Hospital-based Meningococcal Disease Epidemiology over 2006-2010 in Delhi, India

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ABSTRACT

Meningococcal disease is a low endemic infection in Delhi and its outbreaks re-emerge in irregular cyclical fashion. The morbidity and mortality due to it, is not reflective of the population level disease burden as most of the data is based on reports from the different hospitals of Delhi. The reported data was analyzed for the period 2006-2010 from public and private hospitals located in Delhi. The aggregate caseload has reduced markedly over five years period since 2006 though the case fatality rate was comparatively higher in 2009 (16.8%). Maximum cases occurred in males of the age-group 10-45 years. The Central, South and West zones of Municipal Corporation of Delhi (MCD) have been most vulnerable and affected. The usual emergence period for cases is between November and December which continues till June with a peak in the month of March every year. There is a need to take pre-emptive prevention and control measures in the preceding months; in the high risk zones of Delhi at the outset of any imminent outbreak of the disease; along with strengthening of the surveillance.

Key words: Meningococcus, *Neisseria meningitidis*, Epidemiology, Delhi, India

INTRODUCTION

Meningococcal disease is caused by *Neisseria meningitidis* (meningococcus) and is a grave public health challenge. *N. meningitidis* causes a disease spectrum ranging from occult sepsis (meningococcemia) with rapid recovery to fulminant disease. It accounted for an estimated 171, 000 deaths worldwide per year.[1] The most recent meningococcal meningitis pandemic began in the mid-1990s. In 1996, almost 190, 000 cases were notified to the World Health Organization (WHO) in Burkina Faso, Chad, Mali, Niger, Nigeria and other countries.[2] However, true disease burden is likely to be greater because routine reporting systems break down during epidemics. In addition, many cases die before reaching a health facility and thus remain unrecorded in official statistics. Despite availability of antimicrobial therapy and advanced intensive care, case fatality rates are 5-10% in developed countries[3-8] and are higher (up to 17%)[9-11] in the developing world.[12-14] Among survivors of meningococcal disease, 11-19% have sequelae; such as hearing loss, neurological disabilities or loss of limb.[15-19]

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The human naso-oropharyngeal mucosa is the only reservoir of *N. meningitidis*. Meningococci are transmitted from one person to another either by direct contact or via droplets. The average incubation period is four days, but can range from two to ten days. The age groups most susceptible to the disease are young children, adolescents and young adults.[20,21] During the inter-epidemic period, 8-20% of adults are asymptomatic nasopharyngeal carriers of *N. meningitidis,* most of which are not pathogenic.[22,23] In populations studied in some other studies, 2-70% of people have been found to be carriers of the organism in their airways.[21,24-26] The carriage rate of meningococci is higher in lower socio-economic classes and populations subject to over-crowding such as pilgrims, boarding-school students and military recruits.[27,28] Carriage of Neisseria plays an important role in the epidemiology of the disease, a role that is still not well understood.[25,29] In households where a case of meningococcal disease has occurred, the risk of invasive disease in family members is increased by a factor of 400 to 800.[30]

As meningococcal disease is an airborne disease so there may be events due to global warming likely to affects the incidence and geographical distribution of the disease.[30-32] Global warming will change precipitation levels with a combination of more severe droughts in some areas and more frequent heavy precipitation events in others.[33-35]

Effects suspected to be the result of climate change are already evident on the distribution of meningococcal disease in Africa.[34,36]

Although N. *meningitidis* isolates can be divided into 13 serogroups based on chemically and antigenically distinct polysaccharide capsules[37] but only five serogroups, designated A, B, C, Y and W135, account for majority of meningococcal disease.[38-40] In Europe, 50-90% of cases are attributable to group B strains, and most of the remainders to group C strains.[41] For more than 100 years group A[42] and to a lesser extent, group C[43] strains have been responsible for recurrent epidemics in the so-called meningitis belt countries in sub-Saharan Africa.[29,31,44,45] These epidemics take place in irregular cycles every 5-12 years, and last for two to three dry seasons, dying out during the intervening rainy seasons.[33,36] Large outbreak of group A disease occurred frequently in China and Mongolia during 1970, and disease occasionally reached Nepal and India.[44,46,47] However, the sudden emergence of cases of meningococcemia and meningococcal meningitis in the period 2005-06 especially in the states of Delhi, Uttar Pradesh and Haryana was alarming.[48] This article attempts to update the hospital-based epidemiological situation of Meningococcal disease in Delhi from 2006 to 2010.

