CHAPTER IV

Cholera in Delhi : 1965-2000
Within the overall context of the pandemics detailed in the previous chapter, the study now focuses on Delhi's experience with cholera. This chapter is divided in three sections. The first section analyses time trends of cholera since the introduction of El tor strain in Delhi in 1965 to the year 2000. There were two major peaks during this period in 1988 and 1994. The second section explores the 1988 epidemic of cholera in the context of the areas and population groups affected, infrastructural, administrative and other causes that contributed to the epidemic and finally the control measures that were applied including the questionable emphasis on vaccination against cholera. The third section of the chapter describes a series of measures taken for the control of diarrhoeal diseases, with an underlying emphasis on cholera control. These were introduced and implemented following the epidemic of 1988.

**TIME TRENDS OF CHOLERA IN DELHI: 1965-2000**

Since 1947, there had been a general decline of classical cholera in the country. Following the introduction of El tor cholera in India in 1964, it began spreading to other Indian states. In 1965, El tor cholera was reported from several states including Delhi (Patnaik and Kapoor, 1967). This section describes the time trends for the period 1965-2000. There were two major watersheds in this period. A major epidemic in 1988 raised several administrative, infrastructural and managerial issues. In the aftermath of the epidemic a series of steps were taken for prevention and control of diarrhoeal diseases. Despite these measures, there was another spurt of cases in 1994-95 owing to the introduction of a new strain – O139 Bengal (graph 4.1).

Graph 4.1 has been computed on the basis of the reported cholera cases and deaths in Delhi from 1965-2000 shown in Table A.1 in the Appendix.

In 1965, the first case was reported during the week ending 8th May and the last case was reported during the week ending 2nd October. The initial phase of the spread of the El Tor infection was not an explosive phase as may be ordinarily expected when a new strain is introduced. Only 55 cases were detected in Delhi in 1965. El tor infection spread to Delhi from adjacent Uttar Pradesh where more than 1800 cases were reported in 1965 (Patnaik

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1 The first El tor case was reported in India from Calcutta (Barua, 1974).
and Kapoor, 1967). Epidemiological studies investigating El tor cholera in Delhi (Chuttani, 1967) demonstrated that most of the patients belonged to lower socio-economic groups and were living in unauthorised colonies without proper water and sanitation services. No relationship could be found between one case and another. The exact mode of transmission could not be established in most cases.

Graph 4.1: Cholera Cases and Deaths in Delhi, 1965-2000

During 1966 and 1967, cholera cases showed an upward trend; the onset of the first case, however, was delayed to the second half of June and the last case was reported in the second half of October. In 1968, though the first case was reported in June the total number of cases rose to a new high of 333 and the season lasted till November. 1969 saw cholera being reported as early as April and it lasted till November. 1970 was a particularly low-incidence year with only 63 cases. The onset was unusually delayed to July and the last case was reported in December. The April-November pattern was back in 1971 and the number of cases also rose appreciably. The National Institute of Communicable Diseases (Aggarwal, 1983) reported that the incidence of cholera in 1968 and 1969 was as high as 27% and 30% respectively, of all diarrhoeal cases admitted in the Infectious Diseases Hospital. This parameter showed a downward trend in 1970-75 when the rate ranged between 6% to 16% with the exception of 1972 when it rose to 24%.
Though the number of cases show fluctuations over the years, the 5-year moving average trendline shows an upward trajectory. Cholera cases reached a plateau during the seventies. The first half of the eighties experienced a considerable increase in the case load followed by a sharp rise following the 1988 epidemic. There was a temporary lull following the epidemic. However, following the introduction of the 0139 strain, there was another sharp rise that continued till the late nineties. It is observed that there is an increasing trend in the three year moving average of cases.

Following the introduction of the El tor strain, there was an increase in the number of deaths and it peaked to a maximum 22 in 1980. There was a steady decline of deaths during the 1980s and zero mortality was achieved in 1990. This state continued upto 2000 and despite the introduction of another new strain (0139 Bengal) in 1994, no deaths were reported.

Most cholera cases in Delhi were found to be occurring between May to October (Aggarwal, 1983). The same seasonality was observed in Gujarat, Maharashtra, Rajasthan, Bihar and Orissa. The peak period for cholera in Calcutta and Dhaka was September-October while that for Andhra Pradesh and Tamil Nadu was reported by the author to be January. The study reported that the emergence of clinical cholera was favoured by higher relative humidity and rainfall. Gradually as the infection became endemic, Aggarwal (1986) observed that more than 50% of the cases occurred in children below 15 years and that less than 10% of the cases occurred among infants. No cases were however reported among neonates. Males and females were observed to be affected equally. In this study also, Ogawa was reported to be the dominant serotype.

Graph 4.2 shows the trends in incidence rates of cholera cases (per 1000 cases) during the period 1965-2000.

Data source for the annual cholera cases are:
- Health Information of India, Government of India, and
- National Institute of Communicable Diseases

Population of Delhi has been obtained from:
The trendline for the incidence rates (per 100,000 population) of cholera cases in Delhi demonstrates an increasing trend over the years. This is in contrast to an overall declining trend over the corresponding period in India (Graph 4.2). Case fatality rate was as high as 9% in 1965. But this dropped sharply during the following years and settled in this phase of the epidemic to a 2-4% level and continued throughout the seventies. Though
incidence rate continued to rise steadily across 1980s and 1990s, in Delhi, case fatality rate (CFR) dropped down further to zero level, in keeping with the national trend. Case fatality rate was relatively higher in the earlier high incidence years of 1980 and 1985. It registered a sharp decline after 1980 only to rise to a 3%+ level in 1985. In 1986 it dropped sharply to 0.3% and even the 1988 epidemic witnessed a CFR of 0.47%. It is observed that the 1988 epidemic recorded the second highest incidence rate in this 25 years series ~ 20.02 per 100,000 and the rate in 1994 was the highest ~ 21.02 per 100,000. Interestingly, in 1989 cases fell by as much as 90%; but the CFR rose marginally up to 0.5%. Since 1990, no cholera deaths have been reported and consequently the CFR has also dropped to 0%.

While El Tor cholera is marked by low mortality, other factors that have played crucial role in bringing down mortality is the sensitisation of both the community and the health administration. The system of referral to the Infectious Diseases Hospital, on clinical suspicion of cholera, is as prevalent among the large formal medical institutions as among the informal practitioners like the RMPs. The possible role of host-agent adaptation also merits investigation.

**Trends in Gastro-Enteritis (GE)**

Sentinel surveillance of gastroenteritis (GE) cases began from 13 Index Hospitals of Delhi following the epidemic of 1988. The number of Index Hospitals was increased to 22 from 1993-94. These 22 Index Hospitals are fairly representative of the geographical areas of Delhi, but by no means represent a complete picture of the case/disease load. Graph 4.3 shows the incidence rate per 100,000 population and case fatality rate (CFR %) of reported gastroenteritis cases from 1988 to 2000.

It is interesting to compare the trends for GE and cholera for the corresponding period i.e. 1988-2000. Following the 1988 epidemic both cholera and gastroenteritis cases registered a sharp decline. The declining trend continued in the case of gastroenteritis up to 1991. Cholera cases meanwhile increased about two and a half times in 1991 from the 1990 level and this trend was maintained in 1992 as well. GE figures were on the rise since 1992. There was an acute rise in 1993 which is attributable partly to the import of the
*Vibrio cholerae* O139 and partly to the fact that the number of Index Hospitals went up. Though the O139 epidemic lasted throughout 1994 and 1995, GE incidence rate showed a marginal decline in 1994 and again rising in 1995. Since 1996, however, gastroenteritis and cholera trends have moved in an identical fashion.

**Graph 4.3 Gastroenteritis in Delhi: Incidence Rate and Case Fatality Rate, 1988-2000**

The 1988 epidemic recorded 84792 cases and 643 deaths. During the epidemic, only 8 cholera deaths were recorded and most of the deaths were notified as GE deaths. The VHAI report (1988) elaborated that the concerned authorities went at great lengths to deny that a cholera epidemic was at hand and also that there was a "clamp down" on information. In such a situation it can be expected that cholera deaths were denied and the cause simply recorded as gastroenteritis. Thereafter, GE deaths and CFR registered a sharp drop. In contrast to the cholera situation, GE deaths have touched the zero figure after a decade, in 2000. It is however too early to judge whether this is a sustainable trend or not. Cholera cases are reported only from the Infectious Diseases Hospital (IDH) which acts as a referral centre. GE cases are admitted at all hospitals; on clinical suspicion these are referred to the Infectious Diseases Hospital. Some institutions perform the hanging drop
test for the clinically suspected cases and refer only the hanging drop positive cases. These referred cases are by and large clinically stabilised in their primary care institution. But this is not to imply that deaths do not occur at the IDH. A scrutiny of records reveal that the primary cause of deaths is certified as some other cause like aspiration of vomitus or other respiratory and cardiac complications. It is often also the case that the laboratory confirmation of cholera is received after the death. In none of these situations is the case certified as a cholera death. Such deaths average about 3 to 6 per year. The 'correct' case fatality rate would thus be similar to the national picture rather than a zero-mortality one.

