A Review on the Potential of Antivenom Industry in Bangladesh

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ABSTRACT
Snakebite is a buzzing issue among neglected diseases. Bangladesh is one of the most affected zones by snake bites due to its geographical location, tropical climatic conditions, high population density, agricultural practices, human-wildlife interaction, etc. Treatment facilities are getting interrupted owing to a lack of sufficient antivenom and health care providers, the high cost of antivenom, delayed reporting, etc. Although there are several species of both poisonous and non-poisonous snakes available in Bangladesh, no regional or country epidemiological data and organized snake farming systems are available. There is an opportunity to produce antivenoms through snake farming in Bangladesh. Researchers, policymakers, and other respected authorities should look into this issue to reduce the snake bite burden as well as the opportunities of a new era. In addition, the development of the local polyvalent antivenom may decrease treatment costs by developing medical facilities in rural networks.

Keywords: Antivenom, Bangladesh, Snakebite, Venom.

1. Introduction
Snakebite is considered a neglected disease worldwide widely with risks of 5,800,000,000 per year, among them, 81,000–138,000 deaths occur [1] where Africa, Asia, and Latin America are the hot spots for it [2]. South Asian region is prone to high-risk zones due to geo-climatic conditions and immense human-wildlife interaction. It covers around 70% of global statistics [3], [4]. Epidemiological studies among the Indian sub-continent reveal that around 50,000 deaths annually in India, and 2,000 fatalities in Pakistan and Bangladesh due to snake bite intoxication [5]–[8]. There are 82 indigenous snake species with 28 venomous in Bangladesh [9], [10].

Since Bangladesh is situated at the confluence of the Indo-Malayan, Indo-Chinese, and Indo-Himalayan regions, there are tremendous prospects to have a wide variety of ecosystems for snakes and other wild creatures. In Bangladesh, snakebite in humans is referred to as an occupational health hazard, because biting occurs most frequently when individuals are at work, engaging in tasks like farming, fishing, cultivation, wood cutting & collection, or taking care of crops or gardens [11], [12]. In addition, Bangladesh is also prone to natural disasters as a result of its geographic location and meteorological circumstances leading to an increase in the incidence of snakebites. Snakebites have a substantial negative impact on both human and animal health and the economy due to the cost of medical care and loss of productivity.

2. Snake Venom
Snake venoms are toxic secretions of snakes that are synthesized and stored in modified parotid salivary glands called venomous glands. Snakes normally expel their venom through fangs with some exceptions like splitting of venom. Snake venom is a complex mixture of enzymatic and toxic proteins, which include phospholipase, myotoxins, hemorrhagic metalloproteinases and other proteolytic enzymes, coagulant components, cardiotoxins, cytotoxins, and neurotoxins. Snake venom also contains inorganic cations such as sodium, potassium, magnesium, and small amounts of zinc, nickel, cobalt, and iron which act as catalysts. It has an acidic pH. Specific gravity is 1.03 and is water soluble [13]–[17].

3. Pathogenesis and Pathology
The pathological characteristics of toxins of snake venoms are classified into three categories such as hemotoxicity, cytotoxicity, and neurotoxicity. Hemotoxins cause
hemorrhage and coagulopathy, cytotoxins herms on cell physiology and are prone to necrosis, and neurotoxins paralyze the neuromuscular activity and lead to heaven [18–21]. Numerous factors like geographical location, habitat, and climate are playing a vital role in carrying different types of toxins among snake species [22], [23].

4. Antivenom

Snake antivenom is one kind of therapeutic serum that is the only effective treatment choice for snake bite envenoming [24], [25]. Antivenom may be a mono variant or poly variant but the second one is best for treatment cause biting a snake may not be familiar to the victim [26]. A recent study reveals that 48 public laboratories produce antivenom across the world. Among them, 04 (four) are running in India and it is the largest antivenom producer as well [3], [5], [26–28]. A previous study reported that some countries provide free antivenom for snake bite envenoming but most of the common practice is to buy the antivenom by victim [28].

5. Bangladesh Scenario

Bangladesh is a tropical country with a variation of monsoon characteristics depending on rainfall, temperature, and humidity. Due to the geo-climatic zone, snakes are one of the major parts of our ecosystem. Snake biting is a regular medical case throughout the country, but its prevalence is higher in rainy seasons. Multiple factors are interrelated to each other in our socio-cultural lifestyle, natural disasters like floods, flush floods, deforestation, etc., and human-animal interactions, etc., which increase the incidence of snakebite in Bangladesh [29].

