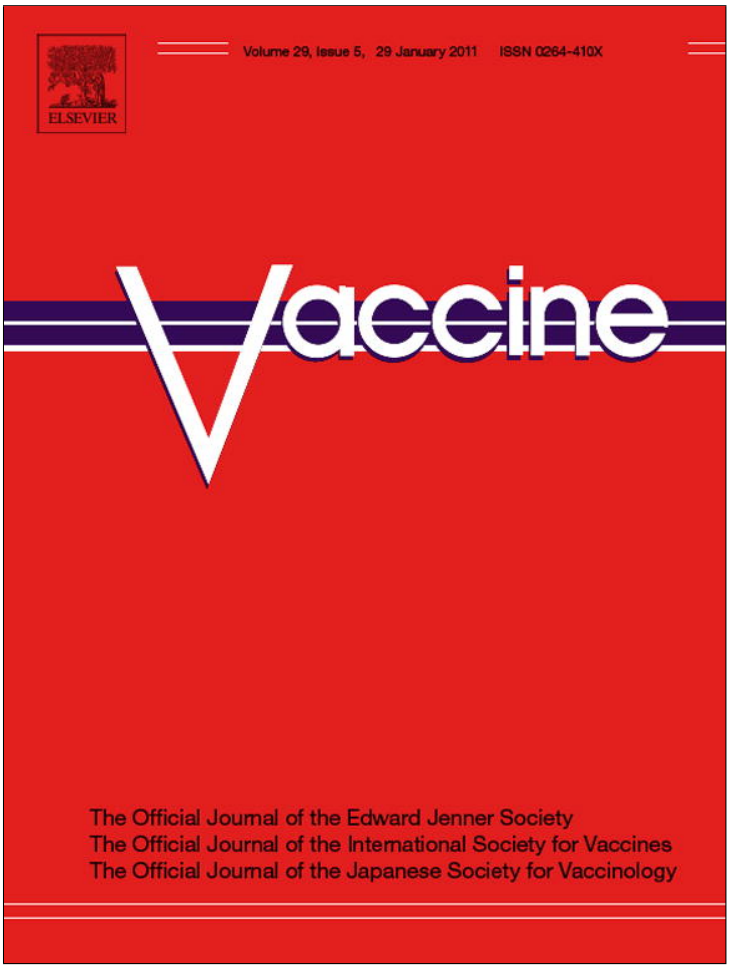

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Five-year (January 2004–December 2008) surveillance on animal bite and rabies vaccine utilization in the Infectious Disease Hospital, Dhaka, Bangladesh

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ABSTRACT

The magnitude of animal bite and utilization of rabies vaccine was determined at the Infectious Disease Hospital, Dhaka, Bangladesh. From January 2004 to December 2008, 150,068 patients with animal bite visited the hospital, 86.2% and 13.8% of them received nerve tissue and tissue culture vaccine (TCV), respectively. Dog bite was most frequent, found in 90.7% cases. In 794 rabies cases only 24.4% had a history of post-exposure vaccination. Only a negligible number of patients received rabies immunoglobulin (RIG). To prevent further human deaths and economic losses intra-dermal TCV regime and equine RIG should be immediately introduced in Bangladesh.

1. Introduction

Rabies is primarily a disease of terrestrial and airborne mammals and is widely distributed across the globe. Rabies virus belongs to the genus *Lyssavirus* of the Rhabdoviridae family. The virus is present principally in the nervous system of rabid animal and is excreted via the saliva. As a result, the route of transmission is usually by bite. Safe and effective vaccines are available to prevent rabies in animals and humans before and after exposure. To prevent rabies after exposure the WHO recommends cleaning and disinfecting a wound or point of contact and then administering anti rabies immunization as soon as possible [1]. Rabies vaccine is recommended for category II and III exposures, in addition rabies immunoglobulin (RIG) is recommended for category III contact [1].