In this context it is relevant to recollect the death certification recommendations of the WHO (Park, 2000). Part I of the certificate should deal with the immediate cause and the underlying cause which started the whole trend of events leading to death. In fact, the notion of underlying cause is the "essence of the international death certificate". It is defined as:

(a) The disease or injury which initiated the train of morbid events leading directly to death, or,
(b) The circumstances of accident or violence which produced the fatal injury.

Part II of the certificate records any significant associated diseases that contributed to the death but did not directly lead to it. Cholera should therefore feature at least as the underlying condition if not the immediate cause.

Kumar et al (1995) described epidemiological features of 75 GE deaths in 22 index hospitals of Delhi during 1990-92. 75% of the deaths occurred in the under-5 years age groups and more than half of the total deaths were infants. Majority of deaths were from slum areas. 53% of the households from where these deaths were reported did not have access to piped water supply and only about a similar proportion lacked access to sanitary latrines. Majority of deaths in the series were reported during May to September and the vulnerability factors for incidence of cases identified by the researchers included scarcity of drinking water, increased consumption of unsafe water and contamination of sub-soil water.
Seasonal Trends

Monthly incidence data of cholera in Delhi, as reported from National Institute of Communicable Diseases, is available for the period 1977-2000. These are only reported cases of patients admitted at the Infectious Diseases Hospital (IDH) whose stool samples are tested for cholera and therefore do not reflect the actual case load in the community. However, IDH is the only sentinel centre for cholera and these are the only information available for cholera in Delhi. The data has been grouped in four groups of three months each, namely, January-March, April-June, July-September and October-December.

January to March has traditionally been cholera-free months in Delhi. Cholera was reported for the first time in January 1994 when the O139 epidemic was unfolding. Two cases were reported from Govindpuri, Central Zone. The same area later witnessed a major Hepatitis E outbreak which lasted from the end of January to March. The cholera cases and the hepatitis outbreak were attributed to the supply of unchlorinated water from a deep tubewell. A cholera case also occurred in January 1999. The case was reported from Narela. Earlier, during 1991-92, there was an increased incidence of winter cholera cases in Bangladesh that was followed by the O139 epidemic. No cholera case has ever been reported during February. Cholera had never been reported during March till 1996, when 2 cases were reported one each from Civil Lines and Central Zones. 3 cases were again reported – one each from Central, Civil Lines and South Zones. Again, in 1999, one case was reported during March from South Zone.

Thus there has been a rising trend in winter cases of cholera since 1994 with most of these cases being diagnosed as O139 cases. Cholera was reported for only eight months in 1977 while it was reported for eleven months in 1999 and 2000. This is one of the pointers to increasing levels of endemicity of the disease in Delhi.

April to June marks the summer season in Delhi. Summers in Delhi is marked by high temperature and water scarcity. Cholera naturally follows. Incidence rate has been computed for all the four quarterly periods on the basis of the population figures reported by the Census of India (2001), Registrar General's Office – for the census years.

A definite increasing trend is observed in the incidence during the summer months. The nineties have been marked by water scarcity in summer and a sharp rise in the incidence rate in cholera cases. The incidence rate for summer registered a sharp rise from the eighties (1981-1990) with an average of 1.53 per 100,000 population to 3.42 per 100,000 population in nineties (1991-2000). With the onset of the O139 phase in 1993 the average incidence rate in 1991-95 was 4.04 per 100,000 population; during 1996-2000 this rate declined to 2.81 per 100,000, still nearly double the rate of the eighties.

July to September is the rainy season in Delhi accounting for 75% of the annual rainfall. These months account for a significant proportion of the annual cases with a correlation coefficient of 0.95. The average incidence rate for 1981-1990 was 4.80 per 100,000. The corresponding rate for the period 1996-2000 was at the same level – 4.89 per 100,000 population. O139 epidemic accounted for a higher rate during 1991-95 ~ 7.14 per 100,000 population.

Thus over two decades, incidence rate in rainy season (July-September) has remained at nearly constant levels barring fluctuations due to O139 strain. This is in contrast to average incidence rates during the summer season (April-June) which has doubled over the nineties as compared to the eighties and with a sharper rise if the peak O139 phase is considered.

The period October-December represent the 'tail' of the cholera season. It account for 5% of the annual rainfall. Since 1991, cholera cases are being reported every December. Simultaneously, there has also been a rise in the number of cases of cholera being reported during November. While average annual incidence rate during 1981-1990 was 0.28 per 100,000 population, the corresponding rate during 1991-2000 was 0.74 per 100,000 population, a nearly three fold increase. Interestingly, the rise in the average annual incidence rates in winter cases has been more for the period 1996-2000 (0.84 per 100,000 population) as compared to 1991-1995 (0.64 per million). This increase probably indicates the rising level of endemicity.
Table 4.1 shows normal rainfall in Delhi as reported by the Regional Meteorological Centre, New Delhi. Percentage of rainfall for each month vis-à-vis the total annual rainfall is calculated. The summer months are identified as April, May and June. Peak rainfall is reported during July, August and September. This table provides a convenient starting point for the discussion on seasonal trends, in as much as it serves to identify the seasonal pattern of rainfall, given the critical role of this parameter in a discussion on the determinants of Cholera in Delhi.

Table 4.1: Rainfall in Delhi

<table>
<thead>
<tr>
<th>Rain</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>24.9</td>
<td>21.8</td>
<td>16.5</td>
<td>6.8</td>
<td>7.9</td>
<td>65</td>
<td>211</td>
<td>173</td>
<td>150</td>
<td>31.2</td>
<td>1.2</td>
<td>5.2</td>
<td>714.5</td>
</tr>
<tr>
<td>%</td>
<td>3.47</td>
<td>3.15</td>
<td>2.31</td>
<td>0.94</td>
<td>1.11</td>
<td>9.10</td>
<td>29.6</td>
<td>24.2</td>
<td>20.9</td>
<td>4.36</td>
<td>0.16</td>
<td>0.72</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Delhi Statistical Hand Book, 1998; Govt. of Delhi

Table 4.2 presents the ratio of the number of cases occurring during the summer months (April-June) to the cases occurring during the monsoon months (July-September) for the zones where annual incidence of cholera is observed to be high i.e. Central, South, Shahdara (N), Shahdara (S), Civil Lines, Rohini and Narela.

Table 4.2: The ratio of Summer : Monsoon cases for the major zones

<table>
<thead>
<tr>
<th></th>
<th>94</th>
<th>95</th>
<th>96</th>
<th>97</th>
<th>98</th>
<th>99</th>
<th>2K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>1.00</td>
<td>1.14</td>
<td>1.47</td>
<td>0.53</td>
<td>0.42</td>
<td>2.15</td>
<td>4.61</td>
</tr>
<tr>
<td>South</td>
<td>0.94</td>
<td>1.10</td>
<td>0.97</td>
<td>0.58</td>
<td>0.52</td>
<td>2.32</td>
<td>2.24</td>
</tr>
<tr>
<td>Shahdara (N)</td>
<td>0.13</td>
<td>0.25</td>
<td>0.31</td>
<td>0.35</td>
<td>0.21</td>
<td>1.02</td>
<td>0.66</td>
</tr>
<tr>
<td>Shahdara (S)</td>
<td>0.21</td>
<td>0.31</td>
<td>0.62</td>
<td>0.41</td>
<td>0.50</td>
<td>2.56</td>
<td>0.60</td>
</tr>
<tr>
<td>Civil Lines</td>
<td>0.26</td>
<td>0.30</td>
<td>0.35</td>
<td>0.26</td>
<td>0.51</td>
<td>0.82</td>
<td>0.44</td>
</tr>
<tr>
<td>Rohini</td>
<td>0.18</td>
<td>0.19</td>
<td>0.07</td>
<td>0.16</td>
<td>0.18</td>
<td>0.48</td>
<td>0.34</td>
</tr>
<tr>
<td>Narela</td>
<td>0.29</td>
<td>0.37</td>
<td>0.15</td>
<td>0.35</td>
<td>0.26</td>
<td>1.24</td>
<td>1.00</td>
</tr>
<tr>
<td>All Zones</td>
<td>0.36</td>
<td>0.47</td>
<td>0.45</td>
<td>0.34</td>
<td>0.35</td>
<td>1.25</td>
<td>0.96</td>
</tr>
</tbody>
</table>

It is observed that the picture within each zone remains fairly consistent till 1998, with a low standard deviation across the years except for Central and South Zones. The proportion of cases reported in monsoon is higher (more than double) than that in summer for most of the zones. In the initial period, an equal proportion of cases is reported during
both the seasons for Central and South Zones. This trend, however, changes with the proportion of cases in summer dipping in 1997 and 1998.

Graph 4.4: Seasonal Trends in Central, South and Shahdara (South) Zones

From 1999, a marked rise is observed in the case ratio, with the proportion of cases in summer being much higher than in the monsoon season. It is worth noting that for Central and South Zones this pattern persists in 2000 as well. It is thus observed that cholera incidence by seasons is widening as it becomes endemic at higher level, indicating
indigenous transmission increase in early summer and in winter. This is represented graphically in Graphs 4.4 and 4.5.