DISEASE BURDEN AT NATIONAL LEVEL

The meningococcal disease has been reported mostly from North Indian states; Haryana, Uttar Pradesh, Rajasthan, Sikkim, Gujarat, Jammu & Kashmir, West Bengal, Chandigarh, Kerala and Orissa during outbreak in 1985.[49] It was followed by an outbreak of meningococcal meningitis in Surat (Gujarat state) during 1985-87.[50] As per National Health Profile 2008, a total of 5077 cases and 307 deaths of meningococcal disease were reported in the year 2007 from all the states and Union Territories of India.[51] The most affected states in 2007 were West Bengal, Madhya Pradesh, Andhra Pradesh Karnataka, Delhi, Maharashtra, Puducherry and Uttar Pradesh in descending order of morbidity burden.[52]

DISEASE BURDEN IN DELHI

Meningococcal disease is seen in Delhi as low endemic infection. Outbreaks of meningococcal disease have been documented during 1966 and 1985-86.[45,52] In 1966, the highest proportion of cases and deaths occurred in age group less than one year followed by that in 1-4 years.[52] During the recent outbreak of meningococcal disease in 2005; a total of 444 cases and 62 deaths (case fatality rate 13.9%) due to meningococcal serogroup A were reported in Delhi during April-July 2005. The disease again emerged in an outbreak in January-March 2006 (177 meningococcal cases and 17 deaths); mainly reported from the major hospitals of Delhi (Vardhaman Mahavir Medical College and Safdarjung Hospital, Maulana Azad Medical College, Dr Ram Manohar Lohia Hospital, Hindu Rao Hospital,Sir Ganga Ram Hospital).[53-58] During the period, December 2005- June 2006, a total of 257 (48.4%) cases out of 531 were confirmed positive for Group A *Neisseria meningitidis*.[57] The majority of reported cases and deaths occurred in young adults between 15-30 years of age and were from walled city of Old Delhi and Shahdara Zone of Municipal Corporation of Delhi (MCD).

DEFINITIONS AND METHODS

National Centre for Disease Control (NCDC), New Delhi has been involved in the laboratory based surveillance of meningococcal disease since last 3 decades. The clinical samples from suspected cases of meningococcal disease as well as information regarding the cases in different hospitals of Delhi are regularly sent to NCDC for laboratory confirmation. In addition, data regarding cases of meningococcal disease admitted in different hospitals of Delhi is regularly sent to NCDC after collation by office of Municipal Health Officer (MHO), Municipal Corporation of Delhi. In addition, active data collection is also done by NCDC by visiting various hospitals during the times of disease outbreaks. In this article, the data reported from different hospitals of Delhi to the NCDC was analyzed for the period 2006 to 2010.

Cases were classified as: Confirmed cases are those in which *N. meningitides* has been isolated from typically sterile body fluid, such as blood or cerebrospinal fluid (CSF). This also includes cases showing a positive meningococcal antigen test in the above said samples. *Probable cases* are those with clinical illness characteristic of meningococcal infections with a positive smear test.

FINDINGS: HOSPITALS-BASED REPORTS

Out of more than 40 public and private sector hospitals in Delhi, the meningococcal cases reporting hospitals were the All India Institute of Medical Sciences (AIIMS), Guru Teg Bahadur Hospital, Hindu Rao, Lok Nayak Jai Prakash Hospital (LNJP), Lady Harding Hospital, Max Hospital and the Safdarjung Hospital; covering most of the catchment areas of Delhi. In the year 2009 (Total cases 89), the maximum cases were reported from AIIMS (24), Lady Harding Hospital (17), Safdarjung Hospital (11) and LNJP (10). It also indicates the existence of more undiagnosed or unreported cases of meningococcal disease in the catchment area population of these hospitals that may have attended the private hospitals or smaller public

health facilities. However, there were only 24 probable cases and no confirmed case in 2010.

