengue fever and tread both the people as well as travelers visiting the archipelago [14]. Its burden is a result of a constant ground of established infections in the past period, combined with epidemics of emerging infectious diseases (EID) [15]. This chapter describes the dengue fever status or situation in Indonesia, its vulnerability among population, the future challenges, and the disease prevention and control.

2. Dengue fever status in Indonesia

Indonesia is reported as the second largest with dengue fever cases among 30 endemic countries. The number of cases of dengue fever is most prevalent in the provinces of East Java, West Java, and Central Java. However, there are a number of provinces that are vulnerable with its high incidence rate of dengue fever. In 1968, the first 58 dengue cases were reported in Indonesia from the city of Jakarta (DKI Jakarta) and Surabaya (East Java) [16–19]. Since then, the sharp increasing numbers of cases and spreading to many other geographical locations have been reported [16, 17, 20–25]. The epidemiology of dengue fever in Indonesia has been described mostly in the form of case series, reporting on single outbreaks, or clinical and virological studies in confined geographical locations and selected years [26].

A study in 2014 reported that the annual dengue fever incidence increased from 0.05/100,000 in 1968 to ~35–40/100,000 in 2013. The highest epidemic occurred in 2010 with the incidence of 85.7/100,000 population. The data revealed declining of case fatality rate (CFR) from 41% in 1968 to 0.73% in 2013. Dengue cases increased among ages during the observation period up to 1998 with the highest incidence of aged 5–14 years. From 1999 onward, the trend of dengue incidence increased among those aged 15 years or over. This study indicates incidence of dengue fever increased rapidly over the past 45 years in Indonesia with peak incidence shifting from young children to older age groups [27].

The threat of dengue fever among children was emphasized clearly on a recently published study among 3194 children aged 1 through 18 years who lived in 30 different urban neighborhoods. Children blood samples were drawn for antibodies to dengue, an indication that someone has been infected with the virus in the past, and found that 69.4% of all children tested positive for dengue antibodies. Among the age groups, positive antibodies found 33.8% at the group of 1–4 year olds, 65.4% at the group of 5–9 year olds, 83.1% at the group of 10–14 year olds, and 89% at the group of 15–18 year olds. The first time to become infected with dengue was at the age of 4.8 years as the median, and in addition, 13.1% of children on average get their first dengue infection each year. It was also found that the more people in a household who had been diagnosed with dengue since a child's birth, the more likely the child were to test positive for dengue antibodies [28].

The incidence rate (IR) for every 100,000 population in seven provinces were found over 100 or are prone to dengue cases. The seven provinces are Bali (484), East Kalimantan (306), DKI Jakarta (198.7), DI Yogyakarta (167.9), North Kalimantan (158.3), Southeast Sulawesi (123.3), and South Kalimantan (101.1). The lowest IR is achieved by Papua province (11.8) and West Kalimantan (12.1) (**Figure 1**). The whole of Indonesia is high (IR is 78.0). In general, the increasing number of dengue fever cases is more likely followed by the spread of the cities