The O139 Phase

1994 marked another watershed with the introduction of the *Vibrio cholerae* O139 strain. 1994 was an epidemic year with 2,226 cases and the trend continued in 1995 with 1989 cases. Detection of O139 cases had however begun in 1993 though the peak isolation was in 1994. Following the subsidence of the O139 strain, cases declined in 1996 and 1997 to below-1000 cases.

Table 4.3: Cholera cases (O1 and non-O1) in Delhi: 1983 – 1993

<table>
<thead>
<tr>
<th>Year</th>
<th>Samples</th>
<th>O1</th>
<th>O1 Rate</th>
<th>Non-O1</th>
<th>Non-O1 Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>1983</td>
<td>1969</td>
<td>455</td>
<td>23.1</td>
<td>60</td>
<td>3.0</td>
</tr>
<tr>
<td>1984</td>
<td>2051</td>
<td>305</td>
<td>14.9</td>
<td>10</td>
<td>0.5</td>
</tr>
<tr>
<td>1985</td>
<td>2543</td>
<td>587</td>
<td>23.1</td>
<td>69</td>
<td>2.7</td>
</tr>
<tr>
<td>1986</td>
<td>1770</td>
<td>330</td>
<td>18.6</td>
<td>41</td>
<td>2.3</td>
</tr>
<tr>
<td>1987</td>
<td>1579</td>
<td>285</td>
<td>18.1</td>
<td>60</td>
<td>3.8</td>
</tr>
<tr>
<td>1988</td>
<td>4164</td>
<td>1702</td>
<td>40.9</td>
<td>26</td>
<td>0.6</td>
</tr>
<tr>
<td>1989</td>
<td>1620</td>
<td>197</td>
<td>12.2</td>
<td>32</td>
<td>2.0</td>
</tr>
<tr>
<td>1990</td>
<td>2006</td>
<td>533</td>
<td>26.6</td>
<td>14</td>
<td>0.7</td>
</tr>
<tr>
<td>1991</td>
<td>1917</td>
<td>537</td>
<td>28.0</td>
<td>12</td>
<td>0.6</td>
</tr>
<tr>
<td>1992</td>
<td>2783</td>
<td>1075</td>
<td>38.6</td>
<td>52</td>
<td>1.9</td>
</tr>
<tr>
<td>1993</td>
<td>2850</td>
<td>697</td>
<td>24.4</td>
<td>831 (O139)</td>
<td>29.2</td>
</tr>
</tbody>
</table>

Source: National Institute of Communicable Diseases, Delhi

Non-O1 vibrios were regularly being isolated from stool samples in Delhi, much before the O139 epidemic (Table 4.3). Non-O1 isolation rates were similar to those reported from Bangladesh but lower than that from Calcutta. The isolation rate ranged between 0.5-3%. But following the introduction of the O139 strain, isolation of non-O1 vibrios rose remarkably to 29.2%. A detailed month-wise break-up of the 1993 situation (Table 4.4) reveals that the peak isolation rate was in May. This tapered off in the later months though no month was free of it.
Table 4.4: Isolation of *V. cholerae* in Delhi in 1993

<table>
<thead>
<tr>
<th>Month</th>
<th>Samples No.</th>
<th>O1 No.</th>
<th>O1 Rate %</th>
<th>Non-O1 No.</th>
<th>Non-O1 Rate %</th>
</tr>
</thead>
<tbody>
<tr>
<td>January-March</td>
<td>60</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>April</td>
<td>219</td>
<td>8</td>
<td>3.7</td>
<td>73</td>
<td>33.3</td>
</tr>
<tr>
<td>May</td>
<td>710</td>
<td>155</td>
<td>21.8</td>
<td>290</td>
<td>40.8</td>
</tr>
<tr>
<td>June</td>
<td>564</td>
<td>117</td>
<td>20.7</td>
<td>201</td>
<td>35.6</td>
</tr>
<tr>
<td>August</td>
<td>505</td>
<td>133</td>
<td>26.3</td>
<td>141</td>
<td>27.9</td>
</tr>
<tr>
<td>September</td>
<td>432</td>
<td>109</td>
<td>25.2</td>
<td>81</td>
<td>18.8</td>
</tr>
<tr>
<td>October</td>
<td>206</td>
<td>107</td>
<td>51.9</td>
<td>37</td>
<td>18.0</td>
</tr>
<tr>
<td>November</td>
<td>32</td>
<td>10</td>
<td>31.3</td>
<td>1</td>
<td>3.1</td>
</tr>
<tr>
<td>December</td>
<td>5</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total</td>
<td>2850</td>
<td>697</td>
<td>24.4</td>
<td>831</td>
<td>29.2</td>
</tr>
</tbody>
</table>

*Source: National Institute of Communicable Diseases, Delhi*

The National Institute of Communicable Diseases, Delhi (Sachdeva et al, 1995) reported a large series both from Delhi and other states where NICD had investigated different cholera outbreaks. Out of 2,850 samples tested from Delhi in 1993, 29.2% yielded *V. cholerae* O139 and 24.4% *V. cholerae* O1. Out of 423 samples collected from other states of the country, 38.1% were confirmed to be *V. cholerae* O139. The 64 strains of non-O1 isolated from Delhi during 1991 and 1992 were tested serologically with O139 antisera. None of them were found to agglutinate with *V. cholerae* antisera, indicating that the O139 strain had arrived in Delhi during 1993.

Till 1993, non-O1 vibrios had been associated with sporadic cases or relatively confined outbreaks of diarrhoea (Ramamurthy et al, 1993). Incidence of non-O1 Vibrio was reported to be 5-10% of the hospitalised cases in Calcutta (Ramamurthy, 1993) and 1-3% in Bangladesh (Albert et al, 1993). In Delhi *V. cholerae* O139 has been demonstrated to coexist in focal outbreaks in a small locality (Dasgupta et al, 1995) discounting the then prevailing notion that O139 would replace El tor in the manner in which El tor had replaced classical vibrios.

During 1995, 1,988 cases of *V. cholerae* O1 and only 1 case of the O139 serogroup were isolated from Delhi. In 1997, O139 cases in the months of May, June and July accounted for approximately 3% of the cases while in 1998 this proportion rose to about 20%. Incidentally, the cholera cases reported from Delhi showed a steep rise from 956 in 1997
to 1,908 in 1998, which is attributable to the re-emergence of the O139 strain and is a signal for increasing O139 surveillance.

THE 1988 EPIDEMIC

Delhi experienced a cholera epidemic in 1988. The realisation that the capital city could suffer from such an epidemic not only shook the country but also led to major changes in the approach towards control strategies in Delhi. The plight of the urban poor and the lack of urban basic services was brought into focus. Knee jerk responses and the obsession with vaccination during this epidemic provided a textbook case of how not to manage a cholera epidemic. Over the years, cholera became a political issue and was used by the community leaders to scare a lull administration into action for various civic problems — primarily relating to water and sanitation.

Tracing the Epidemic

In 1988, the first cholera case was detected during April, as in earlier years. This was followed by an increase in reported cases during May and June. From late June, a spurt in the number of cases was noted reaching its peak in July and August [Datta et al (1993), Khanna et al (1990)]. While some investigators attributed a focal outbreak in Rajokri Village, Najafgarh Zone to be the source of the epidemic, others opined that the epidemic started in Brahmpuri and Gokulpuri areas of Shahdara (North) Zone.

Between 14th and 17th May, 1988, 14 children from Rajokri, aged between 3 and 14 years, were admitted at the Infectious Diseases Hospital (ID Hospital) with gastroenteritis (GE). A preliminary survey of 248 households in the area on 17th May revealed 36 cases of GE and 2 deaths. Three wells considered to be the cause of the epidemic were disinfected. 1,498 people were inoculated with the anti-cholera vaccine. The National Institute of Communicable Diseases (NICD) conducted their investigation on 20th May and put the number of deaths at 5. By 19th May, 5,690 persons had been inoculated against cholera.

A Bharatiya Janta Party fact finding team claimed that this was a cholera outbreak; 25 people had died and that 250 were affected (VHAI, 1988).
Rajokri is a village in Najafgarh Zone with a population of about 8,000. The village itself was not affected by the outbreak. The area that was affected was Rajokri Pahari on the outskirts of the main village. Rajokri Pahari had stone quarries and was inhabited by migrant labour living in slums, without access to any basic services. "The entire environment appears to be highly polluted with thick dust particles all around coming out of the stone crushing operation in the area", recorded the NICD report. There was no tap water and the residents were defecating in the open fields. The contractors were filling up two dry shallow wells in the area with tanker water and the labourers were using it for drinking and other purposes. This contaminated water source was considered to be the cause of the outbreak by the NICD.