Globally, more than 7.7 million people undergo post-exposure prophylaxis (PEP) for rabies and more than 55,000 people die of rabies each year, 99% of these occur in the developing countries [2] largely due to inadequate rabies control measures. Control of stray dogs and vaccination of pet animals has led to reduced disease in several countries. However, recent increase in human deaths in several countries evidenced that rabies is reemerging as a serious public health crisis [3–6].

Rabies is widely distributed and a major public health problem in Bangladesh. In the number of human death due to rabies this country is ranking third in the world after India and China (http://apps.who.int/globalatlas/DataQuery/default.asp). Rabies is not a notifiable disease in Bangladesh and there is no organized surveillance system for rabies therefore reliable data are scarce and the mortality may be several fold higher than anticipated. Keeping in mind this scenario it is needed to evaluate the overall situation of animal bites and its treatment and preventive aspects in Bangladesh. This study was therefore carried out at the Infectious Disease Hospital, Dhaka (IDH) to understand the magnitude of animal bite and rabies, and the utilization of vaccines in Bangladesh. IDH is the main referral center for rabies patients and therefore most of the animal bites cases from different areas of the country turn up here to receive free vaccine and treatment. Our study revealed that the situation of rabies vaccine utilization is of concern in Bangladesh and the implementation of rabies control program is urgently needed.

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Table 1
Age distribution of patient with animal bite by years reported at the Infectious Disease Hospital, Dhaka, Bangladesh.

Year	Age (years)						Total
	1–10 (%)	11–20 (%)	21–30 (%)	31–40 (%)	41–50 (%)	>50 (%)	
2004	8040 (30.0)	6374 (23.8)	5292 (19.7)	3597 (13.4)	2599 (9.7)	887 (3.3)	26,789
2005	9183 (28.4)	7549 (23.4)	7617 (23.6)	3961 (12.3)	2950 (9.1)	1025 (3.2)	32,285
2006	8498 (33.7)	5383 (21.4)	4399 (17.5)	3332 (13.2)	2567 (10.2)	1004 (4.0)	25,183
2007	10,206 (33.7)	6429 (21.2)	5511 (18.2)	3824 (12.6)	3150 (10.4)	1164 (3.8)	30,284
2008	11,123 (31.1)	7448 (20.8)	6764 (18.9)	4772 (13.3)	4138 (11.5)	1559 (4.3)	35,804
Total	47,050 (31.5)	33,183 (22.2)	28,683 (19.2)	19,486 (13.0)	15,398 (10.3)	5639 (3.8)	149,439

2. Methods

Data were collected from clinical records and register books of patients with animal bites and rabies cases attended at IDH from January 2004 through December 2008. All rabies cases were diagnosed clinically. Demographic data, date of visit or admission, nature of injury, inoculation of rabies vaccine, treatment with rabies immunoglobulin (RIG), type of vaccine administered, animal species involved, interval between development of rabies and animal bite were collected. Targeted information of all cases was not retrievable from the documents as several of these were incompletely recorded. Perhaps, the concerned medical officer could not elicit a detailed history from the guardian at the time of reporting. All statistical analyses were performed using Prism software (GraphPad Software). ArcGIS 9.3 software was used to illustrate the distribution of rabies cases from different districts of Bangladesh attending at the IDH.

Information regarding nerve tissue vaccine (NTV) production was collected from the Institute of Public Health, Dhaka (IPH) (Dr. Mohammad Ajijar Rahman, Director, IPH, Dhaka, Bangladesh). Since 1956, IPH has been producing NTV from sheep brain by inoculating fixed strain PV. Approved quality control tests are done at IPH before releasing NTV for use. Information regarding tissue culture vaccine imported from abroad was obtained from two private pharmaceutical companies (Mr. Iftekharul Islam, Managing Director, Sanofi-Aventis Bangladesh Limited & Mr. Syed Kaiser Kabir, Managing Director, Renata Limited, Dhaka, Bangladesh).

Data regarding extermination of stray dogs were collected from Dr. Mohammad Nurul Islam, Deputy Chief Health Officer, Dhaka City Corporation, Dhaka, Bangladesh.