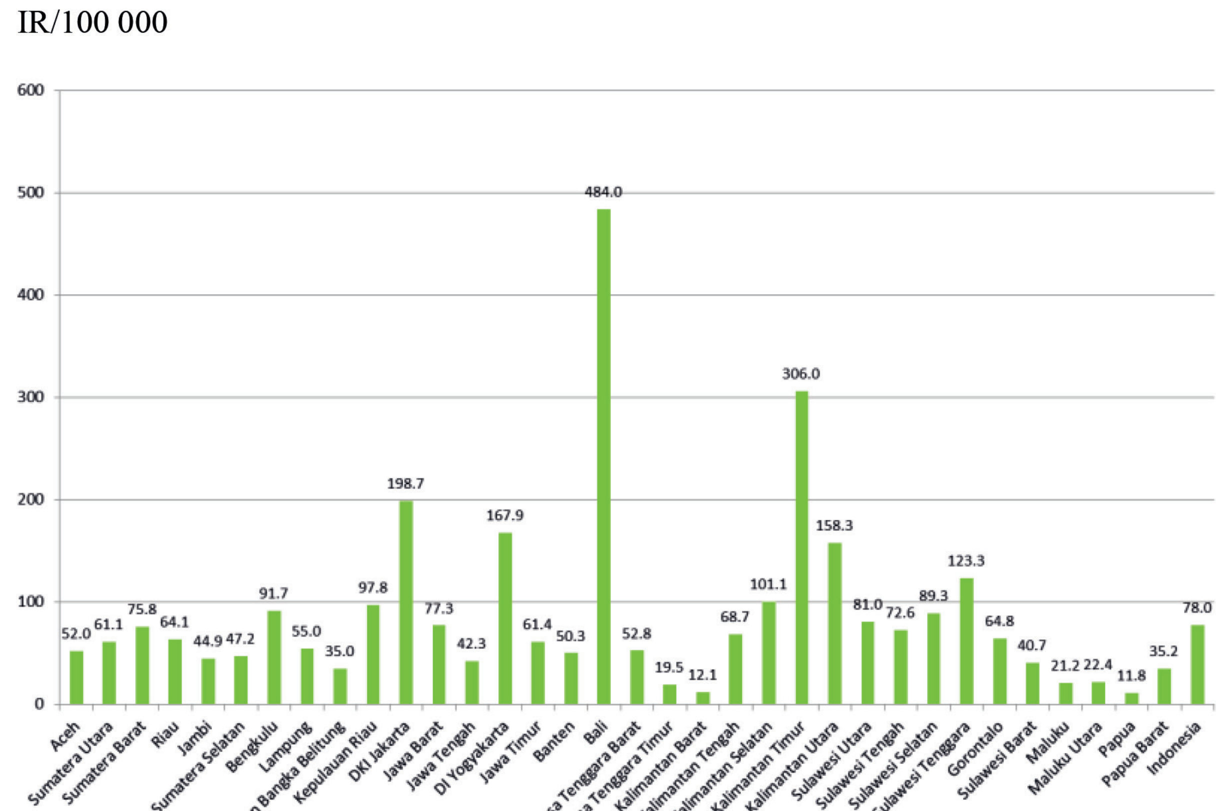

Figure 1. Incidence rate (IR) of dengue fever per 100,000 population by province in Indonesia 2016 (source: DG of CDC MOH 2017).

