Floods in Mumbai: Impact of public health service by hospital staff and medical students

Kshirsagar NA, Shinde RR*, Mehta S**

Dean (G & K), Prof & Head, Departments of Clinical Pharmacolcogy, *Preventive and Social Medicine, **Medicine, Seth G. S. Medical College & KEM Hospital, Mumbai, India

Correspondence:
Nilima Kshirsagar,
E-mail: dcpkem@vsnl.com

Received : 06-05-06
Review completed : 13-06-06
Accepted : 02-08-06
PubMed ID :
J Postgrad Med 2006;52:312-4

Disaster scenarios once deemed theoretical have become a reality. Some impact a small number of people, others involve casualties but reach a plateau after a latent period.[1] On 26th July 2005, Mumbai city received 944 mm of rainfall in a single day, the heaviest rainfall recorded in the past 90 years. The city was flooded and waterlogged for 48 hours. This event disrupted the physical, social and environmental milieu of the city. Mumbai floods and later the floods in the European countries and the Hurricane Katrina disaster in New Orleans are comparable[2,3] in terms of public health concerns, although differences existed in terms of pre-disaster medical care, disease prevention methods used and resources available. Public health management issues during disasters include the safety and survival of the afflicted. Providing food, safe water and medical services, relocation of those affected and implementing primary prevention measures are the key areas of action during a disaster. This communication wishes to share the experiences during Mumbai floods so that views regarding this important public health agenda are discussed on a global platform.

Mumbai, the financial capital of India, with an area of 875.4 sq. km and a population of 12.2 million, is an ancient city comprising seven islands joined with land filling. About 64% of its citizens reside in slums. The city is divided into 24 Municipal administrative areas (called wards), each area being designated by an alphabet. Mumbai has an annual rainfall of approximately 1000 mm which occurs in the monsoon season (June to September). Many of the city areas are low-lying (below the sea level). During high tide, the storm water drainage to the sea is drastically affected.

On 26th July 2005, the city faced a heavy monsoon downpour of 944 mm in its northern suburbs (heaviest in 90 years) in a short span of four hours, from 14:00 hours to 18:00 hours and this coincided with high tide. It also coincided with the homebound journey of commuters. The Mithi river, a small rivulet in the city (Map 1) was flooded and water gushed into the surrounding regions and remained there for many hours. People waded through water or were forced to remain in water for many hours. There were approximately 100 deaths due to drowning and house collapses. The water-logging affected transport and electric supply and disrupted the daily life for the next seven days. It was estimated that at least 3 million citizens accounting for 25% of the city's population remained in contact with at least knee-deep water for over one hour.

For the past 10 years, the city has been witnessing a seasonal increase in the number of cases of leptospirosis, malaria, dengue and gastroenteritis during the monsoons. The densely populated slums of Mumbai are infested with rat population—*Rattus ratus* being the commonest species. Studies in previous years reported that common leptospirosis strains were Icterohemorrhagiae (rats-rodent reservoir), Gryppotyphosa (mouse reservoir), Canicola (dog reservoir) and Australis (reservoir not known) (unpublished data). The city's suburban areas that still harbor cattle sheds for cows and buffaloes further increase the risk of leptospirosis. The flood and heavy rains resulting in floods were expected to increase the magnitude of these major health threats.

As a response to this threat, manpower and materials were deployed at the three tiers of the public health system with greater emphasis on providing primary care. KEM Hospital deployed health teams, each consisting of one team leader, one supervisor and 10-15 doctors (total 108 doctors) in each of the six suburban wards assigned to it. Other teaching hospitals under the Municipal Corporation of Greater Mumbai and State government also deployed their teams to cover 12 other wards.

Prior to posting in the field, the doctors were given orientation about the treatment and prevention of flood-related maladies including leptospirosis. The teams conducted health camps close to homes in the areas of maximum water-logging and in those that were recording maximum cases in previous seasons. They also made home visits. The services at the secondary level hospitals were strengthened by deploying additional 10-12 doctors at each hospital and also by ensuring that standard treatment protocols were followed. At the tertiary hospital, a separate

Table 1: Morbidity and mortality related to outbreak of leptospirosis during flood and nonflood years: Comparison between Mumbai and Rio de Janeiro

	Non-flood year (Previous year records)					Excess rain and flood year				
	Mumbai									
	July - September 2004					*July - September 2005*				
Ward	Population	Total cases	Total deaths	Incidence/ 1,00,000	Case fatality rate	Population	Total cases	Total deaths	Incidence/ 1,00,000	Case fatality rate
L	905081	19	2	2.099	10.53	920081	74	9	8.04	12.16
K-W	721916	21	1	2.908	4.76	728857	9	0	1.24	0
P-S	466907	10	2	2.141	20.00	476907	36	3	7.55	8.333
P-N	821125	15	1	1.826	6.666	836915	67	4	8.01	5.97
R-S	603152	14	0	2.321	0	614751	75	5	12.20	6.67
R-N	363991	3	0	0.824	0	371271	49	6	13.20	12.25
Total	3882172	82	6	2.11	7.34	3948782	310	27	7.85	8.709
	Rio de Janeiro									
	Nonflood year‡					*Year 1996 (flood year)*				
	275000	*	*	1	†	275000	73	*	26.48	†