The stool samples of the patients admitted at the ID Hospital had tested negative for cholera. NICD had collected 3 stool samples from the community. These also tested negative for *Vibrio cholerae*. All these 3 samples, however, were positive for *E. coli*. MCD had tested 11 water samples on the 17th of May and all these samples were found to be unfit for human consumption. NICD tested two samples from wells of which one was fit and the other was unfit.

The Director General of Health Services in a communication issued earlier on 29th January, 1988 had categorically ruled out the role of vaccination during an epidemic/outbreak. Interestingly, the Director-in-charge, NICD recommended in her report on the Rajokri episode, dated 27th May, 1988 that all the inhabitants of the village should be inoculated against cholera with anti-cholera vaccine. It is possible that the subsequent thrust on, inoculations (June onwards), though largely blamed on the then Prime Minister, could have been guided by the think tanks of the apex institute.

*Increase in Cholera Cases in Hospitals*

In the last week of May, Safdarjung Hospital had also tested several GE patients to be positive for cholera from different areas of South, Central and Najafgarh Zones. The affected areas were Govind Puri, Dakshinpuri, Mehrauli, Sadiq Nagar, Palam and
Sagarpur. The information was communicated to the public health authorities and field action was taken for prevention of further spread.

Analysis of the data from the Infectious Diseases Hospital revealed that up to the end of July 1988, Shahdara (North) Zone had demonstrated an unusual rise in the number of cases and reported 255 cases till 26.07.88. This accounted for nearly a third of the cases in Delhi. The worst affected areas were Seemapuri, Gokulpuri, Ghonda-Maujpur and New Seelampur (VHA, 1988). On 15th July, after repeated denials, the Government admitted that there were at least 30 cholera deaths since July 1st, most of them children.

On 22nd July the Prime Minister visited some of the affected areas of Shahdara (North) Zone and an "action plan" was formulated. It was an eight point (eleven according to some reports) plan. The emphasis remained on vaccination (900,000 vaccinations within a week), cleaning up of the area within a week that was later extended to two weeks and installation of permanent drinking water sources within 15 days (Priya Ritu, 1989).

Spread of the Epidemic

1,708 bacteriologically proved El tor cholera cases was reported in 1988 along with 8 deaths. This was the highest number of cases recorded in a single year in Delhi, since it was first detected in 1965, The corresponding figures for GE were 84,972 cases and 643 deaths. As many as 1,324 cases of cholera were reported during July-August, 1988 with nearly 600 cases in the second half of July. Table 4.5 compares the figures of July and August for the preceding 10 years.

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>July</td>
<td>32</td>
<td>242</td>
<td>98</td>
<td>46</td>
<td>76</td>
<td>70</td>
<td>148</td>
<td>116</td>
<td>45</td>
<td>684</td>
</tr>
<tr>
<td>August</td>
<td>52</td>
<td>152</td>
<td>122</td>
<td>112</td>
<td>203</td>
<td>88</td>
<td>154</td>
<td>45</td>
<td>84</td>
<td>650</td>
</tr>
<tr>
<td>Total</td>
<td>84</td>
<td>394</td>
<td>226</td>
<td>258</td>
<td>279</td>
<td>158</td>
<td>302</td>
<td>161</td>
<td>129</td>
<td>1324</td>
</tr>
</tbody>
</table>

Source: National Institute of Communicable Diseases
Out of 2,873 diarrhoea stool specimens from the I D Hospital, 1324 (46%) were positive for cholera\(^3\). The peak of the 1988 epidemic was during the last week of July and the first week of August. The highest incidence rate of 77 per 100,000 was observed in the age group of 1-4 yrs. (Dutta et al, 1992), with decreasing attack rates in higher age groups, the lowest being in the age group of 25 yrs and above (10 per 100,000). Khanna et al (1990) found that 6.6% of the cases occurred in infants, Dutta et al (1992) reported an incidence rate of 55/100,000 for infants. Overall, 73% of the cases occurred in children below the age of 15 years. The ratio of males to females was 3:2 (780 : 544).

307 deaths were reported from hospitals. While the exact cause cannot be ascertained (GE or cholera), micro studies (Priya Ritu, 1989) revealed that most of the children who died were malnourished and were already suffering from chronic diarrhoea. Gastroenteritis in these children were accompanied by other complications like bronchitis, pneumonia or septicaemia. The National Institute of Health and Family Welfare has been quoted by the VHAI (1998) to have reported that incidence of diarrhoea among the children of slums and resettlement colonies of Delhi was more than four times the national average. Though 6.6% of cases occurred among infants (Dutta et al, 1992) more than half of the deaths during the epidemic were infants (VHAI, 1988).

### Table 4.6 : Incidence of Cholera in 1988 Epidemic

<table>
<thead>
<tr>
<th>Affected Areas</th>
<th>Mid-year estimated population in 100,000</th>
<th>Cases</th>
<th>Incidence Rate per 100,000 population</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCD Zones</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>City</td>
<td>5.19</td>
<td>10</td>
<td>1.9</td>
</tr>
<tr>
<td>Sadar Pahargunj</td>
<td>5.14</td>
<td>45</td>
<td>8.8</td>
</tr>
<tr>
<td>Karol Bagh</td>
<td>7.64</td>
<td>43</td>
<td>5.6</td>
</tr>
<tr>
<td>West</td>
<td>9.68</td>
<td>50</td>
<td>5.2</td>
</tr>
<tr>
<td>Civil Lines</td>
<td>5.93</td>
<td>508</td>
<td>85.7</td>
</tr>
<tr>
<td>Narela</td>
<td>2.83</td>
<td>48</td>
<td>17.0</td>
</tr>
<tr>
<td>Najafgarh</td>
<td>5.62</td>
<td>79</td>
<td>14.1</td>
</tr>
<tr>
<td>South</td>
<td>6.34</td>
<td>69</td>
<td>10.9</td>
</tr>
<tr>
<td>Central</td>
<td>6.77</td>
<td>26</td>
<td>3.8</td>
</tr>
<tr>
<td>Shahdara</td>
<td>10.47</td>
<td>583</td>
<td>55.7</td>
</tr>
<tr>
<td>NDMC</td>
<td>9.88</td>
<td>15</td>
<td>1.5</td>
</tr>
<tr>
<td>DCB</td>
<td>1.20</td>
<td>11</td>
<td>9.2</td>
</tr>
</tbody>
</table>

Source : Dutta et al 1992

\(^3\) It is interesting that during June-July, 1968, 47% isolation was reported by Pal et al (1969) out of a total of 193 diarrhoea admissions.
Table 4.6 gives the distribution of cholera cases across the different zones. Shahdara (43%) and Civil Lines (29%) Zones were the worst affected, contributing about 72% of the total cases. In terms of incidence, Civil Lines reported 85.7 cases per 100,000 population while Shahdara reported 55.7 per 100,000. Both these Zones are part of the riverine belt on the banks of the River Yamuna that is vulnerable for waterborne diseases. The highest proportion of cholera cases have been consistently observed every year from these two zones.

The affected colonies can be classified by their municipal zone and type of settlement as follows (Table 4.7):

Table 4.7: Affected Colonies of the 1988 Epidemic

<table>
<thead>
<tr>
<th>Zone</th>
<th>Colony</th>
<th>Settlement Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shahdara 4</td>
<td>New Seemapuri, Nand Nagri, Sunder Nagri, Kalyanpuri, Trilokpuri</td>
<td>Resettlement</td>
</tr>
<tr>
<td></td>
<td>Gokulpuri, Maujpur, Brijpuri, Bhajanpura, Khajuri, Karawal Nagar</td>
<td>Unauthorised</td>
</tr>
<tr>
<td></td>
<td>Tahirpur, Johipur</td>
<td>Urbanised Village</td>
</tr>
<tr>
<td>Civil Lines</td>
<td>Jahangirpuri</td>
<td>Resettlement</td>
</tr>
<tr>
<td>Rohini</td>
<td>Haiderpur</td>
<td>Urbanised Village</td>
</tr>
<tr>
<td>Najafgarh</td>
<td>Mangolpuri, Sultanpuri</td>
<td>Resettlement</td>
</tr>
</tbody>
</table>

The earliest and the worst affected areas were the resettlement colonies, particularly in Shahdara Zone. The epidemic later affected the adjacent urbanised villages and unauthorised colonies. The 1988 epidemic is thus closely identified with the plight of the resettlement colonies. It is significant that the epidemic followed the collapse of services in these resettlement colonies following the handing over of these colonies from DDA to MCD, a key factor that will be explored later in detail.

4 During the 1988 epidemic, Shahdara was one zone. In the aftermath of the epidemic one of the many steps taken was to bifurcate Shahdara Zone into Shahdara (North) Zone and Shahdara (South) Zone, in 1990, for more effective administration. The entire area on the east bank of the Yamuna River was one Shahdara Zone. The railway line from the Old Yamuna Bridge to Uttar Pradesh was taken as the line of demarcation between the two zones.
Causes of the Epidemic

This section explores the background in which the epidemic occurred and the causes that explain an outbreak of this magnitude. The major factors explored in this section include settlement patterns of the affected colonies, the state of infrastructure and the administrative factors that went with it. Other issues including microbiological and behavioural factors have also been duly considered.

