Snakebite as a Neglected Tropical Diseases in Indonesia: A Review

Dewi Yuniasih, Ario Tejosukmono, Junaidy Heriyanto

Abstract — Despite its promising economic growths, there are group of neglected tropical diseases (NTDs) still existing in Indonesia. Since these neglected tropical diseases cause severe disability, therefore they may thwart future national growth and recent gains. The aim of this paper presents an epidemiology perspective to describe the health system situation in Indonesia and highlights the problems beneath NTDs. The epidemiology approach is provided as basis for policy decision making in reducing the threat of NTDs and improving country’s health indicators levels. Earlier, the global NTDs according to the causative agents referring to WHO classifications will be discussed and the cases of NTDs in Indonesia will be detailed. It is worthy to mention that snake bite is one of the major causes of mortality and morbidity in many areas, particularly in the rural tropics such as Indonesia. However, a study case of snake bites in Indonesia do not appear that can be evidenced by the difficulty of obtaining data or information about the number of cases in all regions in Indonesia. Therefore, it is difficult to deal with a comprehensive prevention programs and health policy intervention towards minimizing the threat of this disease.

Index Terms: Epidemiology, health system, neglected tropical disease, prevention programs, snake bite.

1 INTRODUCTION

With a population of more than 250 million people, Indonesia has promising economic potentials where a large market and a dynamic and competitive market exist. With an area of some 1.9 million km² scattered in more than 17,000 islands, in addition, Indonesia’s nature is home to some of highest level of biological diversity in the world. However, as with most other tropical countries, the country is not free from the threat of spread tropical diseases worldwide which their incidences are disregarded, a group of disease known by the World Health Organization (WHO) as neglected tropical diseases (NTD) [1].

The term of NTD referred to a group of disease caused by a variety of pathogens such as viruses, bacteria, protozoa and helminths and based on the fact that these tropical diseases are not being considered as important diseases. They affect more than billion people in tropical and subtropical countries. Moreover, NTD leads to long life’s deformities and handicaps, decrease productivity and economic status as well as many social burden and stigmatization [2].

In line with Indonesian national economic targets, there are 11% people living below national poverty line in 2014 [3], your paper. Rural residences are living poorer than urban residence where 13.8% of them are living below rural poverty line [3]. In addition, there are rapid changes in socio-economy and environmental degradation has decreased drastically in Indonesia. In this case, some aspects such as population growth, the emergence of sudden disease outbreaks, natural disasters and cases of pollution and environmental damage due to fast growing industrialization could threat public health. Therefore, at attempting to boost national economic growth of Indonesian government, unpredicted exposure of NTD cases could thwart country’s development targets. As a logical consequent, the focus of research on the epidemiology of NTD must be strengthened [4].

Therefore, this paper presents an epidemiology view of NTD in Indonesia. Two sections shall discuss in general magnitude NTD in Indonesia and the health and environmental factors affecting public health. As a case study, snakebite will be shown as one example of NTD cases that rarely receive any publicity and lack of data epidemiology.

2. LITERATURE REVIEW

2.1. Neglected Tropical Diseases in Indonesia

Despite NTD has been already introduced several years by WHO there are very few studies reported concerning NTD incidences in Indonesia and epidemiology data in Indonesia is minimal. As a consequence, risk factors, prevention and control programs were poorly understood in most of national and regional health services in Indonesia.

Table 1 represents the NTD cases specified by WHO and its magnitude in Indonesia. Wibawa and Satoto [5] reported that by the end of 2015 NTD is still problematic in Indonesia. Even though the Ministry of Health of Indonesia reported only five NTD that can be found in Indonesia, namely leprosy, filariasis, schistosomiasis, soil-transmitted helminth, and yaws, however, the magnitude of problems of other three diseases shall be

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addressed and considered since NTD are closely related with local vector and intermediate host distribution which are specifically associated with geographic region.