3. Results

Over 5 years a total of 150,068 patients attended at IDH for proper management and treatment of animal bites. On an average 29,888 (95% confidence interval 24,729–35,046) patients attended per year. From 2006 onwards an upward trend of animal bite was found. Table 1 shows the age distribution of 149,439 cases recorded; animal bite was more frequent among children of age group 1–10 years than other age groups which constituted roughly 30% of cases. The frequency of animal bite gradually decreased in older age groups.

Gender distribution could be determined in 150,026 cases (Table 2). Yearly the average number of male and female patients were 23,284 (95% CI, 18,208–28,359) and 6722 (95% CI, 5715–7728), respectively. On an average 77.4% (95% CI, 73.5–81.2) was male and 22.6% (95% CI, 18.8–26.5) was female.

Table 2
Gender distribution of patients with animal bite by years.

Gender	Year					Total
	2004	2005	2006	2007	2008	
Male (%)	20,712 (77.3)	24,992 (79.6)	18,993 (75.4)	22,281 (73.4)	29,440 (81.1)	116,418 (77.6)
Female (%)	6080 (22.7)	6400 (20.4)	6191 (24.6)	8068 (26.6)	6869 (18.9)	33,608 (22.4)

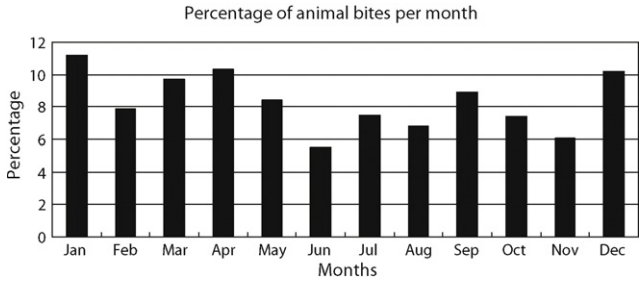


Fig. 1. The monthly occurrence of rabies cases attended at the Infectious Disease Hospital, Dhaka. The monthly occurrence is represented as percentage of rabies cases detected.

To elucidate the temporal relationship of animal bite, percentage of animal bite cases by months were plotted in 149,439 cases (Fig. 1). It was observed that animal bite was prevalent throughout the year however it varied from 5.5% to 11.2%, lowest was found in the month of June and highest in January. Peaks were found in the month of December and January then again in April. We could not find any correlation with monthly temperature or rain fall with the number of cases with animal bite.

Among 150,019 cases the species of animal that caused bite was recorded. Dog bite was most frequent, found in 136,069 (90.7%) cases followed by cat in 7495 (5.0%), fox/jackal in 643 (0.4%), mongoose in 426 (0.3%) and undetermined in 5386 (3.6%) cases.

In 121,785 cases, information regarding post-exposure vaccination was recorded, 105,034 (86.2%) of them were inoculated with NTV, while only 16,751 (13.8%) received TCV.