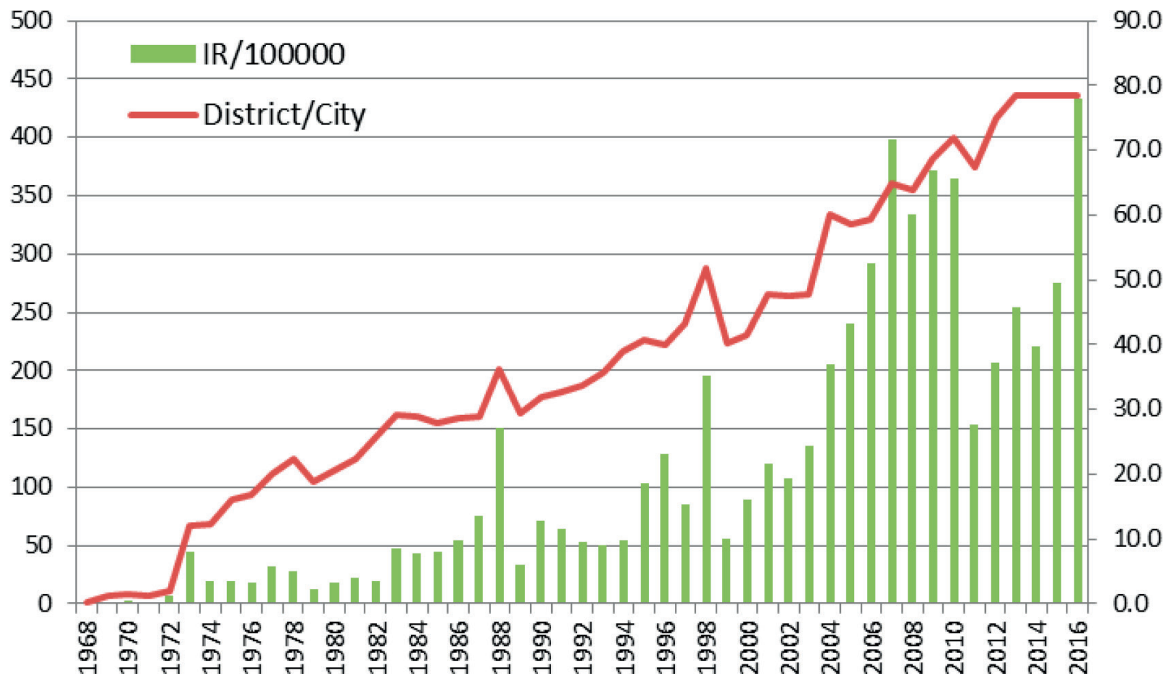

Figure 2. Incidence rate (IR) of dengue disease per 100,000 population and number of cities/districts infected in Indonesia 1968–2016.

and districts infected in all of 34 provinces in Indonesia (**Figure 2**). From the total of 497 cities and districts in Indonesia, about 80% have reported the dengue fever cases in 2017.

In the context of dengue fever mortality, as many as 1229 people died in 2015 from the disease caused by this dengue virus. Throughout the history of dengue fever in Indonesia, the highest death rate occurred when first time the disease was discovered in 1968 in Surabaya. Of the 58 people infected, 24 lives were lost. In 2016, the highest percentage of CFR was obtained in Maluku Province (6.0%), Gorontalo (6.1%), and West Papua (4.6%). Provinces with the lowest CFR were achieved by Papua (0%), DKI Jakarta (0.1%), and NTT (0.2%). In some provinces, dengue disease was an outbreak in 1998 and 2004 that caused 79,480 people and 800 more deaths. In subsequent years, there has been reported a decrease in the case of death but note that the number of cases continues to increase. In 2008, there were 137,469 cases and 1187 deaths. In 2009, there were 154,855 cases and 1384 deaths [29].

3. Dengue fever vulnerability

Studies on Indonesian vulnerability to climate change were mostly focused on mitigation aspects, such as water scarcity, reduction emission from deforestation and degradation (REDD), the forest conservations, disasters, land drought, floods, and others. Meanwhile, the vulnerability study on adaptation is still rare, especially to human health. In 2013, Research Center for Climate Change—University of Indonesia (RCCC-UI) initiated a study on vulnerability of dengue disease to climate change/variability in collaboration with the Directorate of Environmental Health of the Ministry of Health and supported by Indonesia Climate Change Trust Fund (ICCTF). The study involved 20 districts/cities in 5 provinces namely West Sumatra,

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Jakarta, East Java, Bali, and Central Kalimantan which were selected based on the availability of monitoring station of the Indonesian Agency for Meteorology, Climatology, and Geophysics (BMKG). The dengue disease vulnerability components were generated based on bionomic mosquito and habitat, pathology dengue disease, and factors related to dengue disease occurrence. The exposure variables include land use (settlement, offices, business, schools, etc.) and population density. The sensitivity variables include breeding places and resting areas of *Aedes* mosquitoes, pupa and adult density, incidence of dengue fever, and population mobility. The adaptive capacity variables include availability of health services (number of hospitals, clinics, and public health centers), treatment management and skilled providers, implementation of dengue fever intervention program, community participation and involvement on dengue fever prevention program, and personal protection behavior. The Intergovernmental Panel Convention for Climate Change (IPCC) vulnerability analysis was implemented to gain the coping range index of DF for each city/district [31]. The coping range index (CRI) = 1 (blue) indicates the people vulnerability of having dengue fever is very low and located at quadrant between low exposure and sensitivity index and high adaptive capacity index; CRI = 2 (green) indicates the people vulnerability of having dengue fever is low and located at quadrant between high exposure and sensitivity index and high adaptive capacity index; CRI = 3 (yellow) indicates the people vulnerability of having dengue fever is medium and located at quadrant between medium exposure and sensitivity index and medium adaptive capacity index; CRI = 4 (brown) indicates the people vulnerability of having dengue fever is high and located at quadrant between low exposure and sensitivity index and low adaptive capacity index; and CRI = 5 (red) indicates the people vulnerability of having DF is very high and located at quadrant between high exposure and sensitivity index and low adaptive capacity index (**Figure 3**) [30].