Settlement Factors

In 1972-73, the Town and Country Planning Organisation (TCPO) reviewed and evaluated the Master Plan of Delhi. Among its major findings were the facts that there was a housing deficit of 380,000 in 1971, with little progress in housing facilities for low income groups. The slum population (excluding squatters) was estimated to be nearly one million and a total of about 1.5 million were living in substandard housing. Concern was also expressed about congestion in the urbanised villages and environmental pollution (Ritu Priya, 1993).

Slum clearance work received a major thrust following the TCPO review. Simultaneously, this job was transferred from the Municipal Corporation of Delhi (MCD) to the Delhi Development Authority (DDA) by the Government of India in 1974. 27 resettlement colonies were constructed in the peripheries of the city during this period to relocate 120,000 squatter households. The resettlement colonies were site-cum-services schemes. Each family was provided a plot of 25 sq. yds. These colonies were provided with roads, parks, public toilets, shops, schools, dispensaries and community centres. Industrial areas were also provided for in nearby areas to provide employment. Further, these areas were planned areas and appropriate and adequate infrastructure was to be expected.

Despite these guiding principles, there were several major deficiencies in the resettlement colonies (Ritu Priya, 1993). The colonies were located at the periphery of the city on low lying waste land often along drains and ditches that was basically unsuitable for human
habitation. In contravention to the caution sited in the master plan, these were set up in the trans-Yamuna area without developing an adequate drainage system. The area of individual plots was lowered from an initial of 89 sq. yds. (recommended by the Delhi Improvement Trust) to 25 sq. yds. (allotted by the DDA)\(^5\). Thus little was done for improvement of 'substandard' housing. Adequate water supply and proper waste disposal system were not given due attention at city level. Implementation of local level systems also remained weak. The minimum standard of public latrines was fixed at one seat for 20-50 persons which in actual practice stood at one seat per 150 persons. Parks almost invariably deteriorated into dumping areas for solid wastes and wastewater due to inadequate drainage and solid waste collection and disposal systems.

The state of the civic amenities and basic services that existed in the resettlement and other colonies have been explored by the three member committee appointed by the Supreme Court in response to two Writ Petitions (Criminal) Nos. 330 and 400 of 1988\(^6\). The following discussion on the deficiencies of basic services that were considered to contribute to the epidemic draws on information available from the report of this committee. Two other micro-studies – one by the Voluntary Health Association of India (1988) and the other by Ritu Priya (1989) provide insights into the ground situation and takes the community's accounts and perceptions as well. The report of the expert committee goes into considerable detail regarding the infrastructure situation; it quotes figures by the civic agencies themselves and even by their own admissions, the deficiencies were gross enough. The other two reports have the strength of going to the community level for fact finding. While the VHAI study (1988) takes the various component of causality and control into account, it is incomplete to the extent that the report went to the press even while the epidemic was on. The case study by Ritu Priya (1989) is confined to only one colony – Sunder Nagri. This was the worst affected colony and the findings expose the vulnerability of such colonies in general.

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\(^5\) The intermediate sizes of plots recommended by the DDA at various points of time were 80 sq. yds. and 55 sq. yds.

\(^6\) The Committee consisted of Mr. P. C. Tyagi, Chairman, Central Pollution Control Board, Mr. B. P. C. Sinha, Chief Hydrologist and Dr. Mira Shiva, Voluntary Health Association of India. The Report was submitted in 1990.
**Water Supply**

The availability of piped supply was inadequate in all the affected colonies in June 1988 and in the resettlement colonies of Shahdara, less than a third had piped supply. The official standard was one water tap for every 30 families and one handpump for every 32 families. Micro studies revealed that each lane had one or two taps supplying water from the local deep tubewells. The supply was erratic and had been reported by residents to be two to four hours a week.

Lack of reliable and adequate piped water supply forced residents to draw their daily requirement from shallow handpumps that were installed by the administration and also by residents at their own cost. Disposal of solid and liquid wastes in these colonies was grossly inadequate leading to contamination of groundwater and subsequent consumption of the unsafe water by the residents. This will be dealt with in a later section.

However, quantitative inadequacies apart, there was a big question mark on the quality of water that was being supplied to the residents through the piped supplies. The expert committee pointed out that defects were detected in pipelines in several resettlement colonies that led to contamination. Further, the condition of pipelines in Sunder Nagri and Seelampur was much worse and that they could not be commissioned in time.

Different agencies conducted laboratory tests for water quality during the epidemic period. The largest number of samples was tested by the Public Health Laboratory of the Municipal Corporation of Delhi – 548 samples. Other central agencies that conducted tests included National Environmental Engineering and Research Institute (NEERI) and Industrial Toxicology Research Centre (ITRC)\(^7\). Table 4.8 summarises the findings of these agencies. Baweja et al (1990) also reported a series of 60 samples.

There are overlaps across categories of sources as reported by different agencies. Moreover, none of these agencies specified whether the water sources reported were collected at the source or at the consumer end. Moreover, for some water source

\(^7\) NEERI and ITRC conducted the tests between 25th July and 3rd August, 1988
categories, the sample size is small and interpretations should be made with caution. All agencies tested for total coliforms to determine fitness for human consumption.

Table 4.8: Bacteriological fitness of water during the 1988 epidemic

<table>
<thead>
<tr>
<th>Source</th>
<th>MCD</th>
<th>ITRC</th>
<th>NEERI</th>
<th>Baweja et al</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sample</td>
<td>Fit</td>
<td>Sample</td>
<td>Fit</td>
</tr>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
</tr>
<tr>
<td>MCD</td>
<td>89</td>
<td>85.39</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DDA</td>
<td>2</td>
<td>100.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Piped supply</td>
<td>-</td>
<td>-</td>
<td>23</td>
<td>78.26</td>
</tr>
<tr>
<td>Tubewell</td>
<td>22</td>
<td>0.00</td>
<td>15</td>
<td>60.00</td>
</tr>
<tr>
<td>Handpump</td>
<td>391</td>
<td>1.02</td>
<td>30</td>
<td>46.67</td>
</tr>
<tr>
<td>Public Hydrant</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tanker</td>
<td>6</td>
<td>100.00</td>
<td>3</td>
<td>100.00</td>
</tr>
<tr>
<td>Trolley</td>
<td>15</td>
<td>0.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ice</td>
<td>23</td>
<td>0.00</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>548</td>
<td>16.06</td>
<td>71</td>
<td>61.97</td>
</tr>
</tbody>
</table>

Considerable variation can be observed regarding fitness of piped supplies. The critical issue is that for large piped supplies (including public hydrants), coliforms must not be present in 95% of the samples taken throughout any 12-month period as per WHO guidelines of 1993 and 1996 (Park, 2000). The reported values fall far below the required standard. Most of the unfit MCD samples were from Civil Lines, Shahdara and South Zones, that had reported majority of cholera cases.

Tubewells emerged as the key source of unsafe water in the reports. Tubewells were generally the only source of piped water supply for the resettlement colonies. The failure to maintain the quality of tubewell water implied that the chlorination system was not functioning properly. This was entirely a failure of the concerned agencies to chlorinate water drawn by deep tubewells and to that extent the problem was avoidable and man-made.

Groundwater samples obtained from handpumps were unfit for drinking. In unauthorised colonies and JJ Colonies, where people were acutely dependent on groundwater because of lack of piped supply, contaminated groundwater led to the spread of infection. The dependence of resettlement colonies on handpumps has already been highlighted.
Number of samples taken from tankers were small and the 100% fit results should be interpreted with caution. Most of the contamination of tanker water occurs while accessing it and often by dipping containers into the tanker or by drawing water through rubber pipes. However, the VHAI study (1988) reported foreign bodies in tanker water, though the lack of laboratory testing of such samples fails to provide evidence whether such samples were bacteriologically fit or not.

What was of concern was that 100% of the ice and water trolley samples were unsafe. These are trades subject to regulation and licensing. The failure of public health administration thus stood exposed. It can be safely surmised that consumption of these items being higher during the summer months, transmission of diarrhoeal diseases (and cholera) must have been greatly facilitated.

Bandopadhyay et al (1992) collected water samples from known cholera foci of the city from May to October 1990. They found that overall, 43.3% of the water samples were unfit for human consumption. 75.3% of the handpump water samples and 9.7% of the tap water samples were unsatisfactory. When available, a sample from stored water and a sample of the primary source was also taken. The sample size of paired samples was small – 29 piped water samples and 14 handpump water samples. Of the 26 fit piped water samples, 18 (69.23%) stored samples were reported to have tested unfit. Out of 6 handpump water samples, 2 (33.3%) stored samples tested unfit. On the basis of such small samples, the authors argued that it was personal hygiene that was one of the critical determinants for diarrhoeal diseases.