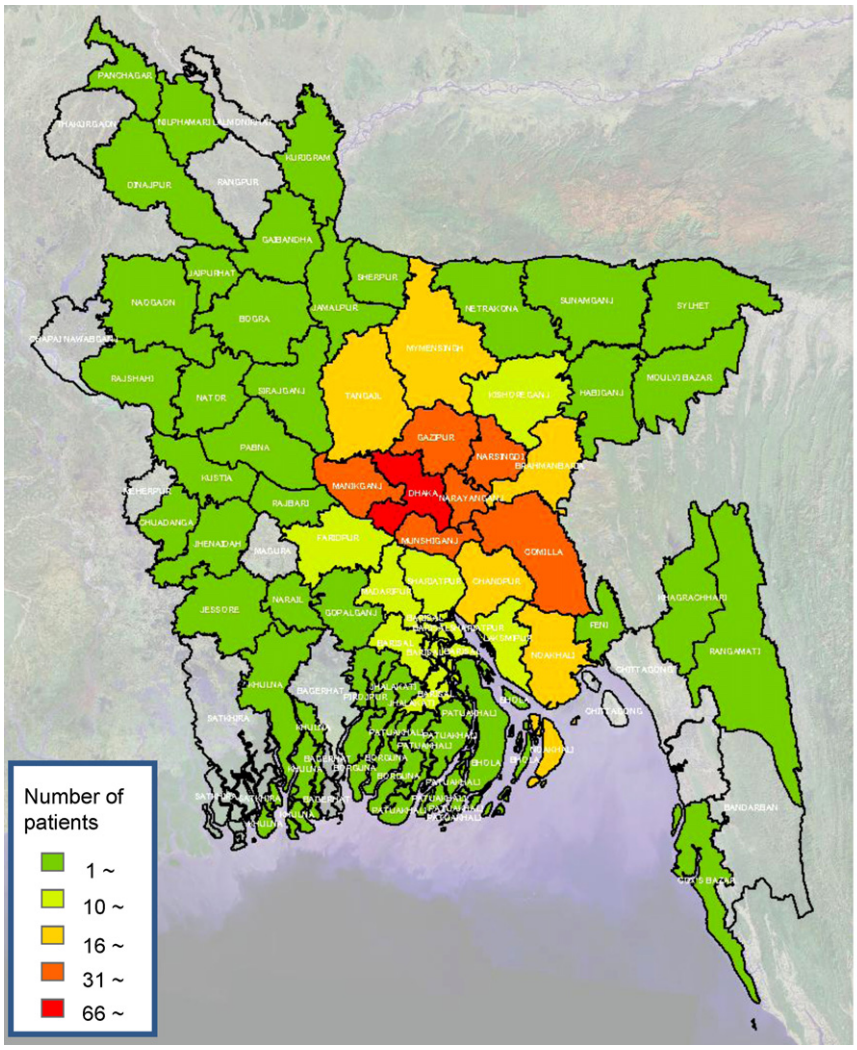
Among 794 rabies cases only 194 (24.4%) patients had a history of post exposure vaccination. Only 7 cases were treated with RIG. A total of 732 rabies cases, 625 (85.4%) and 107 (14.6%) patients were from rural and urban areas, respectively. Among 728 rabies cases, 341 (46.8%), 348 (47.8) and 39 (5.4%) had category III, II and I according to the WHO criteria.

Gender distribution was found in 733 entries of rabies cases, among them 190 (25.9%) and 543 (74.1%) was female and male, respectively. Age ranged from 1 to 100 years with a mean 20.9 years (95% CI 19.5–22.3). Rabies was more among children of age group 1–10 years which constituted 46% of the total cases (Table 3). On an average 76.4 days (95% CI, 68.5–84.4 days) interval was found from bite to development of rabies. There were no effects of seasons on the number of rabies cases.

In 20 cases the animal species which caused rabies was undetermined. In 655 (91.7%) cases of rabies, dogs were responsible for biting followed by cats in 41 (5.7%) cases, mongoose in 11 (1.5%)

Table 3
Age distribution of patients with rabies attended at IDH.

Age (years)						Total
1–10 (%)	11–20 (%)	21–30 (%)	31–40 (%)	41–50 (%)	>50 (%)	
332 (46.0)	130 (18.0)	60 (8.3)	70 (9.7)	78 (10.8)	51 (7.1)	721



