

Assessing Acute Gastroenteritis Risks Associated With Water Quality and Sanitation in Hyderabad City

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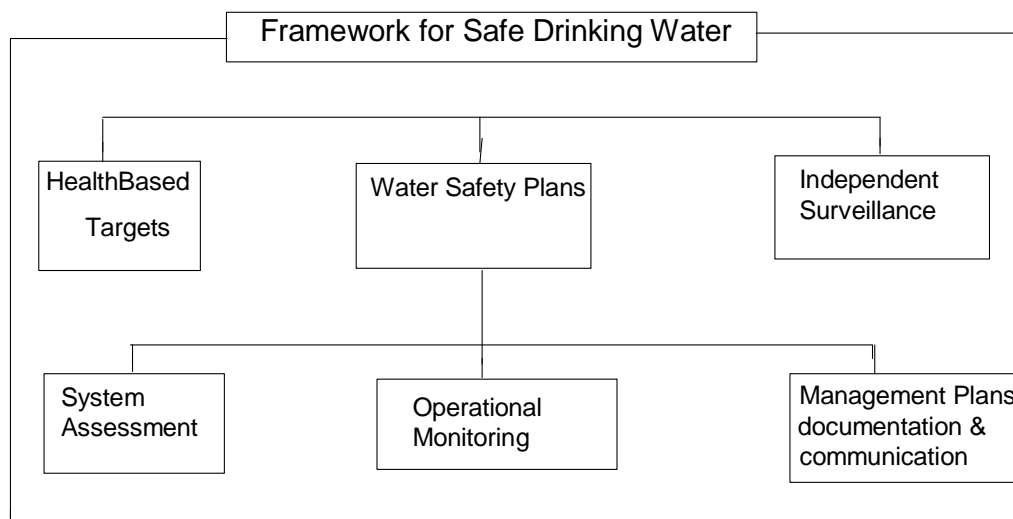
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1. Background of the Study

The quality of drinking water is a vital element of public health and well-being. Poor quality drinking water and inadequate sanitation are among the world's major preventable causes of early mortality, disease and economic burden for individuals and communities. Contaminated water is an important cause of diarrhoeal diseases which kills 2.4 million persons globally, each year (WHO, 2005). According to World Health Organization estimates, diarrhoeal diseases is responsible for about one-fifth of deaths among 'children under five' in the developing countries (WHO, 1997).. Poverty, poor sanitation, lack of sufficient and good quality drinking water, malnutrition, crowded living, lack of access to health care, poor hygienic practices etc., contribute to perpetuation of waterborne diseases. Therefore, strategies to improve water quality, in conjunction with improvements in sanitation and personal hygiene can play a crucial role in interrupting this vicious cycle of waterborne disease epidemics and deliver substantial health gains in the population.

The most effective means of consistently ensuring the safety of a drinking-water supply is through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer (WHO, 2005). World Health Organization guidelines on water quality term these approaches as water safety plans (WSPs). The WSP approach has been developed to organize and systematize a long history of management practices applied to drinking-water and to ensure the applicability of these practices to the management of drinking-water quality. WHO Guidelines for Drinking-water Quality outlines a preventive management framework for safe drinking-water that comprises five components, three of which combine to form the Water Safety Plan (See Figure-I). The WSP is guided by health-based targets and overseen through drinking-water supply surveillance.

Figure-1.1 WHO Framework for Safe Drinking Water



The Hyderabad Metropolitan Water Supply and Sewerage Board (HMWSSB) which caters to the drinking water needs of about 6.5 million people, is in the process of developing pilot WSPs in three sites, in collaboration with the WHO and the USEPA. Each site represents one of the three major modes of water supply in Hyderabad city. In two of the sites-Adikmet and Moinbhag, the HMWSSB is directly providing water to the consumer. Moinbhag in the old city of Hyderabad receives intermittent water supply and has water supply and sewerage systems that were mostly laid about 70 years ago. Adikmet has comparatively newly laid systems with 24X7 water supply. Serilingampalli is an adjoining municipality of Hyderabad and receives bulk water supply from HMWSSB which is then provided to consumers by the Municipal Council.