On analysis of the reported hospital-based disease burden across 2006 to 2010 is shown in Figure 1.

It has been noted that since 2006, there has been a marked decrease in number of cases of meningococcal disease with no confirmed case in 2010. (Table 1). The cases of meningococcal disease started appearing during the months of November and December, and continues till June with a peak of cases in March. The total case fatality rate (among both probable and confirmed cases) was higher in 2009 (16.8%) as compared to that of 2008 (11.4%) and 2007 (8.2%) though the number of reported cases were comparatively lesser (10 probable and 19 confirmed) in comparison to previous years. This may be due to more cases reached at hospitals at advanced stage of infection making higher possibilities of cases in the population that did not reach the reporting hospitals of Delhi.

The case attack rate in 2009 was 6.4 per 100, 000 population in Delhi. Males were more susceptible to the disease (Table 2**).** Majority of cases (87.6%) occurred in the age groups 10-45 years with maximum in the age group 15-30 years (33.7%) involving higher case fatality rate (46.7%).

In 2009, the case attack rate per 100, 000 population was highest in Central (0.83) and City Zone (0.75) followed by South Zone (0.59), Civil Lines (0.43), Rohini (0.42) and Shahdara South (0.33). However, Civil Line zone, Sadarpahrganj, Ciy Zone and NDMC Central Zones have been most reporting zones for case attack rate during 2007-2009 (Figure 2).

DISCUSSION

The disease burden estimation of meningococcal disease in Delhi is based on hospitals reporting.[45,52-58] Owing to intensity of the symptoms of the meningococcal disease, the cases reach to the nearby hospitals but it may not be always true because of limited access and affordability of health care to people from impoverished population. Hence, the reported burden of morbidity and mortality due to meningococcal disease in Delhi may not be comprehensive. The case fatality rate was significantly higher in 2009 in comparison to that in previous years although the case load was reportedly lower (Table-1). Although, there was no confirmed case in 2010 but case fatality rate among probable cases was even higher (33.3%). The worst hit areas in Delhi in descending order are Central, City Zone, South Zone, Civil Lines, Rohini and Shahadra South Zone. Each zone

