CHAPTER VII

Cholera and the Urbanisation Process: A Discussion
This study has taken a holistic epidemiological approach using an integrative model that locates biological, environmental and behavioural factors to understand and analyse within a structural framework the time trends of cholera and its determinants in Delhi. Historical methods have proved to be of great relevance in delineating relationships between issues related to population vulnerability that act as determinants of waterborne diseases in general and cholera in particular. Cholera has been viewed as a complexity that represents the interface between biomedical, environmental and social domains. This study encompasses an entire spectrum of analysis beginning from the colonial period, moving on to the early post-Independence period and then to the contemporary period and conducting within them population analysis for cholera prevalence and its determinants. For 1994 onwards, zonal and household level analyses have been conducted to construct a holistic picture.

The analysis of time trends brings out some very important features. During the first pandemic of cholera Delhi was affected for the first time in 1818. Delhi was affected several times from the first to the sixth pandemic. Infection generally reached Delhi either from Punjab or from the United Provinces. Unlike several adjacent states cholera did not become endemic in Delhi. The experience in Delhi was thus one of periodic outbreaks with years of quiescence in between. During the seventh pandemic (current) that began in 1964, Delhi reported its first El tor cases in 1965. Since then, along with few other states, Delhi has emerged among the front runners in terms of endemicity of cholera.

In the post Independence period, 1965-2000 there has been a rising trend in the incidence of cholera (and gastro enteritis) accompanied by a steady decline in deaths. Zero mortality status was attained during the 1990s. Another feature that emerges is the seasonality of cholera. During the earlier pandemics peak incidence of cholera in Northern India was reported during the two monsoon months of July and August. The analysis of the contemporary period establishes that three clear seasonal trends have emerged in Delhi.

- A rising trend during summer
- A steady state during monsoon
- A rising trend during winter since 1994 that coincided with the introduction of the O139 strain.
Macnamara (1876) had made an observation that cholera did not occur during the cold season in Northern India. He also postulated the linkage between rain and cholera in Bengal. Review of the literature of the colonial period shows that cholera was unusual in Northern India during summers as well. In the transformation from an epidemic to an endemic nature, cholera in Delhi has also undergone significant changes in seasonality – it now occurs in winter months as well.

The broad time trends of cholera in India generally correspond with the global trends till the 1920s. Within these broad trends the history of the epidemiology of cholera in India is a history of epidemics generally attributed to events such as religious fairs and famines. The British administration during the second half of the nineteenth century concentrated on containing cholera among the troops. In fact, the sanitary commissioners focussed on wider public health measures only when it was realised that the sanitary and medical security of the military could not end at the gates of the cantonments and that such measures needed to be extended into adjacent urban and rural areas. The implementation of such sanitary measures including water supply and sewage services resulted in a sharp decline in cholera mortality in Presidency towns like Calcutta, Bombay and Madras. However, the slum dwellers in these towns hardly benefited from such measures. Further, the small towns and villages where not covered by such services and continued to remain vulnerable to cholera. It was only in the first half of the twentieth century that provision of piped water supplies began to reach the small towns and the benefits were evident particularly in Bengal and United provinces. It is also significant that the hallmark of the epidemiological trend during the first half of the twentieth century was the story of declining deaths.

Wide spread dissemination of cholera pandemics that had its origins in the Indian subcontinent became a symbol of fear for the West. Religious pilgrimages were identified as a critical determinant for the origin of epidemics in India. Mass bathing at Kumbh and Ardh Kumbh melas at Hardwar and Allahabad the ritual sipping of water and the practise of pilgrims bringing back Ganga water was hypothesised to propagate the infection. Though epidemic increases in cases have been sought to be correlated in literature with these melas careful scrutiny of available data reveals that all fairs did not inevitably result in epidemics.
Some of the increases can be attributed to import of infection from Bengal. There are exceptional years when fairs were held but incidence of cholera remained low. The colonial health administrators held the poor pilgrims at par with the slum dwellers of the industrial towns of Europe as far as reservoir and transmission of diseases was concerned. Till the beginning of the twentieth century it was considered that cholera was inevitable in fairs and pilgrimages and the role of the state was not given due consideration. With the institution of sanitary measures in the fairs cholera declined simultaneously with the Independence movement acquiring steam the colonial administration refrained from associating fairs with the epidemics.

There have been epidemic years in Punjab that do not correlate with fairs. These can be correlated with the famine years in line with Zurbrigg's correlation of famines and deaths due to malaria. Famines and cholera have been closely associated in several epidemics in other parts of India notably Madras Presidency in 1887 and in Bengal in 1942. The absence of major famines has been considered to be one of the crucial causes for reduction in cholera in the early decades of the twentieth century. Cholera disappeared from Europe after 1925 but kept occurring regularly in several Asian countries. In India the declining trend was achieved during the 1950s with dramatic decreases in mortality.