**TABEL 1. RESUME OF THE MAJOR REPORTED NEGLECTED TROPICAL DISEASES IN INDONESIA (SUMMARIZED FROM: [4],[5])**

<table>
<thead>
<tr>
<th>Diseases</th>
<th>Reported cases</th>
<th>Highest prevalence regions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schistosomiasis</td>
<td>Prevalence fluctuated</td>
<td>between 0.3% and 4.8% in Napu Valley and between 0.8% and 3.6% in Lindu Valley during 2008-2011</td>
</tr>
<tr>
<td>Lymphatic Filariasis</td>
<td>11,914 chronic cases in 2000-2009</td>
<td>Maluku, Papua, West Irian Jaya, East Nusa Tenggara and North Maluku Classa and 160 districts, which mostly are located in Java island Spread in 18 provinces of Indonesia, mostly in eastern part of Indonesia</td>
</tr>
<tr>
<td>Leprosy</td>
<td>5.29 new cases detection rate in 2013</td>
<td>Fourteen provinces Spread across the country</td>
</tr>
<tr>
<td>Yaws</td>
<td>5,319 cases in 2011 and 3,476 cases in 2012</td>
<td>6 districts in Indonesia (Tangerang, Karanganyar, Ngawi, Jembrana, Mataram)</td>
</tr>
<tr>
<td>Dengue</td>
<td>35–40 incidences per 100,000 people in 2013</td>
<td>Spread in 33 provinces</td>
</tr>
<tr>
<td>Chikungunya and Japanese encephalitis</td>
<td>3,529 cases in 2008, 83,756 cases in 2009</td>
<td>Spread in 33 provinces</td>
</tr>
<tr>
<td>Soil transmitted helminthes (STH)</td>
<td>400,000 individuals (mostly children) in elementary schools</td>
<td>6 districts in Indonesia (Tangerang, Karanganyar, Ngawi, Jembrana, Mataram)</td>
</tr>
<tr>
<td>Rabies</td>
<td>206 cases in 2010 and 119 cases in 2013</td>
<td>24 provinces, Bali is still enigma</td>
</tr>
</tbody>
</table>

2.2. Snakebite as a neglected disease

Snakebite is an important and serious public health problem in many parts of tropical countries [6]. The World Health Organization estimates place the number of snake bites to be 421,000 envenoming and 20,000 deaths occur worldwide from snake bite each year, but warn that these figures may be as high as 1,841,000 envenoming and 94,000 deaths per annum [6].

Due to poor reporting system, the incidences are commonly not well documented and thus reliable data for levels of morbidity and mortality are not available. Moreover, in many developing countries the records of a large number of cases do not appear in official statistics since people often seek traditional methods of treatment. Indeed, it would appear that delayed presentation to hospitals frequently contributes to increased morbidity and mortality from snake bites.

Despite being included in the 2009 WHO list of NTDs, snakebite has not been incorporated into the globally coordinated efforts to reduce the impact of the NTDs [7]. The reason of this negligence is probably based upon the perception that, because snakebite is not an infectious disease, therefore the strategies for its alleviation do not fit within the strategies used to combat the “typical” NTDs [7].

2.3. Snakebite in Indonesia

Indonesia is harbor of approximately 450 species of snakes. Four of those indigenous species commonly found in rural area, namely Russell’s viper, saw scaled viper, cobra and Krait, are thought to be venomous snakes. Bites from these snakes can be important cause of mortality [8]. However, there is no information available on the magnitude of snakebite incidences in Indonesia.

In Kasturiatne report [9], Indonesia was identified as a country where venomous snakebites do not occur, since there are no reports regarding estimation of incidence rate and the number of snakebites envenoming in recent peer reviewed publication.

The fact that most effective treatment for snakebite based on the recommendations of WHO is the administration of monospecific antivenin [10],[11],[12]. However, such monospecific antivenin therapy is not always available to snakebite victims because of its high cost, frequent lack of availability, lack of technology and the difficulty in identifying the snake correctly [13].

Although there are various locally venomous snakes in Indonesia that demands specific antivenin, but in fact until now a common antivenin used in Indonesia is polyvalent antivenin. Table 2 shows the specifications of standard polyvalent antivenin used in all hospitals and community health centers in Indonesia [14],[15].

Since the public health burden of snake bite is very substantial and similar to other more widely recognized NTDs, therefore efforts and attention to commensurate with its burden should be made available for the report and control of snakebite incidences.
4. RESULTS

We have three articles that provide some epidemiological information such as morbidity and mortality and also incidence of snakebite in Indonesia (Table 3).

<table>
<thead>
<tr>
<th>No</th>
<th>Title</th>
<th>Author</th>
<th>Relevancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Guidelines for the management of Snakebites, 2nd Edition</td>
<td>WHO Regional Office of South-East Asia</td>
<td>Morbidity Snakebite’s cases,</td>
</tr>
<tr>
<td>2</td>
<td>Where did Venomous Snakes Strike? A Spatial Statistical Analysis of Snakebite Cases in Bondowoso Regency, Indonesia</td>
<td>Farid Rifai, Tri Maharani, Amir Hamidy</td>
<td>Morbidity Snakebite’s cases</td>
</tr>
<tr>
<td>3</td>
<td>Severe coagulopathy and transient hypertension following a Rhabdophis subminiatus bite: a case report</td>
<td>Nelwan EJ, Adiwinita R, Handayani S, Rinaldi I</td>
<td>Morbidity Snakebite’s cases</td>
</tr>
</tbody>
</table>

The estimation of snakebite which was obtained from direct personal contact Maharani with the hospital in some area, are reported at WHO South-East Asia Region Office (SEARO) [10].