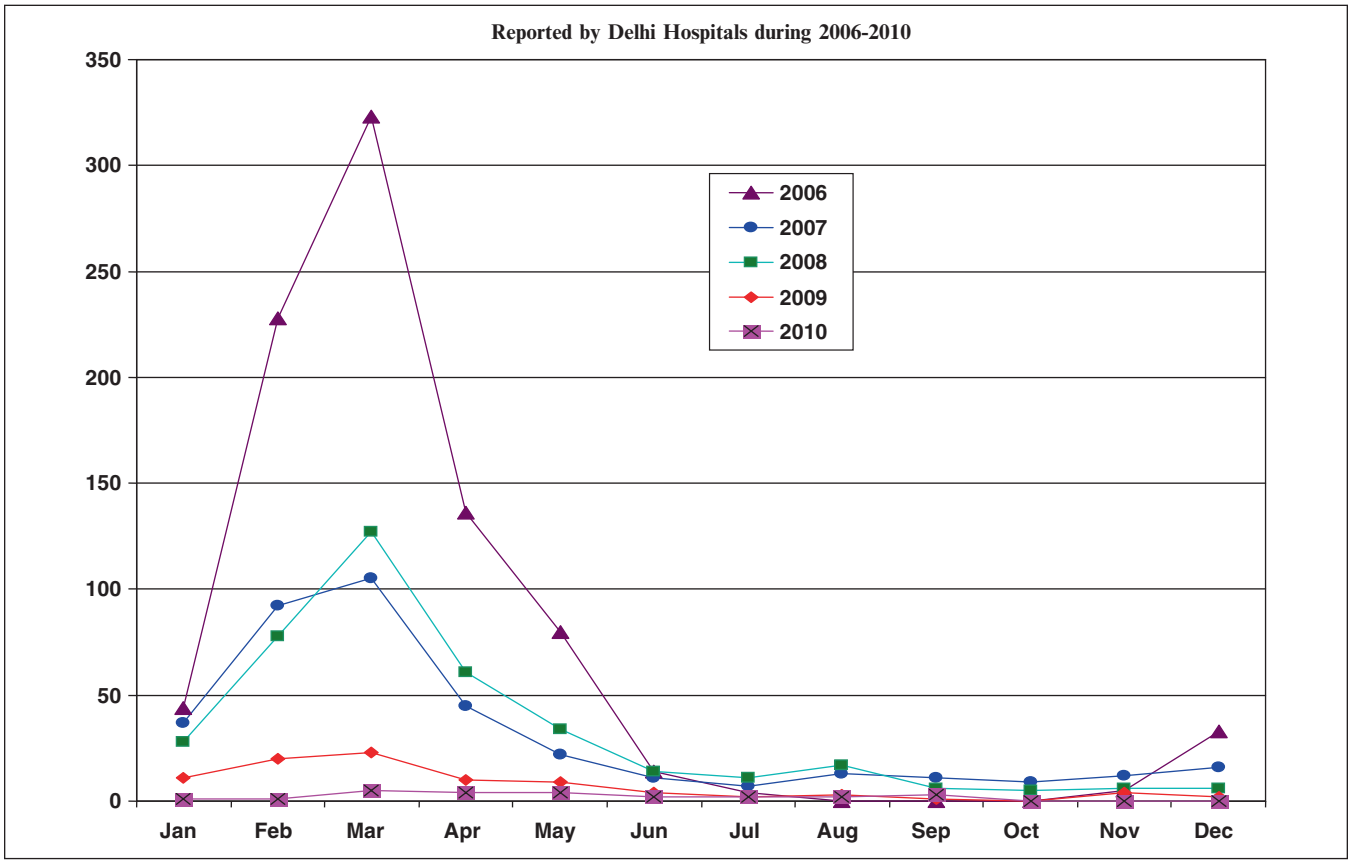

Figure 1: Month-wise Menningococcal Disease Cases (Probable + Confirmed) Reported by Delhi Hospitals during 2006-2010

Table 1: Hospital-based reported Morbidity and Mortality of Meningococcal Disease in Delhi during 2006-2010

Months	2006			2007					2008				
	Prob	Conf	Total	Prob	Conf	Total	Deaths	CFR (%)	Prob	Conf	Total	Deaths	CFR (%)
Jan	23	21	44	22	15	37	5	13.5	20	8	28	4	14.3
Feb	94	134	228	67	25	92	6	6.5	64	14	78	8	10.3
Mar	279	44	323	91	14	105	6	5.7	112	15	127	8	6.3
Apr	111	25	136	34	11	45	4	8.8	53	8	61	7	11.5
May	67	13	80	19	3	22	0	0.0	28	6	34	3	8.8
Jun	12	2	14	11	0	11	0	0.0	12	2	14	1	7.1
Jul	4	0	4	7	0	7	0	0.0	9	2	11	1	9.0
Aug	0	0	0	9	4	13	3	23.0	13	4	17	5	29.4
Sep	0	0	0	10	1	11	0	0.0	6	0	6	2	33.3
Oct	0	0	0	7	2	9	3	33.3	4	1	5	3	60.0
Nov	1	4	5	11	1	12	3	25.0	6	0	6	1	16.6
Dec	22	11	33	13	3	16	1	16.6	6	0	6	2	33.3
Total	**613**	**254**	**867**	**301**	**79**	**380**	**31**	**8.2**	**333**	**60**	**393**	**45**	**11.4**

Months	2009					2010				
	Prob	Conf	Total	Deaths	CFR (%)	Prob	Conf	Total	Deaths	CFR (%)
Jan	9	2	11	1	9.1	1	0	1	0	0.0
Feb	14	6	20	7	35.0	1	0	1	0	0.0
Mar	18	5	23	3	13.0	5	0	5	2	40.0
Apr	9	1	10	1	10.0	4	0	4	0	0.0
May	6	3	9	0	0.0	4	0	4	3	75.0
Jun	4	0	4	3	75.1	2	0	2	1	50.0
Jul	2	0	2	0	0.0	2	0	2	1	50.0
Aug	3	0	3	0	0.0	2	0	2	0	0.0
Sep	1	0	1	0	0.	3	0	3	1	33.3
Oct	0	0	0	0	0.0	0	0	0	0	0.0
Nov	3	1	4	0	0.0	0	0	0	0	0.0
Dec	1	1	2	0	0.0	0	0	0	0	0.0
Total	**70**	**19**	**89**	**15**	**16.8**	**24**	**0**	**24**	**8**	**33.3**

has its own specific characteristic but the location of popular public sector hospitals that report the cases to NCDC and their catchment areas with high population density are the obvious reasons.