With the arrival of the El tor strain a new pattern began emerging in India. In the early phase of this seventh pandemic cholera outbreaks began to be reported among slum dwellers and poorer populations of the industrial towns. Lack of basic amenities was incriminated as the principal cause in a series of investigations. Delhi along with several other states became new endemic foci and urban centres began to emerge as the new hotspots. India and Bangladesh were majorly affected on account of the introduction of a new strain – *Vibrio cholerae* O139 and an "eighth pandemic" was forecast. It was hypothesised that O139 would replace El tor in the manner that El tor had replaced the classical biotype. This did not happen and the threat of O139 gradually abated.

Following the first El tor cases in Delhi in 1965, though there was a general rising trend for the next two decades, there were no epidemics. The first master plan of Delhi (MPD- I)
aimed at planned development of Delhi and the Delhi Development Authority (DDA) was visualised as the engine for change. The MPD-I was a land management plan and adopted different strategies for areas with different qualities, and aimed to channelise the growth of Delhi. It projected a population of 50 lakhs by 1981 and set urbanisable limits for 1981. The MPD-I was reviewed in 1972-73 and the review commented that development was taking place "in response more to pressures than according to programmes." The 1981 Census reported a population of 62 lakhs. The housing deficit was put at 380,000 up from 150,000 in 1961. Slum population was estimated at 1 million. Extensive unauthorised construction had taken place and commercial activities had infiltrated residential areas. The ridge and the green belt were also compromised and environmental pollution increased. There was a preoccupation with higher income residential areas and beautification of Delhi while low cost housing was neglected.

Great emphasis was placed on slum clearance and relocation of these population groups. The DDA set up 27 resettlement colonies for relocating slum population from different parts of the city during the Emergency period of 1975-77. These resettlement colonies were among the most affected settlements in the 1988 epidemic, which was a landmark in the contemporary phase of the history of cholera in Delhi.

The immediate cause of the epidemic is generally considered to be a break down of service provision during the transition phase of handing over of these colonies from DDA to Municipal corporation of Delhi (MCD). However, there were several intrinsic deficiencies in the resettlement colonies that not only rendered them vulnerable to the epidemic but till date remain endemic for cholera. These colonies were generally located at the periphery of the city on low lying wasteland, often along drains and ditches, that were essentially unsuitable for human habitation. Moreover, in contravention to the caution cited in the Master plan, such colonies were set up in the trans Yamuna area without developing an adequate drainage system. The size of the individual plots was arbitrarily lowered from the initial recommendation of 89 square yards to 25 square yards. The colonies lacked reliable and adequate piped water supply. The minimum standard of public latrines was fixed at one seat for 20–50 persons which in actual practice was often as bad as one seat per 150 persons.
Disposal of solid and liquid wastes in these colonies was grossly inadequate and in turn led to contamination of groundwater. The parallel with earlier historical evidence of cholera being prevalent among poor and infrastructure deficient groups is obvious.

Following the epidemic a series of public health and engineering measures were undertaken. At about the same time the second Master plan (MPD II) was adopted in consonance with the Regional Plan 2001 that envisaged developing the National Capital Region (NCR). Both the plans targeted regulating the growth of commercial activities and population in Delhi by diverting the growth to priority towns within the NCR. The decade of the 1990s was marked by large scale in-migration, further growth of industries, proliferation of slums and unauthorised colonies, shortage of water and electricity and pollution of air and water. The review of the MPD II pointed out the lack of a housing policy and the resultant shortage in housing, leading to the growth of slums and unauthorised colonies. Between 1957 (when DDA was formed) and 2000 Delhi's population increased from 3 million to about 14 million. The 11 million increase consisted of about 5.5 million people in the higher income groups plus economically weaker sections and another 5.5 million people in the "poverty group." During this period DDA had provided for 1 million dwelling units and the private sector (both formal and informal) provided for another 1 million units. The shortfall in housing thus stood at 342,000 units by 2002. The review went on to espouse the cause of the private sector which could build at "six times the rate of the public sector." Relocation of slum clusters again received a boost during the second half of the 1990s but this time the size of the plots was slashed from 25 square yards to 12.5 square yards.