DISTNAME	Number of Patient
BAGERHAT	n.a.
BANDARBAN	
BARISAL	14
BHOLA	8
BOGRA	3
BORGUNA	3
BRAHMANBARIA	20
CHANDPUR	21
CHAPAI NAWABGANJ	n.a.
CHITTAGONG	n.a.
CHUADANGA	1
COMILLA	59
COX'S BAZAR	1
DHAKA	118
DINAJPUR	4
FARIDPUR	14
FENI	5
GAIBANDHA	3
GAZIPUR	54
GOPALGANJ	3
HABIGANJ	8
JAIPURHAT	1
JAMALPUR	4
JESSORE	1
JHALAKATI	1
JHENAIDAH	1
KHAGRACHHARI	1
KHULNA	1
KISHOREGANJ	10
KURIGRAM	1
KUSTIA	6
LAKSMIPUR	11
LALMONIRHAT	n.a.
MADARIPUR	15
MAGURA	n.a.
MANIKGANJ	40
MEHERPUR	n.a.
MOULVI BAZAR	1
MUNSHIGANJ	46
MYMENSINGH	29
NAOGAON	4
NARAIL	3
NARAYANGANJ	65
NARSINGDI	43
NATOR	2
NETRAKONA	5
NILPHAMARI	5
NOAKHALI	19
PABNA	3
PANCHAGAR	1
PATUAKHALI	3
PIROJPUR	7
RAJBARI	4
RAJSHAHI	2
RANGAMATI	2
RANGPUR	n.a.
SATKHIRA	n.a.
SHARIATPUR	12
SHERPUR	3
SIRAJGANJ	9
SUNAMGANJ	2
SYLHET	1
TANGAIL	30
THAKURGAON	n.a.
TOTAL	733

Fig. 2. Distribution of rabies cases from different districts of Bangladesh attending at the Infectious Disease Hospital, Dhaka, Bangladesh. Most of the patients were from Dhaka and surrounding districts.

and fox/jackal in 7 (1.0%) cases. Whether these animals were pet or stray were documented in 520 cases, among these pet animals were responsible for 55 (10.6%) cases, of them 45 (81.8%) were dogs and 10 (18.2%) were cats.

Origin of rabies cases based on different districts could be traced in 733 entries (Fig. 2). Among the 64 districts of Bangladesh, from 10 (15.6%) districts no patient visited IDH during the study period. Most patients, 425 (58%), were from Dhaka and surrounding 6 districts, Gazipur, Narsingdi, Narayanganj, Comilla, Munshiganj and Manikganj. Adding to this lists the number of patients from Mymensingh, Tangail, Brahmanbaria, Chandpur and Noakhali constituted 75.2% (544) of the total patient with rabies. Only from Dhaka district 118 (16.1%) patients with rabies visited IDH.

Data from the fiscal year 2005 to 2008 showed that on an average annually 41,420 (95% CI, 28,280–54,560) doses of NTV was produced by IPH in Bangladesh (Table 4). Data from 2004 to 2008 showed that per year on an average 92,816 (68,000–120,800) doses of TCV were imported to Bangladesh which cost 2,451,757 (1,900,471–3,003,043) US$ per year (Table 5).

The responsible departments of major city offices revealed that elimination of stray dogs are performed on a regular basis with some annual variations (Table 6). The population of these cities is the following: Dhaka 7,000,940, Khulna 855,650, Rajshahi 472,775, Sylhet 463,198 (Statistical Pocket Book 2008) and Tongi 350,000 (http://en.wikipedia.org/wiki/Tongi). Considering the human:dog ratio as 7.5 in urban areas of Asia [2] the number of dog population in Dhaka is 933,459, Khulna 114,087, Rajshahi 63,037, Sylhet 61,750 and Tongi 46,667. Per year on an average 22,416 (15,191–27,691), 1824 (1195–2275), 949 (730–1556), 740 (521–1173) and 2438

Table 4
Annual production of nerve tissue vaccine in Bangladesh.

Financial year (July–June)	Vaccine production (NTV)		
	5 ml (dose)	10 ml (dose)	Total (dose)
2005–2006	38,820	1127	39,947
2006–2007	35,941	1082	37,023
2007–2008	46,105	1184	47,289
2008 (December)	25,495	804	26,299

Table 5
Amount of two commercial tissue culture vaccines, Rabipur® and Verorab®, imported in Bangladesh by private sectors and the cost in US$.