The actual disease burden in the community may be more than what is surfacing at the tip of the iceberg. Furthermore, repeated outbreaks and emerging drug-resistance for commonly used drugs for the treatment of meningococcal disease necessitates the active surveillance system for precise estimation of disease burden and timely public health response to any imminent outbreak.

Meningococcal disease is potentially fatal and should be considered as a medical emergency. Admission to a hospital or health facility is necessary, although isolation of the patient is not necessary. Appropriate antibiotic treatment must be started as soon as possible, ideally after the lumbar puncture if such a puncture can be performed immediately. If treatment is started prior to the lumbar puncture it may be difficult to grow the bacteria from the spinal fluid and confirm the diagnosis.

The drug of choice for meningococcal chemoprophylaxis is rifampicin and has been shown to eradicate nasopharyngeal carriage of *N. meningitidis*.[59] Persons who qualify as being at increased risk for contracting *N. meningitidis* from a confirmed case should receive chemoprophylaxis and health education. People in the same household, those in direct contact with naso-oropharyngeal secretions (kissing, mouth-to-mouth resuscitation, sharing fomites) and day-care centre contacts are the only contacts for which chemoprophylaxis is recommended. Prophylactic treatment beyond 14 days after the case is identified is of little or no value. Developing

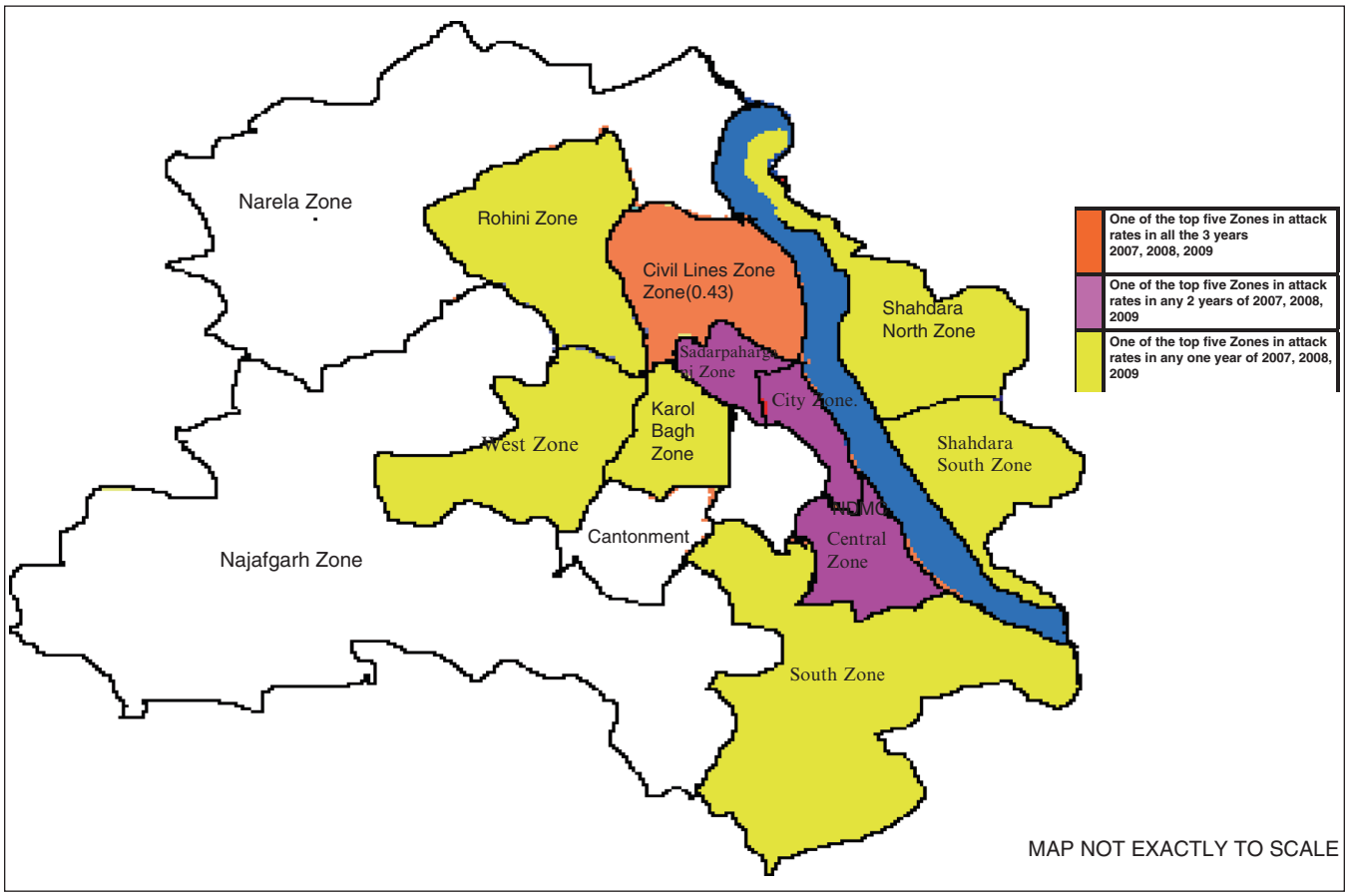

Figure 2: Zone-wise Attack Rates Status of Meningococcal Disease reported from Delhi Hospitals during 2007, 2008, 2009

Table 2: Age and Sex-wise Distribution of Meningococcal Disease cases reported from Hospitals of Delhi in 2009

Age Groups (in years)	Cases (Confirmed + Probable)			Deaths		
	Male	Female	Total (%)	Male	Female	Total (%)
<1	1	1	2 (2.2)	0	1	1 (6.7)
1-<5	5	3	8 (9.0)	2	0	2 (13.3)
5-<10	7	5	12 (13.5)	1	0	1 (6.7)
10-<15	10	5	15 (16.9)	1	1	2 (13.3)
15-<30	24	6	30 (33.7)	6	1	7 (46.7)