*data not available, †case fatality can reach up to 20 if cases are not properly diagnosed and treated, ‡exact population of nonflood year not available

Table 2: Resources utilized conducting health camps, training, indoor patient care in the monsoon deluge in Mumbai city, for public health interventions, in 2005

No.	Resource	Utilization	Approximate expenditure (Rs.)
I	Manpower*	Indoor patient care health caps raining	5,00,000**
II	Control room infrastructure	Data management co-ordination, communication	50,000
III	IEC material	Health camps patients instruction	60,000
IV	Transport	Ambulances for community camps and medical relief	2,40,000
V	Drugs and consumables	Patient care and support	30,00,000
VI	Logistics	Team coordination and liaison documentation	1,00,000

*Interns (40), Residents (86), MOs (3), Paramedical (35), Control Room (16), Administrative staff (6), MSW (4), Lecturer (8), Associate Professor (4), Professor (4). Indirect costs not included viz; services of community volunteers, infrastructure provisions such as ventilators (5), additional beds and other assistance. **Expenditure on daily allowance (D.A.) / Food allowance only; does not include salaries

round-the-clock "Fever casualty" was opened, extra beds were provided for inpatients and emergency laboratory and blood bank services were enhanced to cater to the extra load. The services of trainee doctors and undergraduate students were also utilized in various tasks such as blood collection and issuing laboratory reports.

In the community health camps, patients mainly presented with fever, diarrhea, skin diseases or injuries. A total of 150179 cases (including 35866 cases with fever) were treated over a period of 36 days. Patients with symptoms suggestive of leptospirosis (viz. high fever, muscle ache, conjunctival suffusion) were given doxycycline and referred to secondary level or tertiary level hospitals. All the hospital patients were seen in the emergency section and hospitalized, if necessary. Laboratory tests were carried out immediately for the diagnosis of leptospirosis (Dri dot which is positive for IgM and IgG) and malaria (peripheral smear microscopy).

As the incubation period of leptospirosis is 5-25 days, data regarding the incidence and mortality were collected from 26th July till 5th September 2005. In all, 310 cases of leptospirosis (27 deaths) were reported during this period in the six wards, giving an incidence of 7.85 per 0.1 million population and case fatality rate of 8.7% was recorded. In contrast, during the corresponding period the year before (when no flooding had occurred), the corresponding figures for the incidence of leptospirosis and case fatality rates were 2.1 per 0.1 million and 7.3%, respectively. This confirms that flood year reported an increase in the incidence of leptospirosis. In Rio de Janeiro under similar circumstances, the incidence increased from 1 to 26.8 per million population.[4] It is reported that case fatality rate can reach 20% if cases are not properly diagnosed and treated.[5] Flood-associated outbreaks of leptospirosis have been reported in Portugal (1969), Russian Federation (1997) and Czech Republic (2003). Adverse health effects of flooding have been reviewed by various authors and organizations.[6-9]

Our strategy was to provide care and treatment (to 35000 cases of fever, some of whom might have been related to leptospirosis) at the doorstep so that the number of cases developing full-blown leptospirosis, burden on the hospital services and morbidity and mortality could be reduced. It is possible that the healthcare provided through organization of health camps and upgrading management at hospitals helped combat the disease and resulted in only modest increments in the incidence of leptospirosis and case fatality rates as compared to Rio de Janeiro. The coordinated team efforts put up by the hospital staff and students helped in reducing human suffering and saving lives. The cost of all these efforts and activities was worked out to be approximately Rs. 10 million (US$ 0.22 million). Table 2 lists the resources utilized. Needless to say the dedication and commitment of the staff and students were invaluable.

References

1. Mehta S. Disaster and mass casualty management in a hospital: How well are we prepared? J Postgrad Med 2006;52:89-90.
2. McLellan F. Katrina reveals fatal weakness in US public health. Editorial. Lancet 2005;66:867.
3. Chatterjee P. Mopping up in Mumbai. World Report. Lancet 2005;366:795.
4. Barcellos C, Sabroza PC. The place behind the case: Leptospirosis risks and associated environmental conditions in a flood -related outbreak in Rio de Janeiro. Cad Saude Publica 2001;17:59-67.
5. Benenson AS. Manual Para el control de las Enfermedades Transmissible Washington DC Organizacion Panamericana de la salud. Publisher Abram S. Benenson 16th ed, 1997. p. 559.
6. Vasconcelos P, Unit for preparedness and Response. Flooding in Europe: A brief review of the health risks. Euro Surviell 2006;11:060420.
7. World Health Organization. Flooding and communicable diseases fact sheet: Risk assessment and preventive measures. WHO: Geneva; 2006.
8. Ahen M, Kovats RS, Wilkinson P, Few R, Matthies F. Global health impacts of floods: Spidemiologic evidence. Epidemiol Rev 2005;27:36-46.
9. Zitek K, Benes C. Longitudinal epidemiology of leptospirosis in te Czech Republic (1963-2003). Epidemiol Mikrobiolo Imunol 2005;54:21-6.

Source of Support: Nil, **Conflict of Interest:** None declared.