A study of Research Center for Climate Change—Universitas Indonesia 2013–2014 reported that in almost all districts/municipalities under study (in 17 out of 20 regencies/cities) indicated a very serious vulnerability condition of very high coping range index (CRI) (red = 5) since 2005.

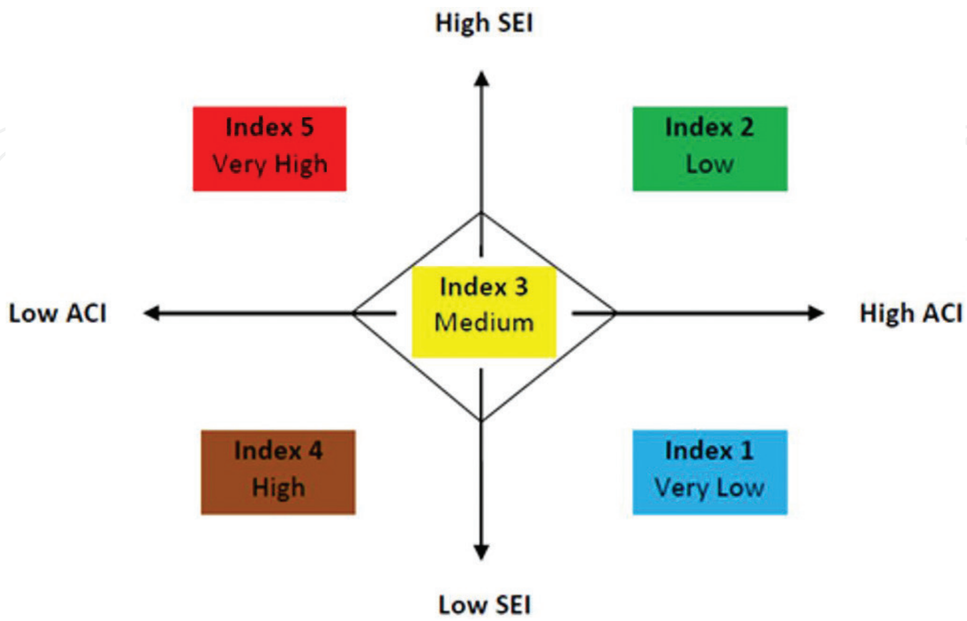

Figure 3. The coping range index (CRI) of dengue disease vulnerability.

Very high CRI was found in 75% of regencies/cities in West Sumatra province (City of Padang in 2005, 2007, 2008, 2009, and 2012; Padang Pariaman Regency in 2008, 2011, and 2012; and City of Padang Panjang in 2007 and 2008), all of regencies/cities in Bali province (City of Denpasar in 2006, 2009, and 2010; Jembrana Regency in 2007; City of Badung in 2007, 2009, and 2010), 80% of regencies/cities in East Java province (City of Surabaya in 2007, 2008, 2009, 2011, and 2012; Malang Regency in 2007, 2008, 2009, 2011, and 2012; City of Pasuruan in 2007, 2008, 2009, 2010, and 2011; Sumenep Regency in 2007, 2008, 2009, 2011, and 2012), all of cities in Jakarta province (City of Central Jakarta in 2005, 2006, 2007, 2008, 2009, and 2012; City of North Jakarta in the year 2006–2012), half of cities in Banten province (City of Tangerang in 2007–2012), all of regencies/cities in Central Kalimantan province (City of Palangkaraya in 2006, 2008, and 2012; Kotawaringin Barat Regency in 2005–2008 and in 2012; Kotawaringin Timur Regency in 2008, 2010, and 2011; Barito Utara Regency in 2008). High CRI (brown = 4) was also happened more often before and following the years of the very high CRIs occurrences in the regencies/cities [30]. Thus, this concluded that dengue fever is in the level of seriously vulnerable to people living in the regencies/cities under study in Indonesia. **Figures 4** and **5** show the dengue fever vulnerability among cities/districts in 2012 in the provinces of Jakarta/Banten, Bali, Central Kalimantan, and East Java.