Inadequacies of safe water supplies in vulnerable colonies, sources of potential contamination and the community's reliance on alternative sources much of which is contaminated groundwater emerge as critical issues. The state of the chlorinators of the Delhi Jal Board (DJB) implores one to conclude that to a significant extent cholera in colonies supplied by DJB tubewells (to which these chlorinators are attached) is manmade. This being evidently a managerial failure implies scope for correction and consequent reduction in the disease burden of cholera. While piped water supplies of the DJB is generally safe, illegal tapings and poor maintenance of service pipes by households often lead to focal
contamination. Attempts to enhance household level supply through individual initiative such as use of online booster pumps, further aggravates the risks of contamination.

It is interesting that the Delhi Jal Board has arbitrary standards of calculating requirement by different types of colonies – 270 lpcd for planned colonies, 153 lpcd for regularised colonies and 50 lpcd for unauthorised colonies and other areas. It is a gross violation and undermining of the WHO norms, right at the planning stage with further inadequacies and inequities when it came to actual distribution. According to estimates made by the DJB, 90% of the population is covered by piped water supply. The crucial question is what proportion of this 90% population's demand was met by piped sources of water? The Delhi Urban Environment and Infrastructure Improvement Project has observed that 10% of the population has no piped water supply and 30% has grossly inadequate access. In essence, poverty coupled with settlements with poor infrastructure conditions implied that at least half the population of Delhi did not have access to more than 25 lpcd, and some, even less. Per capita consumption of water in Delhi ranged from 313 lpcd in affluent households to 140 lpcd in relatively less well off households and a meagre 16 lpcd for the slum households. Delhi Cantonment Board and New Delhi Municipal Committee emerge as the most privileged areas with a per capita supply of 509 lpcd and 462 respectively; at the other end of the spectrum, Mehrauli Zone of the Delhi Jal Board has a per capita supply of 29 lpcd only.

Open defecation and/or improperly constructed sanitary latrines in JJ clusters and unauthorised colonies coupled with an acute dependence on untreated groundwater has been crucial to the emergence of these settlements as highly endemic for cholera. The strong association established between 'sanitary' landfill sites and high incidence of cholera in localities that surround them has ominous implications that must be taken into account in future planning processes. Only 55% of the urban population is being served by the sewer system. Most of the trunk sewers are heavily silted and non-functional at places due to poor maintenance. Sewage therefore cannot reach the treatment plants.

The availability of civic services has been more than inadequate for the less privileged. There was inadequate provision of housing, water and sewerage facilities for large numbers of
people who were attracted by the growth of opportunities in the expanding economy of Delhi, particularly in the post liberalisation phase. The growth of the formal sector in Delhi, accompanied by an expanding informal sector, has implied tremendous in-migration. The majority of migrants belong to the lower socio-economic category, and cannot afford housing in planned settlements. It is precisely these population groups that are rendered vulnerable to cholera.

It is in the light of these factors that the trends and issues of vulnerability should be examined. For the period 1994-2000 for which detailed disaggregated data was available it was possible to conduct an extensive analysis of the causal complexity of cholera. Even within this short time interval distinct upward or downward trends in incidence of cholera have been demonstrated among the twelve municipal zones of Delhi. Analysis of the spatial distribution of the notified cholera cases leads to the identification of endemic areas/localities within each of these zones. These are localities that are consistently reporting cholera cases and contributing significantly to the case load of the respective zones.

The determinants of diarrhoeal diseases are complex and intertwined. However, the analysis of distinct zonal trends provides pointers towards the identification of key factors for vulnerability to cholera. These are:

- settlement types
- economic patterns and occupational activities
- provision of civic services
- population density and predominant activities
- characteristics of the residents
- state of the infrastructure in the field

Civil lines and Rohini Zones have relatively lower population densities, higher per capita availability of water (274 lpcd), higher coverage of sewers (60-80%), and yet, report high incidence rates of cholera. Wide disparities in access to services exist among settlements inhabited by different socio-economic classes. Therein lies the explanation why 87% and
80% of the cholera cases from Civil Lines and Rohini Zones respectively, are being reported from the vulnerable colonies of these zones that comprise largely of population groups of low socio-economic status.

Across the River Yamuna, Shahdara (North) Zone and Shahdara (South) Zone demonstrate a strong declining trend in the incidence of cholera. This decline is largely attributable to the commissioning of the Bhagirathi water treatment plant. Per capita water availability is 130 lpcd but lesser disparities within these zones imply that even the poorer sections actually receive far larger quantities of water than in some other zones with higher average availability. However, sewerage services will need to be augmented to fully reap the benefits of added availability of water.