A key requirement for the development of the WSPs and verification of their successful implementation is the establishment of health based targets. These targets are to be developed taking into account the disease burden in the community, exposures that contribute most to disease and the socioeconomic determinants of exposure to risks. While it is known that the principal risks to human health associated with consumption of unsafe water in these areas are microbiological in nature, there is no reliable data on the disease burden, risk exposure and its determinants, in the selected areas. Currently data on disease burden comes from the public health surveillance system which is based on reporting of cases by major public hospitals and occasional surveys. Hospital surveillance data considerably underestimate the disease burden particularly in the case of enteric diseases which are potentially transmitted through water. For instance; the prevalence of enteric diseases reported by a community based survey conducted in 1996 was 200-fold higher than the estimates arrived from hospital based data (Mohanty et.al., 2002). The reasons for such a large discrepancy can be partly explained by the health seeking behaviour of the people living in Hyderabad and the coverage of the surveillance system. People generally seek treatment from hospitals only if symptoms are relatively serious. Otherwise they either treat themselves or consult local private practitioners. Even when they seek treatment from hospitals considerable number of them approach private hospitals, which are not covered by the surveillance system (Mohanty et.al., 2002). The 60th round of the NSSO survey conducted in 2004 indicate that 80% and 65% of outpatient and inpatient care respectively in urban areas of AP was availed from non-governmental sources (GOI, 2006). Since there is no evidence that the health care utilization pattern in Hyderabad is significantly different from rest of urban AP, majority of cases are therefore unlikely to be captured by the surveillance system.

Epidemiological surveys such as the one cited above provide more reliable data of disease burden and its association with exposure to risks. However no such surveys have been done in Hyderabad in recent times. Further, given the variations in the socioeconomic profile of communities and drinking water system parameters within the HMWSSB service area, there is requirement of generating site specific data which can be compared over a period of time to assess impact of the Water Safety Plan. The Scientific Working Group which was held in Hyderabad to establish Health Based Targets in support of the WSPs,

considered various alternatives by which data on burden due to water-borne diseases and risks associated with them could be collected¹. In the absence of reliable institutional mechanisms to collect the required data, the Group decided that a cross-sectional household survey among a representative sample of population in each of the three project areas was the best option to collect reliable data to support the WSP. Since it did not appear feasible to collect information on different water-borne diseases from a household survey, it was decided that the survey would focus on self reported cases of Acute Gastroenteritis as the major health outcome.

¹ Scientific Working Group on Technical Issues Concerning Water Safety Plans in Hyderabad, Institute of Health Systems, Hyderabad, November 21-22, 2006.

2. Methodology

2.1 Objectives

The overall objective of the survey is to establish baseline information on water quality linked health outcome indicators to guide and evaluate the implementation of the WSPs in the three pilot sites. Specifically, in each of the project areas, the study aims to:

1. Estimate incidence of waterborne disease
2. Estimate intra-household and distribution point prevalence of drinking water contamination
3. Assess relative risk relationship between exposure factors and health outcomes
4. Assess socioeconomic determinants influencing exposure to risks and disease burden

2.2 Survey Population

The target population of the study was household residents in the project areas. A household was defined as a group of persons normally living together and taking food from a common kitchen in accordance with the National Sample Survey Organization (NSSO) of India guidelines. The word “normally” means that temporary visitors were excluded but temporary stay-aways were included. Thus a son or daughter residing in a hostel for studies is excluded from the household of his/her parents, but a resident employee or resident domestic servant or paying guest (but not just a tenant in the house) is included in the employer/host’s household (GOI, 2006)

The Census of India treats households who do not live in buildings or census houses but live in the open on roadside, pavements, in hume pipes, under fly-overs and staircases, or in the open in places of worship, mandaps, railway platforms, etc., as Houseless Households. Such households were also included in the survey. However, Institutional Households which are a group of unrelated persons who live in an institution and take their meals from a common kitchen such as boarding houses, messes, hostels, hotels, rescue homes, jails, ashrams, orphanages, etc., were excluded from the survey.