<table>
<thead>
<tr>
<th>No</th>
<th>City</th>
<th>Cases /week</th>
<th>No</th>
<th>City</th>
<th>Cases /week</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Semarang</td>
<td>1-3</td>
<td>6</td>
<td>Bondowoso</td>
<td>148</td>
</tr>
<tr>
<td>2</td>
<td>Jogjakarta</td>
<td>5-8</td>
<td>7</td>
<td>Bengkulu</td>
<td>2-4</td>
</tr>
<tr>
<td>3</td>
<td>Madiun</td>
<td>1-3</td>
<td>8</td>
<td>Palu</td>
<td>1-2</td>
</tr>
<tr>
<td>4</td>
<td>Surabaya</td>
<td>2-5</td>
<td>9</td>
<td>Timika</td>
<td>1-3</td>
</tr>
<tr>
<td>5</td>
<td>Sidoarjo</td>
<td>2-5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: WHO SEARO 2016 [10].

There is an estimation of snakebite cases in 5 islands in Indonesia. The most cases of snake bites are in eastern Java. Bondowoso alone occurred 148 cases during March 2015 to May 2016 [10].

Whereas Rifai et al found the characteristic of snakebite’s patients (table 5) that more than 38% the victims of snakebite are farmers. The most biting’s area are hands (52%) and the most responsible snake for the cause of snakebite in Bondowoso is Trimesurus albolabris (31%) [16].

The third article is from Nelwan et al reported a snakebite case of disseminated intravascular coagulation with enhanced fibrinolysis following a Rhabdophis bite [17]. The patient received two vials (10mL) of polyvalent antivenom (Biosave) were diluted in 500mL of normal saline solution on the 7th, 8th and 9th days after bite. Although the antivenin from Biofarma

3. METHODOLOGY

We searched two main electronic databases namely MEDLINE (via Pubmed) and Google Scholar. The search was conducted within 3 year, from January 1, 2015 to December 31, 2017 of all publication with the following key words written in English and Indonesia : “snakebite”, “snake envenomation”, “snake envenoming” cross-referenced with the word “Indonesia” to obtain the maximum possible number of studies addressing the burden of snakebite (prevalence, incidence, morbidity, and mortality). We scanned the reference lists of articles yielded by the electronic search in order to retrieve additional relevant studies. We exclude the article which are not relevant for epidemiology of snakebite in Indonesia.

The flow of study selection is shown on the figure 1.

Source Biofarma [14]
indicated for the treatment of Naja sputatrix, Bungarus fasciatus, and Agkistrodon rhodostoma envenomation however Nelwan et al reported the improvements in the patient's hemostatic parameters suggesting a potential for cross-neutralization after administration that antivenin [17]

<table>
<thead>
<tr>
<th>Area of biting</th>
<th>Occupational Characteristic</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Occupation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Farmers</td>
<td>23</td>
<td>38</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>8</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>No Information</td>
<td>30</td>
<td>49</td>
</tr>
<tr>
<td>2</td>
<td>Area of biting</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hands</td>
<td>32</td>
<td>52</td>
</tr>
<tr>
<td></td>
<td>Legs</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Heads</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>No information</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>3</td>
<td>Responsible Snake</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trimeresurus albolabris</td>
<td>19</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>Naja sputatrix</td>
<td>4</td>
<td>6.6</td>
</tr>
<tr>
<td></td>
<td>Bungarus candidus</td>
<td>1</td>
<td>1.4</td>
</tr>
<tr>
<td></td>
<td>No information</td>
<td>37</td>
<td>61</td>
</tr>
</tbody>
</table>

Source [16]

DISCUSSIONS

Comparing to other studies in terms of the number of snakebite victims in a particular period of time [18],[19],[20], [21], the finding in Bondowoso [10], even only in a district level shows a relatively high prevalence of snakebite incidences. In addition, comparing to other common neglected diseases in Indonesia as presented in table 1, snake bite prevalence in Indonesia is comparably high. This study provides evidence that snake bite is a common problem in Indonesia, especially in rural areas. Therefore, a high attention must be paid to prevent the people from such public health threats from snakebite.

Though the data from the reporting from Maharani [10], [15] might not represent the whole populations, the highest incidence in east of Java can be explained by their large population and better reporting of cases due to better management of the health system. Since there is not a systematic organization to record all aspects of snakebite in the whole country, therefore the snakebite incidences may be higher than the documented records in this study.