Bangladesh is an agrarian country; most of the people depend on agriculture for their livelihood. A good number of snake bite cases cover the farmers while harvesting crops in agricultural land especially wet-land or water-logged areas including fishing. Generally, farmers get snake bitten due to getting closure of the snake by the unconscious mind. A study revealed that male farmers were more infected than female farmers. Rural areas were prone to snake-biting cases in comparison to urban areas [7]. Honey collection from the forest is another risky profession for snake biting incidence. A group of people in the southern region of Bangladesh is completely dependent on honey-seeking in the Sundarbans, the largest swamp forest. The Viperidae family, especially the green pit viper is adapted to the swamp forest ecosystem. So, honey-seeking professionals are at high risk of viper biting [30], [31]. Tea garden workers are also at high risk of snake biting tendency due to the high humid conditions of tea gardens. Tea is one of the economic crops in favor of Bangladesh where a good amount of tea gardens is situated in the northeastern, western, and northern regions of our country [32–34]. Coastal regions of Bangladesh are also highly risky for sea snake biting [35]. Normally, the sea snakes get trapped in fishermen’s fishing nets and most of the biting occurs when the fishermen try to free the snakes from the net.

Flood is another important factor in increasing the snake bite frequency. Due to floods, the habitats of snakes are ruined, and they are trying to take shelter in a safe and secure place, so they get very close to humans. This phenomenon plays an important role in increasing snake bite cases [29]. Flush flood is one of the major reasons. Bangladesh is a riverain country, during the flush flood the venomous snakes of hilly area reach to river-islands through turnover of water. Based on this fact, poisonous snakes like Russel viper biting cases are a common issue during the rainy season with the flush flood [29], [30].

Globalization and climate change are another important factor for the rise in the snake-biting phenomenon. It breaks the safe border for human-human-animal-environment interfaces. Due to very close interactions between humans and animals, animal attacks as well as snake biting frequently occur all over the world [33]. Due to tropical geo-locations, snake biting is occurring in Bangladesh [34].

In Bangladesh, Snake bite treatment is available in some selected government hospitals especially tertiary-level hospitals free of cost. Bangladesh’s government is legally dependent on India for antivenom which is inadequate. For this consequence, illegal antivenoms are smuggled resulting in a high cost of approximately $73 for a single dose [35]. A study on snake bite burden in Bangladesh has calculated the total treatment cost of snake bite envenoming which was $231 where per capita income is $2,227 and the poverty rate is 24% [9], [36]. Another study expressed that the total medical expenditure for venomous snake bites is seven times higher than for non-venomous snake bites where a minimum of $34 is needed for non-venomous snake bite management [37].

Nowadays, one private pharmaceutical company named Incepta Pharmaceuticals Ltd. has got the license to manufacture the antivenom with $13 [38]. The expenditure on antivenom treatment may be decreased by producing the antivenoms from local venomous snakes despite purchasing or manufacturing from abroad. The composition of snake venom and potency varies depending on geo-climate and environmental factors [26], [39]. The polyclonal venom from local snake venoms may reduce the doses as well as complexity to patients. So, it is a prudent period to cope with the modern treatment facilities for neglected diseases like snake bites to reduce mortalities in the future [3]. Bangladesh government has taken a five-year project for advanced venom research at Chattogram Medical College (CMC) in 2018 which will lead to local antivenom production at a convenient cost soon [39]. Along with core government projects, public-private collaborative action may accelerate the antivenom-producing actions in Bangladesh.

Published literature revealed the existence of four snake farms around the country. Still, they are facing multi-sectoral challenges in envenomation [40], which is one of the potential issues for the establishment of the antivenom industry in Bangladesh. This industry is highly prospective, which is directly related to health issues or snake bite management but indirectly related to employment sources and earning foreign currencies by exporting venom, a new export item as pharmaceutical products. Global health communities are encouraging developing countries to ensure the security suppling chain with native resources [41–43]. Concern authorities should be
concerned about this issue with sustainable policymaking to initiate antivenom production in Bangladesh.

6. Conclusion

Cheap and easy of availability of antivenom is the basic requirement of reducing the burden of snake bite envenoming. Due to the high incidence of snake bite envenoming, it is crucial for both medical and financial considerations. Therefore, snake rearing in captive conditions or snake farming may be a great source of raw material for antivenom research and production in Bangladesh. Policymakers should look at this new issue to reduce the neglected disease burden in Bangladesh and think about the immense potential of the antivenom industry in Bangladesh.

AUTHOR CONTRIBUTIONS

All the authors have actively participated in this study.

CONFLICTS OF INTEREST

Authors declare that they do not have any conflict of interest.

REFERENCES


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