City, Sadar Pahargunj and Karol Bagh Zones have good availability of basic civic services and in particular, availability of sewerage services is high for all segments of the population. Despite being zones with the highest population densities, they have actually experienced a decline in the population growth rate during 1991-2001. The incidence rates of cholera are among the lowest of all the zones reiterating the central role played by safe water and safe disposal of waste in reducing the prevalence of water borne diseases.

The two zones that have demonstrated a definite rising trend in incidence rates are South and Central Zones. In the post-liberalisation period, there has been phenomenal growth of the tertiary and services sector based activities in these zones. The vulnerable colonies of these zones comprise of urbanised villages and unauthorised colonies. The residents of these vulnerable colonies belong to lower middle socio-economic groups, many of them being tenants. Large disparities exist in the availability of water between these vulnerable colonies that get about one-tenth of the rest of the zone. Acute water scarcity and high levels of contamination because of a combination of factors operating at both the colony and household levels have contributed to the rising trend.

Vulnerability factors were further explored through household level studies. Two data sets were analysed for this purpose. The first data set of 1011 notified cholera cases strengthened
and reinforced the zonal and colony level field observations. It confirmed that the low income households in unplanned settlements were the worst affected group. Though the majority had access to piped water supply, mostly at public hydrants, the reliance on a second source to meet the gaps in water demand was significant. Most importantly, the additional source were almost invariably water from shallow handpumps, which has conclusively been proved to be unfit for human consumption. DJB tankers have, in recent years, been deployed in large numbers in some of the vulnerable colonies, and the benefits in terms of decline in incidence of cholera have been evident. It has to be kept in mind that this is not a cost effective and sustainable solution. Increasing income was found to be correlated with access to or ownership of an additional water source, sewerage services, and water storage. In the aggregate, a large proportion of households stored water although there was no significant difference in the decision to store water between households that had continuous supply and those with intermittent water supply.

It has been recognised that the transmission routes of the etiological pathogens for diarrhoea are complex. The debate on evaluating multiple routes of transmission and assessing the impact of an individual determinant continues. Differences of opinion exist on whether the critical determinants are engineering/infrastructural or socio-economic/behavioural in nature. Literature on diarrhoeal diseases has given considerable emphasis on "secondary routes" of transmission. Contamination of stored water has been incriminated as a major risk factor for diarrhoeal diseases across countries. Though it is recognised that all these factors are highly inter-twined, intervention strategies have often focussed on the behavioural issues rather than tackling the larger capital intensive infrastructural problems.

In the light of this debate, the second data set aimed at the exploration of the relative strengths of neighbourhood and behavioural factors for households located in a given socio-economic setting, in explaining incidence of diarrhoeal diseases. One hundred households each were surveyed in three clusters in Shahdara (North) and Shahdara (South) Zones, two of which were JJ clusters and one was a resettlement colony. The infrastructure conditions in the three clusters studied conformed to similarly placed settlements in vulnerable colonies elsewhere. In effect, households had little choice of options with regard to safe water sources.
and toilet facilities in these clusters, since provision of these is determined by the legal status of the settlement. Thus, the water and toilet facilities being accessed by households are invariant to socio-economic factors such as income and educational levels. However, with increasing income, households invest in additional water sources; but owing to lack of options for investing in a safe source, they invariably acquire a handpump or a tubewell (in better off households) which are a source of contamination. The practice of storage is higher in higher income households, and incidence of diarrhoea is higher among households that store water. Despite the availability of a laboratory proven safe source of piped water supply and theoretically correct storage practises, diarrhoea incidence rates were found to be high in all clusters. Higher incidence rates among school going children in these clusters indicate that exposure is higher outside the home. The analysis leads to the conclusion that household level behavioural factors such as storage practises cannot be analysed in isolation as determinants of diarrhoeal illness when pitted against stronger neighbourhood and external determinants that are beyond the control of the individual household.

This study assumes importance and relevance in the context of the third Master Plan of Delhi (MPD III) whose guidelines have been recently published. Intense debates are on as to the possible impact of the MPD III on the already stretched infrastructural services. Stress is being laid on providing efficient infrastructure and adequate growth opportunities in the towns of the National Capital Region, as a way to decongest Delhi. The new proposed floor area ratios are going to add to the increasing population density. The proposed regularisation of industries in residential areas is bound to have adverse environmental health impacts.

The future plans therefore have the "almost impossible task of having to make-up for 40 years of neglect" (Roy 2000). The tasks for immediate improvement include in situ development of the clusters, more equitable distribution of services and expansion of the sewerage network. Given the enormity of the task, it seems to be that the vulnerability factors that have emerged as the determinants of cholera, are here to stay in the foreseeable future, unless our planners take up the challenge and use cholera as a crucial focus for change.