Snakebites were predominant in rural areas, which suggest that the risk of bites may be higher because of more intense agricultural activities nowadays [15],[16]. This observation corroborates previous studies [21],[22],[23],[24]. In other hand, people in rural area suffer the medical burden of the neglected tropical diseases.

This observation corresponds to WHO study that the NTDs are characterized by their specificity determined by the complex features of environmental and social factors. Recently study still confirmed that the outspread of NTD is common among rural residence with features such as low income and limited resources. In terms of socio-economic factors, many studies pointed that the victims of NTDs are more in rural area than in urban area.

Some explanations underlying this reason is that rural people are living mostly from the extraction of natural resources, such as fisheries, agriculture and plantation sectors, in close contact with infectious vectors and domestic animals and livestock. In addition, barrier factors such as limited access of communications, poor transportation infrastructure, restricted health care services and inadequate quality of sanitation pattern also corroborate risk factors for disease occurrence in the community. In general, rural residence can be a marker for poverty, thus vulnerability to NTD as well.

One of main barrier to effective care for rural residence is cost. In a region where a farmer earns Rp.200,000 (around $14) monthly from their agricultural activities, antivenin product is estimated simply too expensive. As comparison to other countries, many cases of snake bite mortality are strongly associated with poverty and poor investment in health by national governments. The victims did not want to search for hospital treatment just simply because they could not afford the antivenin and the whole treatment [25][26]. Therefore, an adequate health insurance system may support in increasing probability of snake bite victims for adequate quality of treatment and hospitalization hence preventing mortality due to snake bite.

Many people in the rural village thought that snake bite is a harmless incident and the treatment is absent from national and regional health system. Many of them looked for the emergency treatment by means of prepared herbal from traditional healers.

Moreover, people activities in Indonesia with the clearest seasonality pattern were farming, which represents the economic base of Indonesia. The activities traditionally include land clearing, preparation, planting, weeding, tending and harvesting as well as post-harvest handling, processing and storage.

In order snake bite patients to be treated with adequate antivenin, the antivenin supply plays an important role in terms of need (amount and type), logistic, antivenin storage, experts' patients, room during hospitalization and in the end the cost allocated annually from the government can be estimated. As suggested in other research [27], it is important to note here that the only manifestation of venomous snakebite is the timely administration of antivenin.

Learning from the scarcity of antivenin in Africa [13],[27], stakeholders such as governments and private employers, especially agricultural firms, health insurance providers, etc. need to overcome the scarcity caused by inadequate product distribution, deficit of adequate training for medical staffs and funding limitation. Since the snake bite victims affected mainly people in rural areas with from low-income people and less financial, and constraints of access to transport therefore basis of epidemiological studies that detail plays an important role in predicting accurate availability that should be there, the selection of antivenin effective against local species, quite safe
for usage in underequipped facilities, reliable enough for shipping and storage on local weather in Indonesia.

Unfortunately, most snake bite cases in Indonesia were treated with polyvalent antivenin. Since the most effective treatment for snakebite based on the recommendations of WHO is the administration of monospecific antivenin, therefore attempts at developing better region-specific antivenom and distribution shall be urgently initiated. Along with this initiative, epidemiological studies and medical staff training as well as establishment of center for surveillance, record, control or prevention of envenomation shall be programmed.

Reflecting on the case of snake bite discussed in this study, snake bite is lack of public’s attention, therefore snake bite in Indonesia is really a neglected disease. This study observed the fact that the epidemiology data was minimal, the cases often go unreported and patients were not treated standardized antivenin administration. As a consequence, current comprehensive snakebite management, health policy intervention and prevention efforts were not readily implemented.

Therefore, to enhance national health standards in the future, the indicators for snake bite management, prevention and control shall be applied based on the national health system and assessed by the existing health system indicators such as health interventions, health services, health promotion and people empowerment. With regard to neglected snake bite incidences in Indonesia, those indicators shall increase as the health policy intervention and prevention efforts increased.

It is suggested that vulnerable populations need urgent access to effective and affordable treatments. Snake bite cases deserve high attention for the future Indonesian national health system.

CONCLUSIONS

This study identified overviewed major epidemiological and management variables of neglected diseases and their magnitude in Indonesia. With regard to indicators of health systems, in order to prevent the risk of neglected disease problem associated with snake bite incidences and improve country’s health system, following programs are relevant to be implemented: improve medical, improve the management of antivenin supply and its administration standard, accelerate new development of polyvalent antivenin, better reporting system on epidemiology data as well as health management system standardization of snake bite. For future Indonesian national health system, there is a need for increasing focus on epidemiological study of snake bite through establishing a well-planned data collection and information dissemination system to avoid this potentially preventable disease.

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