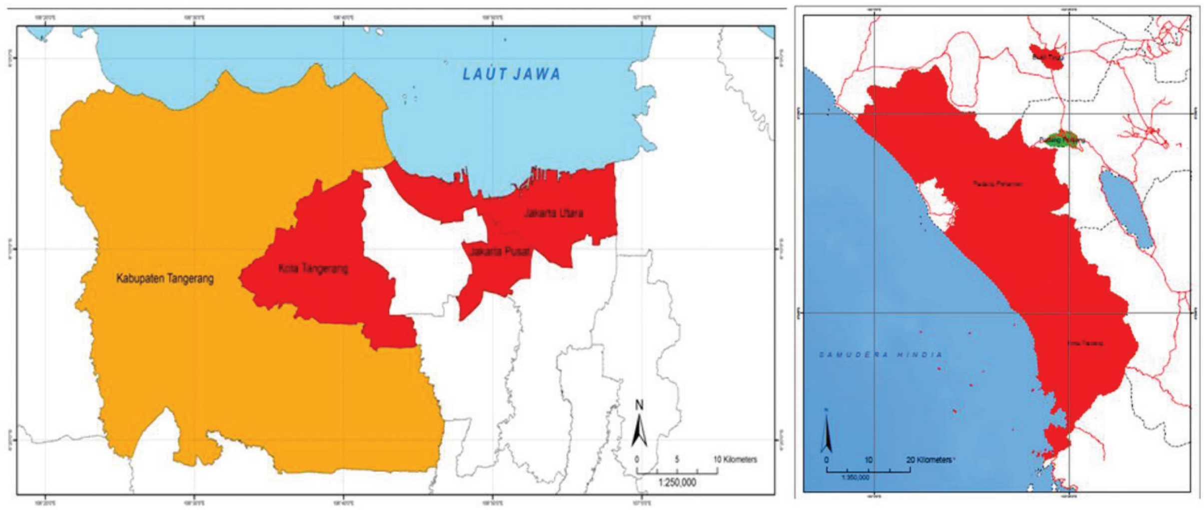

Figure 4. Map of CRI of dengue fever vulnerability in Jakarta/Banten and West Sumatra in 2012.

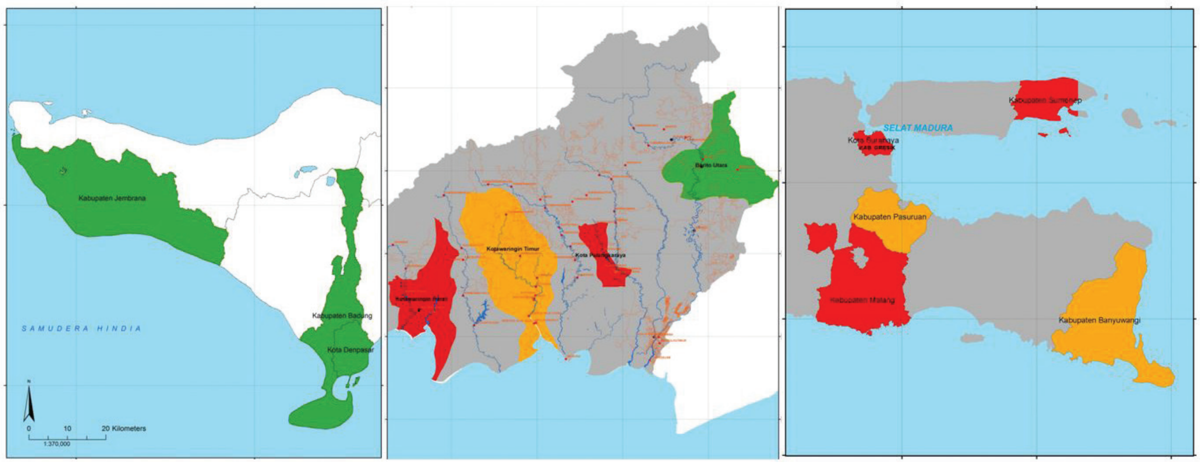

Figure 5. Map of CRI of dengue fever vulnerability in Bali, Central Kalimantan, and East Java in 2012.

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4. Dengue fever challenges

Dengue emerged as a public health burden and has become increasingly important, with progressively longer and more cyclical epidemics of dengue including cases of dengue with alarm signs and severe dengue. In Indonesia, although some programs and control efforts have been performed, both the incidence and case fatality rate are still high and not showing significant changes. There are still some challenges that need to be handled, such as surveillance system, availability adequate laboratory, community knowledge, awareness, and involvement against dengue, many new cases reported from new city or district, high mobility of dengue fever's carrier, density of community in the city/district central, access to health centers, and the availability of drugs and vaccines.