Year	Rabipur® (dose)	Cost ($)	Verorab® (dose)	Cost ($)	Total vaccine	Total cost ($)
2004	48,000	1,092,000	20,000	680,000	68,000	1,772,000
2005	78,300	1,781,325	20,000	680,000	98,300	2,461,325
2006	100,800	2,318,400	20,000	680,000	120,800	2,998,400
2007	69,300	1,593,900	30,000	1,020,000	99,300	2,613,900
2008	37,280	1,053,160	40,000	1,360,000	77,280	2,413,160

Table 6
Number of stray dog elimination per year in Bangladesh under different city offices.

Financial year	Number of stray dog eliminated by different city offices				
	Dhaka	Khulna	Rajshahi	Sylhet	Tongi
2003–2004	15,191	1195	740	1173	–
2004–2005	27,691	1951	822	665	2464
2005–2006	26,516	2275	730	521	627
2006–2007	20,274	1616	896	688	5063
2007–2008	22,406	2081	1556	650	1600

(627–5063) dogs are eliminated in Dhaka, Khulna, Rajshahi, Sylhet and Tongi. Therefore, the percentage of dog elimination per year is 2.4%, 1.6%, 1.5%, 1.2% and 5.2% of the total dog population of Dhaka, Khulna, Rajshahi, Sylhet and Tongi, respectively.

4. Discussion

This study revealed the current situation of animal bite, utilization of vaccine and measures to prevent rabies in Bangladesh. The limitation of the present study is that data could not be extracted from all cases attended at the hospital. Despite this limitation, which is typical of this type of study, we regard results generated by this study as important. To our knowledge, this is the first comprehensive study to show the situation of animal bite and rabies in Bangladesh. Patients of animal bite attended at IDH mainly received NTV, this type of vaccine is not in human use in other countries because of its adverse reactions and poor immunogenicity [7,8]. Bangladesh, Myanmar, Pakistan, Peru and Argentina have not switched to TCV recommended by the WHO [9]. In rabies cases also only a few patients received post-exposure vaccination and further a negligible number received RIG. Since RIG is expensive therefore only few patients were able to purchase it for treatment. These reveal the grievous situation of animal bite victims in Bangladesh. Children and young people were the most vulnerable group for animal bite and were at the highest risk of developing rabies as reported from other countries [2,10,11]. Together they constituted 73% of patients with rabies and animal bites. The reason for this vulnerability is unknown but possibly several factors exists. Children express natural affection for animals particularly for cats and dogs as a result come in close contact with animals. Again male were found more susceptible to animal bite as well as rabies possibly due to more chances of contact with animal as men spent more time outdoor. In rabies patients about three fourth of the patients did not receive any post-exposure vaccination. Of concern a good number of patients after receiving post-exposure vaccine developed rabies, which may be due to the absence of RIG from their treatment. The other reason for developing rabies may be the less effectiveness of NTV [7,8] which was mainly used for animal bite victims. Similar disturbing pictures are obtained from India and Pakistan. In a study in India it was found that about 80% did not receive any rabies vaccine and those received rabies vaccine, NTV was slightly higher than TCV [12]. The use of RIG was negligible reflecting gross negligence on the part of both the bite victim and healthcare system [12]. From January 2005, India has discontinued the production of NTV [12]. In Pakistan for PEP all patients received NTV and only three of the 109 patients with category III bites received RIG [7]. When rabies cases were analyzed in Pakistan similar situation emerged, 67% of the victims received PEP by NTV without RIG and 40% only completed the full course of vaccination [8].