This study also conducted a retrospective analysis of behavioural factors by conducting a case control study. 44 households reporting cholera cases in Shahdara during the 1988 epidemic were selected. From the same area, 300 unaffected households were also selected as controls. The study does not specify the factors for which the controls were matched. Moreover, the study was conducted two years after the epidemic. Still the households reporting cholera cases in 1988 were taken as 'cases'. The relationship of certain household practices and the risk of being affected by cholera was studied among cases and controls. Statistically significant differences were reported for three variables. Storing water in narrow mouthed containers, use of soap and water for handwashing
before meals and storing leftover food for more than 6 hrs without refrigeration and consuming it later were identified as risk factors.

**Sewerage and Wastewater Disposal**

According to the report submitted to the Hon'ble Supreme Court, 35 out of 44 resettlement colonies did not have proper sewerage systems. Out of a total of 543 regularised and unauthorised colonies, only 135 colonies had sewer connections. In 25 of these colonies, internal sewers were not operational for lack of pumps. As many as 221 colonies in this category in Shahdara lacked sewers. At many places, sewage was pumped into open drains resulting in waste water collection near houses.

1,446 out of 1,583 septic tanks were choked with sludge. Public latrines/urinals were generally in dilapidated condition and 1,234 km of open drains were silted up. Latrines and urinals were poorly maintained and there was indiscriminate defecation around the latrines including the newly constructed ones. Though one lavatory seat was supposed to be provided for every 7 families, in reality, as many as one hundred or more persons were actually using it.

Sullage drains were constructed by the DDA without proper slopes and outlets making disposal of wastewater difficult. On account of inadequate garbage bins in the colonies, solid waste was often thrown into the open drains, causing further stagnation. A number of sullage pumps were also not working. The sullage was being pumped into bigger drains which ultimately drained into major drains maintained by the Flood and Irrigation Department of the Delhi Administration. Low lying land within the colonies permitted stagnation of water, mixed with nightsoil and garbage. The groundwater was thus liable to be polluted easily because of the sandy loam soil and the high water table. Only about a tenth of the 59 sullage pumps were functioning when the outbreak started.

**Sanitation Services**

DDA was responsible for the removal of solid waste till the transfer of the colonies to MCD on 1.6.1988. About 5,000 truckloads of garbage was piled up by the end of May 1988. Garbage bins were inadequate and people tended to dump refuse at the roadside or
into drains near the houses. 1,234 km of drains were full of silt leading to wastewater accumulation within the colonies and then percolating to the sub-soil water.

Administrative Issues

The Committee on Reorganisation of Delhi Setup (Sarkaria Committee) published its report in December 1989. The Report examined the administrative issues contributing to the epidemic and pointed out the difficulties due to overlapping of functions between Municipal Corporation of Delhi (MCD) and Delhi Development Authority (DDA). The relevant findings have been analysed here to investigate the then prevailing conditions in the affected colonies and the state response to the epidemic.

The overlap of functions between the Municipal Corporation of Delhi and other authorities concerned with the provision of infrastructure and basic civic services in a development area was of critical importance. Under the DDA Act, 1957 the Central Government, after consultation with the Corporation may declare any area in Delhi to be a development area. After an area is declared a development area, the DDA performs all the functions and exercises the authority normally vested in a local body in respect of an area so long as that area continues to be a development area. After the development of the area is complete, the DDA hands over the area alongwith the basic infrastructure and services such as sewerage, drains, roads, water supply systems, parks and green spaces to the MCD which then assumes the responsibility for their maintenance. While the provisions of law are clear, difficulties have been felt in regard to actual functioning of the authorities concerned. The process of handing over (as pointed out in the report) involved consultations and negotiations, that often lasted upto several years, and during the interim period both the MCD and the DDA were inclined to neglect the maintenance of civic and other services in the area resulting in serious inconvenience to the residents of the area.

Squatters on land acquired for public purposes, known as Jhuggi-Jhonpri (JJ) dwellers, were to be provided developed serviced plots and, in some cases, even tenements as per certain decisions of the government. The implementation of this scheme, known as Jhuggi-Jhonpri Relocation (JJR) Scheme, was originally entrusted to the MCD in 1960, but was transferred to the DDA in January 1968. However, since relocation was not one
of the original objectives of the DDA, the responsibility for this work has been alternating between DDA and MCD. At the time of the epidemic; the policy emphasis was on *in situ* improvement of squatter settlements.

Under the Slums Areas (Clearance and Improvement) Act, 1956, areas lacking basic facilities were declared slum areas. Wherever development of such areas was not possible, they were cleared and occupants provided slum rehousing tenements. 20,000 such tenements had been allotted to slum dwellers under this scheme in different parts of the city. Dangerous *katras* located within the slum areas were demolished and occupants provided with alternative accommodation. Under the Slum Clearance and Improvement Scheme, environmental improvement was carried out to improve the living conditions of the slum dwellers. In 1988, this work was being done by the Slum Wing of the DDA while maintenance services for slums were the responsibility of the MCD. The report noted that the practice of shifting of development and maintenance work relating to slums between the MCD and the DDA had also been criticised by the Estimates Committee of Parliament.

Another function entrusted to the DDA was to provide basic civic facilities in regularised colonies (that were earlier unauthorised) and urbanised villages under the various schemes of the Delhi Administration. The resources made available to the DDA were not sufficient to meet the actual expenditure incurred by the latter on the development of basic infrastructure facilities in these colonies and villages. These colonies, along with development work relating to urban villages, had been transferred to the MCD on April 1, 1987.

Under the Delhi Municipal Corporation (DMC) Act of 1957, the MCD is responsible for providing basic services including public health, drinking water, sanitation and solid and liquid waste disposal. Within the MCD, the Health Department provides for medical services through Dispensaries (of different systems of medicine), Hospitals, Maternity & Child Welfare Centres and Maternity Homes. It is also concerned with the control of communicable diseases and health education. The Conservancy and Sanitation Engineering (CSE) Department maintains environmental sanitation including open drains and is responsible for the disposal of solid waste. Till the late 1970s, this component (conservancy and sanitation) was under the Public Health Division of the Health
Department. Water supply, sewers and liquid waste disposal was done by the Water Department. During 1988, the responsibility for cleaning of septic tanks in the Resettlement Colonies was vested with the Engineering Department of the MCD.

The decision to transfer Resettlement Colonies from DDA to MCD had been under consideration for about 4 years. Without assessing the available facilities, funds, equipment and manpower, the Delhi Administration in May 1988 decided to transfer all the 44 Resettlement Colonies to MCD with effect from the 1st of June, 1988. The Report pointed out that the certain pre-requisites were not paid adequate attention by the MCD before taking charge of these colonies. These included proper infrastructure for distributing water, proper sewage and drainage facilities, proper arrangements for transportation and disposal of garbage, adequate manpower to supervise the workers transferred from DDA to MCD and funds for carrying out the responsibilities in these colonies. The Lt. Governor of Delhi presided over a meeting on 12.5.88 where financial assistance that would be made available to MCD by the Delhi Administration was decided upon.

The figures for actual release of funds demonstrates the administrative failure that led to the virtual collapse of services in the colonies where the transition was under progress from DDA to MCD. Rs 20 crores was allotted for setting up and maintenance of machinery and purchasing of all material and equipment for maintenance of water and sanitation services. Funds for this purpose was released nearly 6 months after the outbreak. The first instalment of Rs. 5 crores was released in January 1989. Rs 10 crores was allotted for immediate repair and for making the services operational. Funds were released about 2 weeks after the outbreak. Rs 106 crores was earmarked for additional facilities. The Lt Governor had directed on 12.5.88 that Delhi Administration should process this fund immediately. The actual release of this fund started from 10.11.88 after the epidemic was already over. Till 31.03.89, only Rs. 26.36 crores had been actually released.

Microbiological Factors

The predominant serotype of the 1988 epidemic was *Vibrio cholerae* El tor Ogawa (99.4%). The isolation rate was 46% of all diarrhoea cases admitted in I D Hospital as
compared to 10-27% isolation, that is normally observed. The antibiogram observed in the 1988 epidemic differed from the previous years' isolates when resistance to furazolidone was much less and that to tetracycline more. Khanna et al (1990) suggested that there was the possibility of introduction of new strains in the environment. The source and mechanism of spread of such a strain has remained unknown. In vitro susceptibility testing of the isolated vibrios showed (Table 5.9) 99% sensitivity each to tetracycline and chloramphenicol, 98% to streptomycin, 97% to furazolidone and 94% to ampicillin. The antibiogram profile of the outbreak, reported in Table 4.9 was different from those of the previous years; resistance to furazolidone was more and that to tetracycline was less in 1988 (Khanna et al 1990)

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<tbody>
<tr>
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<td>0.9</td>
<td>0</td>
<td>0.2</td>
<td>0.3</td>
<td>1.0</td>
<td>0</td>
<td>0</td>
<td>3.8</td>
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<tr>
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<td>5.5</td>
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Source : Khanna et al 1990

Khanna et al (1990) were of the opinion that the reasons for the sudden increase in the cholera cases was unknown. They had noted that this outbreak followed one of the worst drought periods in many areas. Similar experiences had also been noted in the past. It has been hypothesised that such drought conditions apart from affecting the availability of safe drinking water and leading to the consumption of water from unsafe sources and subsequent spread of diarrhoeal infections may also increase susceptibility of humans. It has also been hypothesised that like *Vibrio parahaemolyticus*, *V. cholerae* O1 may have a natural reservoir in the aqueous environment. A sudden proliferation of the bacteria in the aqueous environment and its spread into the drinking water sources like tube wells and hand pumps could have contributed to the outbreak.