Surveillance for this vector-borne viral disease remains largely passive and based on the hospital report which is the estimation of real cases still underreported. It was also reported that many health centers and clinics were without adequate laboratory support. This will lead increasing of referral activities to hospitals with the consequences of time spent and transportation challenges in rural areas. Some studies found about one-third adult population with sufficient knowledge about dengue fever and its fast spreading to other people. However, only about 17% of them aware and clearly know the way for prevention [31, 32]. In addition, the high number of dengue fever incidence can also be caused by increasing *Aedes aegypti* mosquito breeding places, mosquito habitat, more effective mode of transmission, more frequent dengue fever course, shorten dengue fever symptoms, access for dengue fever treatment. Home conditions such as governance and the layout of goods at home can also affect the high number of dengue fever incidence.

Indonesia is a country with a vast region, varied geographic and biodiversity, populated density, and characteristics of various populations. In the last decade, several new administration districts developed with the newly reporting and recording management systems. This will lead underreporting of dengue fever both from the passive surveillance and the number of real cases estimation. The increasing number of people and the area of dengue fever spread in Indonesia is due to the high population mobility, the development of urban areas, climate change, increasing population density, and changes in population distribution. Climate change causes changes in rainfall, temperature, humidity, and air direction thus affecting the breeding of *Aedes aegypti* mosquitoes.

The last and most important thing of the challenges is community participation. The participation of the community to participate consistently to keep the environment from dengue is still difficult. Various breakthroughs by government such as 3 M plus (draining, covering, burying or utilizing/recycling and all forms of prevention, such as to apply powder of larvae-killers in water tanks, to use mosquito repellents, to keep fish predators to consume mosquito larvae, etc.) movement, Jumantik (volunteer or student who periodically monitor *Aedes* larvae on water storages at home) and so have long been circulated. But people who forget and bored easily become a problem. For example, after some time, there was no extraordinary incident, the community considered it safe and careless, consequently when the case exploded, people just reacted [33].

Among other challenges, passive surveillance systems tend to underestimate the burden of communicable diseases such as dengue. By utilizing the data from the Indonesian surveillance