In Bangladesh IPH produces NTV only for PEP and not for pre-exposure immunization; the bulk of vaccine demand is met by imported vaccines. Our study showed that a vast amount of resources is spent to import rabies vaccine which is a burden for the economy of Bangladesh. According to the WHO, every year 1550 people die of rabies in Bangladesh (http://apps.who.int/globalatlas/DataQuery/default.asp) and an estimated 60,000 people seeking post-exposure prophylaxis (www.searo.who.int/Linkfiles/CDS_rabies.pdf.pdf). Taking into account the number of patients attended at IDH with animal bites from different districts, the annual production of NTV and the amount of TCV imported annually, the number of people seeking post-exposure prophylaxis may be several fold higher than the estimated figure by the WHO. The economic burden of rabies in the developing world takes a large toll. Considering the severity of rabies situation in Bangladesh, it is better to introduce TCV and RIG as recommended by the WHO. The high cost of TCV and rabies immunoglobulin hindered their use significantly. The average cost of post-exposure vaccination is US$39.57 in Africa and US$49.41 in Asia [2]. This might be a major financial burden for most households in these countries as well as in Bangladesh. Therefore policy makers are possibly hesitant to switch to TCV for less costly NTV. Several measures may be taken to reduce the cost of PEP. Converting the facility at IPH to produce TCV might reduce the cost than imported vaccines and people will have access to quality vaccine. However it will take time to achieve and get the results. To prevent further human deaths and economic losses immediate action is needed. The introduction of intra-dermal TCV regime and introduction of equine RIG might reduce the cost substantially [13]. In future rabies virus neutralizing mouse monoclonal antibody cocktail might become less expensive alternative since it showed equal or superior efficacy to human RIG [14].

Stray dogs, followed by stray cats, were the principal animal responsible for bite and the transmitter of rabies in Bangladesh as has been reported from other countries [10–12,15,16]. Stray dog elimination is non-existent in the rural parts of Bangladesh. It is apparent from our study that the current level of stray dog elimination from the urban areas is inadequate to improve the animal bite and rabies situation in Bangladesh. Animal birth control program does not exist in Bangladesh. Therefore effective measures should be taken to improve this situation. Pet animals were also responsible for a significant number of rabies cases in Bangladesh and in this category also dogs were mainly responsible for transmission of rabies. The implementation of stricter laws for the vaccination of pet animals is urgently needed. Finally public awareness regarding rabies should be created to successfully eliminate rabies from Bangladesh. Lack of public awareness may be partly blamed for the absence of motivation to eliminate rabies from Bangladesh. Animal bite was prevalent throughout the year however the frequency of animal bite increased during cool dry seasons. Therefore people should be more vigilant during that period to avoid contact with animals. We found that only a few patients developed rabies despite category I injury, we are not sure whether patients' attendants recall the event correctly. All together, victims of wild animals were considerably less compared with that of stray animals. It is not known whether a sylvatic rabies cycle exists in the wild life of Bangladesh or it is spill over from dogs in wild animals.

Bangladesh is one of the most densely populated countries of the world where in an area of 147,570 km^2, 147.3 million people live, of them 76.5 and 23.5% reside in rural and urban areas, respectively [17]. The human–dog ratio in Bangladesh is not known. It is estimated that mean human:dog ratio is 7.4 in urban and 14.3 in rural areas of Asia [2]. It is reflecting the fact possibly in Bangladesh also since we found that majority of rabies victims were from rural areas. Our study found that majority of the patients derived from Dhaka or surrounding districts possibly due to the ease to reach to IDH from those areas. Apparently patients are not coming from a few places and possibly receiving treatment locally. Considering the current situation only one referral hospital for animal bite and rabies victims is not adequate for Bangladesh. Therefore it is better to establish several rabies centers across the country for better treatment and awareness of the people, and for the surveillance of

rabies and animal bites in Bangladesh. Scarcity of laboratory facilities for rabies diagnosis has been noted in several Asian countries severely affected by rabies such as China [15]. This is partly due to financial and logistical barriers; the situation might improve by introducing simple and affordable diagnostics in rabies endemic countries [18]. New technological advances will make available faster, more accurate and may, in time, cost-effective alternative to traditional rabies diagnostic tests [18]. Rabies is mainly reported in Bangladesh without confirmatory laboratory tests, indicating that diagnosis and surveillance system is not fully in service. At present it is very important to establish a laboratory where the diagnosis of rabies can be reliably done. The severe situation of animal bite as revealed in this study might convince the health authorities to facilitate the establishment of national rabies control program in Bangladesh.