The residents of the resettlement colonies were the most affected group owing to near total collapse of services following the transfer of these colonies from DDA to MCD without adequate planning particularly in terms of allocation of resources and release of funds. The existing level of provision of infrastructure and delivery of services was already far below reasonable standards. The affected communities were acutely dependent on groundwater drawn through shallow handpumps. Lack of sanitary latrines
(and consequent open defecation) and improper waste disposal led to massive contamination of groundwater. Drought conditions also contributed to the problem. The shift in antibiogram suggested biological variation of the causative agent.

Containment Measures

Rational principles of management of a cholera epidemic include provision of safe water, proper disposal of solid and liquid wastes of the community and identification, isolation and treatment of the cases at the earliest. Though cholera epidemic is usually associated with panic, yet, cholera need not pose a major public health problem in a community that has a properly managed programme for control of diarrhoeal diseases.

Information to the Community

The essence of a control programme is to inform the community of the appropriate control measures. The report submitted to the Supreme Court criticised that the administration failed to inform the community to administer oral rehydration to a patient of diarrhoea at the earliest and to continue rehydration if needed after discharge from the hospital. The community was not advised to stop using handpump water for drinking purposes, store water properly and use chlorine tablets or boil the water or maintain sanitation and personal hygiene. Further, the affected people should have been told not to have a false sense of security about the vaccine. The VHAI report (1988) observed that mass media like All India Radio and Doordarshan were not utilised. Emphasis was on handbills and posters which were of little relevance for illiterate communities. Moreover, they were not distributed and displayed adequately. Inter-personal communication, the most powerful tool in a situation like this, was conspicuous by absence.

Medical Care

Initial care was provided largely by the private practitioners; but it was costly and often irrational comprising of intravenous infusion, antibiotics and antidiarrhoeals in wrong and hazardous doses. Drugs like tonics, Liv 52 and isaphgol were also prescribed. While a significant number of practitioners failed to give information about oral rehydration, some
of them did prescribe commercial ORS brands which were expensive. Reasonably priced ORS formulations meeting WHO specifications were not available with the chemists. The VHAI report (1988) pointed out that often one ORS packet was given per family which was inadequate for complete correction of an individual patient least of all multiple cases in the same family. Further, distribution of packets was not backed by dissemination of information on dosage; as a result incomplete rehydration and complications were common. The staff of the School Health Services who were making house-to-house visits for disseminating health education and promoting use of ORS were withdrawn for vaccination work resulting in these components being "abandoned" for sometime (Ritu Priya, 1989).

Clear guidelines regarding initial treatment – when to refer, where to refer, how to handle GE and suspected cholera cases and contacts of cholera cases – were not provided to medical practitioners by the concerned health authorities. There was confusion regarding admission and referral criteria of cholera cases causing hardship to patients. Many of them were reaching the Infectious Diseases Hospital directly without correction of dehydration. The facilities for stool examination and emergency care were available at the GTB and Hindu Rao Hospitals but were inadequate to meet the patient load. Due to overload of work, many children were discharged too early and some of them died on their way home with recurrence of diarrhoea and vomiting. This was attributed to lack of clear guidelines where milder cases could have been tackled at the periphery leaving the critical cases to hospital care.

**Vaccination During the Epidemic**

Against a previous directive of the Director General Health Services, cholera vaccination was undertaken after the onset of the epidemic in accordance with the action plan announced following the visit of the Prime Minister on 22nd June. A target of 900,000 inoculations against cholera was set in the Trans Yamuna area from 23.7.88 to 29.7.88.

Jet injector machines were imported as these were considered the 'ideal answer to contingencies ... where quality and the factor of time both are of essence'. These machines could deliver as many as 8000 inoculations per hour. In another context, it was
claimed that, 'the acceptability of jet injector machines among the people is high ... people flocked by themselves and cent per cent people were inoculated in the villages', in the flood affected areas of Orissa. The jetgun was thus projected as the surest and quickest way to contain the epidemic.

It is significant that though a target of 900,000 was set, the administration procured 24,00,000 doses of which as many as 23,61,000 doses were indeed administered. These included vaccines made available on demand to NGOs, political parties, security agencies, corporate organisations, religious bodies and the Super Bazar (a co-operative marketing organisation) for sale to the general public. In the first week of July, typhoid immunisation had also started. 11,57,200 paediatric doses and 7,30,120 adult doses were administered. This was undertaken in the context of the perception of an increased risk of water borne diseases. The whole exercise of vaccination was condemned by the report submitted to the Supreme Court as 'an exercise in futility and a mismanagement from the medical point of view'. The estimated cost of this exercise was put at Rs. 1 crore or more. More importantly, the emphasis on vaccination detracted attention from rational oral rehydration therapy.

Evaluation of Control Measures

On the 7th of August, 1988 (the epidemic had just begun to show a downward trend and the control measures had been fully operational) teams from the Union Ministry of Health and Family Welfare inspected different areas affected by the epidemic and other areas from where cholera cases were reported for evaluation of control measures. The extracts of the report in respect of the control measures in different areas are summarised here.

No cholera immunisation was done in Subzi Mandi (Civil Lines Zone). Safe water supply was lacking. Unlicensed water trolleys were seen operating in most insanitary conditions. In the same zone, the teams also visited Majnu Ka Tilla and Jahangirpuri where immunisation programmes against cholera and typhoid were functioning satisfactorily. No health education campaigns had been carried out in Jahangirpuri. Open drains were choked and overflowing with waste water. Exposed cooked food was on sale.
Garbage was littered in the Faiz Road (Karol Bagh Zone) area. Restaurants were functioning under insanitary conditions. In Ranjit Nagar immunisation programme was yet to begin and exposed food and fruits were seen on sale. Doctors were, however, seen to be imparting health education to the community. In adjacent Baljit Nagar health education activities and the immunisation programmes were functioning well. However, there was rampant sale of exposed food and cut fruits and vegetables.

In Chandni Chowk, Fateh Puri, Khari Baoli and Old Delhi Railway Station (City Zone) garbage heaps were found at most of the places and fly index was extremely high. No publicity materials were seen in the area.

No anti-cholera or TAB vaccine had been given in Harijan Camp, Mehrchand Market (Central Zone). Neither had any health education been carried out. In adjacent Kotla Mubarakpur (Central Zone) no immunisation had taken place. Though people were aware about the outbreak of cholera, no health education campaigns had taken place. Water from shallow wells were being used by the local food vendors and hotels. Lack of safe water supply was also noted. Cholera immunisation programme was progressing satisfactorily in schools’ and dispensaries of Ali Village but the health education component was lacking.

In Sis Ram Park and Indra Park (Shahdara Zone), vaccination was being provided in camps, without disposable needles and syringes. Health education activity was conspicuous by its absence while sale of exposed food and cut fruits was widespread. In Fazalpur Village immunisation programmes against cholera and typhoid were satisfactory. People had obtained health education messages though television only. In the colonies around the GTB Hospital (one of the worst affected areas) immunisation activities were satisfactory. Health education was also progressing satisfactorily through posters, public address systems and group meetings. Immunisation coverage was adequate in Gokulpuri. People were aware of oral rehydration therapy only through the television.

The teams inspected not only those areas that were affected by the epidemic but several other areas as well. Some of these areas are currently endemic foci for cholera. There was overbearing emphasis on vaccination and this vertical programme was functioning well.
Interviews with field workers who had served in the epidemic areas in 1988 revealed that owing to an extraordinary emphasis by the policy makers and adequate provision of the vaccination services by the provider-agencies, a demand was created in the community for vaccination. There had been instances when neighbours and their relations visited the homes of the vaccinators in the evening and night to be vaccinated. Not much attention was paid to environmental and food hygiene. The water tanker fleet was inadequate at that time for providing alternative safe water to the affected areas. Health education, a critical tool for epidemic management, was not given due importance. One reason was that the field staff were over burdened with vaccination targets and had no time for other measures.

It was essentially faulty planning and maintenance of the resettlement colonies set up during the Emergency regime that resulted in the cholera epidemic in the capital of India. The myth of providing planned settlements and "happy and tension free life" for the urban poor through the resettlement colonies was exploded (Ritu Priya, 1993). The response of the health services was no better. What started as a planning and engineering failure was further complicated by the failure of the health administrators to provide rational management strategies for the epidemic.