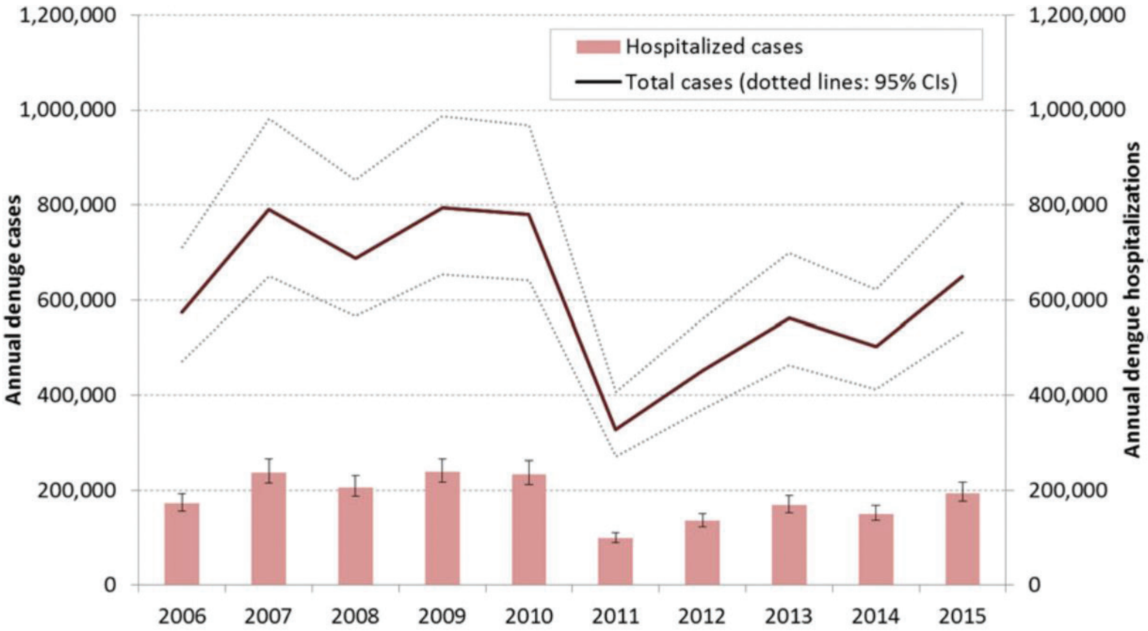

Figure 6. Estimated annual number of dengue cases and hospitalizations in Indonesia following adjustment of surveillance reports with EFs, and their 95% confidence intervals (CIs), 2006–2015.

system and associated health system parameters, a study to estimate the proportion of dengue was conducted by Delphi panel in 2017. The iterative estimation was generated by calculating the expansion factors (EF), the ratio of total and reported cases during the presentation of medical and epidemiological data and subsequent discussions. The data revealed that from all of symptomatic Indonesian dengue episodes, 57.8% enter healthcare facilities to seek treatment but only 39.3% of them are diagnosed as dengue. Furthermore, only 20.3% of them are subsequently reported in the surveillance system. Public sector found dominating occurrence of hospitalizations and followed by private sector for ambulatory episodes (~55%). Therefore, estimations gave an overall EF of 5.00; hospitalized EF of 1.66; and ambulatory EF of 34.01 which, when combined with passive surveillance data, equates to an annual average (2006–2015) of 612,005 dengue cases, and 183,297 hospitalizations (**Figure 6**.). The findings are lower than those similar estimations published elsewhere, perhaps due to case definitions, local clinical perceptions, and treatment-seeking behavior [34].

5. Dengue fever prevention and control

The goal of WHO Global Strategy is to reduce the burden of dengue. Its specific objectives are: (1) to reduce dengue mortality by at least 50% by 2020, (2) to reduce dengue morbidity by at least 25% by 2020, and (3) to estimate true burden of the disease by 2015 (the year 2010 is used as the baseline). The implementing strategy is expected to pave the way for reducing dengue morbidity and mortality nationwide through strengthening local and national capabilities, as well as regional coordination. National Dengue Control Program in Indonesia is currently implementing WHO Global Strategy 2012–2020 that promotes coordination and collaboration among multisectoral partners, an integrated vector management approach and sustained control measures at all levels. Dengue is an ecological disease, therefore coordination and collaboration by all sectors within the government, communities, civil societies, private sectors, and media need to be strengthened. All sectors should harmonize the prevention, surveillance (entomological and epidemiological), and case management with the existing health systems, in order to make the program sustainable, cost-effective, and ecologically sound.

It has long been believed that preventing and reducing dengue virus transmission was very depended upon vectors control (*Aedes sp.*) or interrupt the human-vector contact. Activities to control transmission should target *Ae. aegypti* (the main vector) in the habitats of its adult stages as well as the immature. The high death toll from dengue fever demands people to stay alert to possible outbreaks of this disease in their neighborhoods [35]. Therefore, it is important for the community to collectively jointly create a healthy environment free of larvae to suppress the incidence of dengue disease. The prevention and control programs need to be undertaken with specific commitments from stakeholders from the top to the bottom levels. Currently, the Ministry of Health has launched a program of Nest Mosquito Eradication Program (PSN) through 3 M plus way.

6. Conclusion

Given the wide area in the tropical temperature, high population density in urban area, and various geographic and biodiversity, putting Indonesia as a natural potential for the habitat of dengue viruses. The number of dengue fever cases reported dramatically increases since it was firstly found in 1968 and spread out almost in 80% cities and districts in Indonesia in 2016. Many of those cities and districts were very vulnerable and putting million people at risk to the disease in 2012. Some challenges are still heading in the front of the prevention and control implementation actions. However, keeping spirit for struggling to combat dengue fever in Indonesia along with full commitment and involvement of community are urgently needed as well as to revitalize dengue disease eradication programs at every stage with close monitoring implementation.

In addition, technical guidance and increased skills of health officers are indispensable. Socialization of a hands-on program activities in particular and increased capacity and active participation of community on the action could be a joint action in preventing the increase in dengue disease associated to climate change.

Conflict of interest

The author declares no competing financial interests.

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