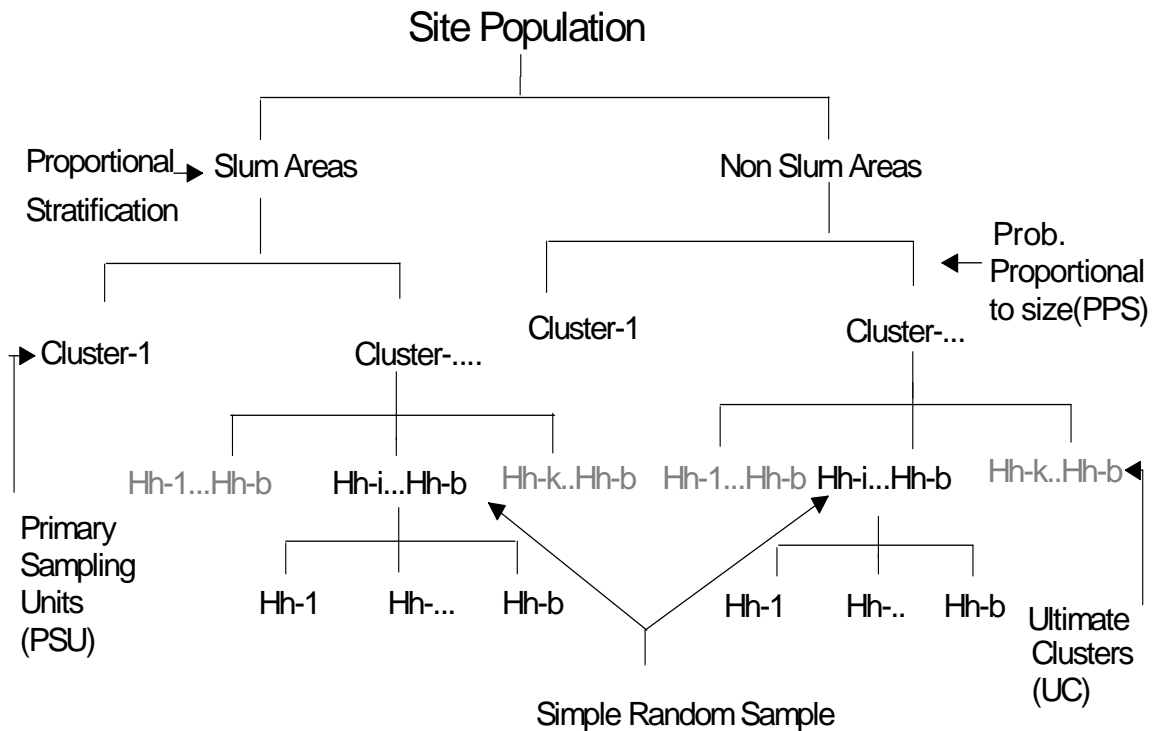
2.3 Sampling Scheme

Each of the project sites had clearly demarcated slum and non-slum areas. The objective of sampling was to ensure a representative sample from the two strata. Simple random sampling of households, within respective strata was not feasible, since each stratum consisted of a sizeable population. A feasible approach was to sample clusters within respective strata. Here again sampling frames of ultimate clusters were not readily available. Ultimate clusters of households were therefore selected from primary sampling units within respective strata. Census Enumeration Blocks (EB) was used as primary sampling units. The EBs was formed for the 2001 decennial census. Each village or urban area has an integral number of enumeration blocks. The average size of an EB is around 125 households. Accordingly each of the project areas covered about 140-150 EBs. The Registrar General of India (RGI) has master census abstracts (MCA) for each EB. In addition, rough sketches

showing the boundary of each EB, prominent landmarks and the layout of all census houses within the EB, were available with the respective state Director of Census Operations, working under the RGI. The primary census abstract (PCA) published by the RGI are based on aggregates computed from the MCA of EBs in a village or urban area.

A list of the EBs in each of the project areas was sought from the RGI, along with an extract containing identification information, total population and number of households in each EB and a copy of the rough sketches of the EBs. The Enumeration Blocks were classified into slum and non-slum strata based on identification information and landmarks in the rough sketches and consultation with RGI and HMWSSB officials. A total of 20 Enumeration Blocks were randomly selected from each project area based on proportional stratification of EBs into slum and non-slum EBs. The information about total population further allowed for random selection of clusters based on probability proportionate to size (PPS). A current list of households in each EB was prepared by door to door survey in each of the selected EB. This updated house list formed the sampling frame for selection of the ultimate cluster of households. 25 households were selected by simple random sampling from the updated house list.