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References

[1] WHO Expert Consultation on Rabies: first report. Geneva: World Health Organization; 2004.
[2] Knobel DL, Cleaveland S, Coleman PG, Fevre EM, Meltzer MI, Miranda ME, et al. Re-evaluating the burden of rabies in Africa and Asia. Bull World Health Org 2005;83(May (5)):360–8.
[3] Salmon-Mulanovich G, Vasquez A, Albujar C, Guevara C, Laguna-Torres VA, Salazar M, et al. Human rabies and rabies in vampire and nonvampire bat species, Southeastern Peru, 2007. Emerg Infect Dis 2009;15:1308–10.
[4] Schneider MC, Romijn PC, Uieda W, Tamayo H, da Silva DF, Belotto A, et al. Rabies transmitted by vampire bats to humans: an emerging zoonotic disease in Latin America? Pan Am J Pub Health 2009;25:260–9.
[5] David D, Dveres N, Yakobson BA, Davidson I. Emergence of dog rabies in the northern region of Israel. Epidemiol Infect 2009;137:544–8.
[6] Windiyaningsih C, Wilde H, Meslin FX, Suroso T, Widarso HS. The rabies epidemic on Flores Island Indonesia (1998–2003). J Med Assoc Thailand 2004;87:1389–93.
[7] Parviz S, Luby S, Wilde H. Postexposure treatment of rabies in Pakistan. Clin Infect Dis 1998;27:751–6.
[8] Parviz S, Chotani R, McCormick J, Fisher-Hoch S, Luby S. Rabies deaths in Pakistan: results of ineffective post-exposure treatment. Int J Infect Dis 2004;8:346–52.
[9] Burki T. The global fight against rabies. Lancet 2008;372:1135–6.
[10] Sriaroon C, Sriaroon P, Daviratanasilpa S, Khawplod P, Wilde H. Retrospective: animal attacks and rabies exposures in Thai children. Trav Med Infect Dis 2006;4:270–4.
[11] Dodet B, Goswami A, Gunasekera A, de Guzman F, Jamali S, Montalban C, et al. Rabies awareness in eight Asian countries. Vaccine 2008;26:6344–8.
[12] Sudarshan MK, Madhusudana SN, Mahendra BJ, Rao NS, Ashwath Narayana DH, Abdul Rahman S, et al. Assessing the burden of human rabies in India: results of a national multi-center epidemiological survey. Int J Infect Dis 2007;11:29–35.
[13] Wilde H, Khawplod P, Khamoltham T, Hemachudha T, Tepsumethanon V, Lumlerdacha B, et al. Rabies control in South and Southeast Asia. Vaccine 2005;23:2284–9.
[14] Muller T, Dietzschold B, Ertl H, Fooks AR, Freuling C, Fehlner-Gardiner C, et al. Development of a mouse monoclonal antibody cocktail for post-exposure rabies prophylaxis in humans. PLoS Neglected Trop Dis 2009;3:e542.
[15] Wu X, Hu R, Zhang Y, Dong G, Rupprecht CE. Reemerging rabies and lack of systemic surveillance in People's Republic of China. Emerg Infect Dis 2009;15:1159–64.
[16] Tiembre I, Aka-Kone DM, Konan YE, Vroh JB, Kouadio DE, N'Cho SD, et al. Adherence to rabies vaccine treatment for people exposed to rabies in Abidjan (Cote d' Ivoire). Sante Publ 2009;21:595–603.
[17] BBoS. Statistical Pocket Book of Bangladesh: Bangladesh Bureau of Statistics (BBS); 2006.
[18] Fooks AR, Johnson N, Freuling CM, Wakeley PR, Banyard AC, McElhinney LM, et al. Emerging technologies for the detection of rabies virus: challenges and hopes in the 21st century. PLoS Neglected Trop Dis 2009;3:e530.