THE DIARRHOEAL DISEASES CONTROL PROGRAMME

Following the 1988 epidemic, the Delhi Government and the Municipal Corporation of Delhi started a massive programme to prevent and contain diarrhoeal diseases in Delhi, which is also the strategy currently practised. Post-1988, the word haija (cholera) came to acquire a special connotation. Politicians and citizens started using it as a tool to attract attention to the water and sanitation problems of their areas, even in the absence of any outbreak of diarrhoeal diseases. This is the word that immediately galvanises the administration into action though routine services for these may be deficient. Substantial significance to this word is also attached in the media. At times it works as an early warning system, while on other occasions they prove to be false alarms. Fear of cholera, therefore, has brought diarrhoeal diseases control into focus. The concerned field staff (of the Health Department) in turn, consider cholera (and diarrhoeal diseases) control as their main duty often at the cost of other communicable diseases.
The various components of the diarrhoeal diseases control programme are discussed below:

**Disease Surveillance**

The reporting system for diarrhoeal diseases was strengthened after the epidemic by introducing sentinel surveillance. 13 Index Hospitals located in different parts of the city were selected to ensure geographical representation. The number of these sentinel centres was later increased to 22 Index Hospitals. Particulars of admissions of diarrhoeal diseases are collected daily and analysed at the respective zonal level. At each hospital, a medical officer is assigned the exclusive duty of maintaining records and investigating all diarrhoeal deaths. All dispensaries are also reporting diarrhoeal cases daily but generally without any patient details.

**Distribution of Chlorine Tablets**

Chlorine tablets (1 tablet being sufficient to disinfect 20 Litres of water for 24 hrs) are distributed through different agencies in the following areas:

- MCD - in unauthorised colonies without piped water supply
- Urban Basic Services Dept - in JJ Clusters
- Directorate of Social Welfare (Delhi Administration) through Anganwadi Workers in the areas of their operation

Since 1996, only MCD is continuing with this programme while other agencies have stopped distribution in their respective areas; distribution in those areas have been taken over by the MCD. The UBS Programme itself has been defunct over the last five years and its functions to some extent have been taken over by the IPP-VIII Programme of the Municipal Corporation of Delhi.
Interviews with field workers revealed that the use of chlorine tablets by communities remain low. In the post-epidemic phase, it was conceptualised that the supply of chlorine tablets that would last two weeks and would purify drinking water requirement of an average sized family will be delivered at the doorstep. 14 chlorine tablets (each tablet being sufficient to purify 20 litres of water per day) were packed in a sachet and were meant to last for 2 weeks for an average sized family. The field worker would thus need to visit every family once in a fortnight to maintain the supplies of chlorine tablets. Over the years, the rise in population and settlements lacking access to safe water supply has made it inordinately difficult for MCD field workers to reach the fortnight's supply to each and every home.

The WHO in association with Population Services International and Sulabh International has started a Pilot Project in 2002 in selected slums in west Delhi for social marketing of liquid chlorine for home chlorination and a narrow mouthed container to prevent domestic level contamination. This strategy has been implemented in several countries of the world. In Delhi, the partners chosen are – Population Services International, for their experience in social marketing of contraceptives and Sulabh International, for their experience in the sanitation sector and network of community-level workers.

**Distribution of ORS Packets**

A network for the distribution of ORS Packets has been set up through:

- Major Hospitals (ORT Corners)
- Dispensaries, Colony Hospitals and Primary Heath Centres
- Maternity & Child Welfare Centres and Maternity Homes
- Mobile Dispensaries
- Field staff

Health education regarding the use of ORS has been imparted to various groups including school children. Since 1999, Chlorine-ORS Depots are being set up within each vulnerable cluster in co-ordination with the local social and political leaders to make these available within the community with the help of community volunteers. Till June 2002, approximately 2500 depots had been set up. The strategy over the last couple of
years has shifted from house-to-house distribution to Chlorine-ORS Depots. Despite these programmes, the usage of chlorine tablets remains low in the vulnerable communities. The use of ORS is however considerable higher\textsuperscript{8}.

**Food Hygiene**

The food hygiene measures that are implemented, particularly during the vulnerable season are as follows:

- food items exposed to dust and flies including cut fruits are seized and destroyed
- no hawkers are allowed to sell eatables outside schools
- sale of water through unlicensed trolleys are not allowed
- sale of ice from unlicensed ice factories is not allowed
- sugar cane crushers in the open and unlicensed sugarcane crushing shops are removed or closed down
- sale of all types of kulfis and chuskies are stopped
- vendors selling various types of drinks from unlicensed factories are stopped
- watch is kept on ice that is imported from the neighbouring states

This regulatory role of the programme is extremely lax. Rather than a routine sustained process the emphasis is on conducting food hygiene raids and policing of the traders. This function is a classical example of the 'inspector-raj' and is subject to various pressures, including political interference.

**Disinfection of Wells**

All open wells where water is used for drinking are disinfected during the vulnerable season twice or thrice a week with bleaching powder. Wells are a minor source of drinking water and are used mostly in the rural areas; a few wells are also operational in the walled city. There are about 250 such wells but only a small proportion of them are

\textsuperscript{8} Informal discussions with Population Services International who conducted baseline surveys before starting the project on social marketing of liquid chlorine and safe container.
used for drinking purposes. The current emphasis therefore is to prevent breeding of mosquitoes in the unused wells by release of larvivorous fish.

Regulating Ice factories

Contaminated ice is a major source of water borne diseases (Koo, 1996). A large proportion of ice consumed in Delhi are imported from the neighbouring states of Uttar Pradesh and Haryana. Ice from factories of Delhi and those from which ice is imported are tested once a year at the time of renewal of licence. There are no mechanisms for regular monitoring of quality. Further, there are unlicensed factories that produce and sell ice. The microbiological quality of ice being sold in Delhi remains suspect and there is scope for improvement in the regulatory aspects of this source of infection.

Checking of Water Trolleys

Residual chlorine content of the water sold through refrigerated water trolleys at the roadside are checked by the health staff to ensure that safe and potable water is supplied to the citizens. The quality checks in this trade is better than that of ice.

Health Education

The lack of effective health education strategies during the 1988 epidemic have been highlighted by the VHAI report (1988). Following the epidemic, there was no change in the approach. More of the same continued and handbills and posters remained the mainstay. Their ineffectiveness in the context of vulnerable communities, many of whom cannot read, is obvious. The use of mass media was conspicuous by its absence. The dengue epidemic of 1996 focussed attention on the role of health education and resource allocation on this head also improved considerably.

Audio-visual media began to be utilised in a major way. Cable television and cinema slides (with audio tracks) began to utilised. Films shows began to be conducted within the
clusters that are vulnerable for waterborne diseases. A variety of outdoor media including DTC buses, bus shelters, large hoardings and kiosks on street light poles were included. Visual messages were designed for handbills, posters and stickers; emphasis on the written words reduced. School children have begun to be involved in the programme; this is a component that needs to be strengthened as school children constitute a very powerful medium. The emphasis of the messages are on personal hygiene and washing of hands with soap and water after defecation and before taking meals, consumption of water made potable by adding chlorine tablets where piped water supply is not available, avoiding consumption of food and cut-fruits exposed to dust and flies and promoting use of ORS and other home based fluids in case of onset of diarrhoea and vomiting.

**Water Quality Surveillance**

Since 1998-99, special thrust has been given to the early detection of contamination of water supply. Each week, surveys are conducted by the field workers in their respective areas for proper checking on the functioning of chlorinators, pipelines passing through drains, residual chlorine in water samples at the consumer end and leakage in pipelines. Information regarding these warning signals are conveyed to the Delhi Jal Board both at local and headquarters levels. Surveys checking on accumulated garbage, choked open drains and water logging are conducted in co-ordination with the Conservancy and Sanitation Engineering Department. These measures have helped build up better intersectoral co-ordination and early rectification following the warning signals.

**Special Measures against Cholera Cases**

Zonal Deputy Health Officers and Zonal Epidemiologists are required to investigate and take certain additional containment measures with regard to all cholera cases, all GE deaths and clustering of GE cases i.e. more than 3 cases in a house or a particular locality. The probable cause has to be identified through epidemiological investigations. Water samples are tested from the affected household and the adjacent households from where the cholera case has been reported. In case of focal contamination of water, repair is done by the Delhi Jal Board. Chlorine tablets are distributed or distribution is intensified in the
area; supplies for two weeks is provided to each family at a time. Health education campaigns at the community level are launched or intensified. Correction of insanitary conditions is done by the Conservancy and Sanitary Engineering Department. Food hygiene raids are conducted in the area to destroy unhygienic food. Antibiotic chemoprophylaxis (doxycycline or tetracycline for adults and furazolidone or cotrimoxazole for children) is given to the family contacts of the cholera cases; this has been discontinued since 1999 following a directive of the Union Ministry of Health and Family Welfare.

These measures were implemented rigorously following the epidemic and the incidence of cholera cases reduced briefly. The key to prevention of diarrhoeal diseases – adequate safe water and safe disposal of excreta remain ignored. There were no major programmes to build up infrastructure for the colonies where they were needed most. In the absence of these two key services, the role of these measures remained peripheral at best. The low incidence rate could not be sustained. From 1990, incidence rate began rising despite this elaborate programme. The arrival of *Vibrio cholerae* O139 strain brought incidence rate above the 1988 level and cholera was back in the public health agenda in a major way. The next chapter examines the spatial distribution of cholera in Delhi and explores vulnerability factors at zonal and colony levels.