30-<45	10	2	12 (13.5)	1	0	1 (6.7)
45 & above	8	2	10 (11.2)	1	0	1 (6.7)
Total	**65 (73%)**	**24 (27%)**	**89 (100%)**	**12 (80%)**	**3 (20%)**	**15 (100%)**

resistance of the *Neisseria Meningitidis* to the drugs like ciprofloxacin and cotrimoxazole is a matter of further concern. [48,53]

Polysaccharide vaccines for serogroups A, C, W135, X and Y have been available for many years for the prevention of the meningococcal disease.[21,23] However, they are not effective in young children, (below 2 years of age) who are at increased risk of disease. Polysaccharide-protein conjugate vaccines are much more effective than unconjugated polysaccharide vaccines in young children.[60-62] However, vaccination (specially using polysaccharide vaccines) does not reduce the transfer of bacteria to non-vaccinated persons and carrier status is unaffected.[63] Even large scale coverage with the vaccine does not provide sufficient 'herd immunity'. Hence, the current WHO recommendation for outbreak control is to mass vaccinate every district that is in the epidemic phase, as well as those contiguous districts that are in alert phase.

Although the confirmed cases of reported meningococcal diseases have reduced to zero in 2010 since 2005-06 outbreak

but still there is a need to establish an Early Warning System to curb down the spread of any imminent outbreak of the disease. The local epidemiological knowledge of the high-risk zones of Delhi should guide the outbreak control preparedness.

CONCLUSION

The populations at-risk for the meningococcal disease in the Central, South and West zones of Delhi should receive adequate attention in the months of November-December every year for the prevention of any imminent outbreak. Use of polysaccharide-protein conjugate vaccines in the high-risk pocket areas of Delhi can further reduce the morbidity and mortality owing to meningococcal disease. There is a need to strengthen surveillance system for better estimation of the disease burden in Delhi.

CONFLICT OF INTEREST

None

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