Figure-2: Overview of Sampling Strategy



Hh= Household,
 b=Ultimate cluster size
 Greyed representation means hypothetical sub samples of the chosen cluster, representing the set of ultimate clusters.

2.4 Estimation of Sample Size

In order to compute the sample size, we needed to specify certain statistical decision rules, such as the maximum tolerable type-1 error and required precision. In addition we had to specify provisional estimates of some of the key parameters that were being studied. We estimated required sample size based on an assumed incidence rate of waterborne diseases (2) prevalence of intra-household contamination of drinking water and (3) prevalence of source point contamination of drinking water supply.

1. Sample size estimation based on assumed incidence of gastroenteritis

Very few studies were available to facilitate an estimation of incidence of waterborne diseases in the selected sites. A cross-sectional survey among 3573 households in Hyderabad done by Mahanty et.al (2002) reported a mean incidence of 37.39 cases of gastroenteritis per 1000 population, during a period of one month prior to the survey. However there are 4 additional factors had to be considered before we assumed a rate based on the aforesaid study for estimation of sample size. They included: (1) trends in waterborne disease incidence in Hyderabad (2) seasonal variation in waterborne diseases in Hyderabad (3) intra-city variation in waterborne diseases incidence rate and (4) the period of recall, the present survey is proposing to collect the data

It was necessary to assume a conservative estimate of incidence during a specified period to reasonably estimate actual incidence of waterborne diseases in the project sites. The Mohanty et.al., survey was done between 30th November and 20th December 1996 and collected data on incidence of waterborne diseases in the household within a period of 30 days prior to the interview. Given our understanding that the principal risks to human health associated with consumption of unsafe water in these areas are microbiological in nature, trends in gastroenteritis incidence appear to be a reasonable indicator of trends in waterborne diseases. Surveillance data do not indicate any significant decline in gastroenteritis trends in the years subsequent to the survey. Seasonality of gastroenteritis in Hyderabad has been well established and historically, the incidence of gastroenteritis is lowest in the months of November and December, the period corresponding to the survey (Mahapatra and Reddy 2001). Two of the project sites (Adikmet and Moinbagh) fall in zones that reported a rate higher than the mean incidence rate². Taking the above into consideration, the mean incidence rate reported by the survey appears to be a conservative estimate and hence do not require any adjustments on account of the first three factors mentioned above. However the fourth factor, i.e., the period of recall which the present survey is proposing to collect the data has implications for the assumed incidence rate. Similar surveys have adopted a recall period ranging from one week to a month. *Ceteris paribus*, a smaller recall period will mean a larger sample size. However when the incidence of gastroenteritis is significantly high as is assumed in the case of the project areas, there is a likelihood of greater “recall bias”. To minimize the recall bias a one week recall period for the current survey was proposed. Since the study design includes cluster sampling, the effect of the cluster design must be factored in to the sample size. The design effect (*D*) is the ratio of variance of the estimate obtained

²The third site Serilingampalli was not included in the survey

through cluster sampling and variance of the same estimate obtained from an equal sized simple random sample. The design effect is usually greater than one and denotes the factor by which the sample size calculated under simple random sampling scheme needs to be increased to keep the desired precision unchanged, while adopting a cluster sampling scheme. The NFHS-2 survey in India selected enumeration blocks as the primary sampling units in urban areas with probability proportionate to size, followed by systematic sampling of 30 households within each sampling unit. In the survey, the design effect estimated for the parameter “children under 3 years with diarrhoea in the past 2 weeks” for urban areas of AP was 1.026 (IIPS and ORG Macro, 2000). However unlike the NFHS-2, the present study proposes to collect similar information for all members of the selected household. Given that gastroenteritis is likely to cluster within a household we assume a higher design effect of 1.5.

Sample size calculations based on the statistical decision rules discussed is given in the table below. Under a simple random sampling scenario which accepts a 5% type-1 error corresponding to 95% level of confidence and assumes a confidence limit of about $\pm 20\%$ around the incidence rate, the survey requires to cover about 4958 individuals in each of the project site. The average household size in Hyderabad Municipal Corporation area as per the 2001 Census is 5.5 (GOI, 2003). This would mean that the survey would have to cover approximately 900 households. After taking into consideration the design effect of 1.5 due to cluster sampling, the sample required will be 1344 households.

2. Sample size estimation based on assumed prevalence of intra-household contamination

Routine monitoring done by the IHS for the HMWSSB indicates that 43.6% of the household stored water samples were contaminated by pathogenic bacteria (IHS, 2006). Findings of an unpublished study done through the Institute reporting that 38.5% of the stored water samples were contaminated (Eshcol, 2006). We therefore assume that the prevalence of intra-household contamination of drinking water in the project sites will be about 35%. Given the high prevalence rates assumed we assume smaller confidence intervals of $\pm 15\%$ and $\pm 10\%$. Other statistical decision rules remain same as that for sample size estimation based on the other 2 parameters. Depending on the confidence interval assumed, a sample of 480 or 1080 households will be then required for the study.

3. Sample size estimation based on assumed prevalence of source point contamination

Routine monitoring done by the IHS for the HMWSSB between Feb 2005 and Feb 2006 indicate that 1.5% of the piped water samples were contaminated (IHS, 2006). We therefore assume that the prevalence of source point contamination of drinking water in the project sites will be about the same. Assuming a confidence interval of $\pm 20\%$, 5% error and a design effect of 1.5, we require a sample size of 9456 households.

Table 2.1: Sample Size Estimates based on Assumed (1) Incidence of Gastroenteritis (2) Prevalence of Intra-Household Contamination of water and (3) Prevalence of source-water contamination

Statistical Decision Rule	Parameter	Estimation Basis			
		Incidence of Gastroenteritis	Prevalence of intra-household contamination	Prevalence of source contamination	
Assumed estimate of parameter	p	0.019	0.35	0.35	0.15
Required confidence interval in % plus or minus from the underlying point estimate	±	20%	10%	15%	20%
Required confidence bound on the plus and minus side, computed in terms of interval for prevalence.	±	0.002	0.035	0.0525	0.003
Width (Length) of the confidence interval	L	0.004	0.07	0.105	0.006
Level of acceptable type-1 error	α	5%	5%	5%	5%
Two tailed Z value corresponding to 95% statistical confidence	Z	1.959	1.959	1.959	1.959
Assumed true variance of the sampling distribution [$p*(1-p)$]	σ^2	0.0099	0.2275	0.2275	0.0148
Required Simple Random Sample Size ¹	$n = (4 * \sigma^2 * Z^2) / L^2 =$	4958			
Design Effect	D	1.5	1.5	1.5	1.5
Average Household Size ²		5.5			
Required sample size of households ³		1344	1080	480	9456

Bernard Rosner 4th Ed p225, Formula 7.31. Sample size estimation based on confidence interval width. RGI, Census of India, 2001. Average household size in area under Municipal Corporation of Hyderabad Rounded off to the nearest cluster size of 24

Greater the sample size, greater will be the precision of estimates of the various parameters. A sample size of 1500 households comprising of 500 households per site was fixed for the study. Choice of sample size was determined by budget constraints.

2.5 Interview and Filling in Respondent Survey Form

A questionnaire was administered to an adult household member after obtaining informed consent. The questionnaire was designed to obtain information on the following:

1. Household characteristics including: number of people in household; ages of household members; education levels and general socioeconomic characteristics.
2. Acute Gastroenteritis Episodes: The respondent was requested to recall Acute Gastroenteritis episodes, if any, of all household members within a one week recall period. For each episode, information about symptoms, signs, medical attendance etc were collected. Recall was aided by a prompt list of symptoms.

3. Hygiene and Sanitation including: hand washing practices; accessibility of toilet facility; food storage practices and practices regarding use of spoiled food; outside eating habits; cleaning practices for utensils; cleaning agents for utensils; laundry practices, status of sewage in the vicinity of household etc
4. Water use practices including: water source type and access; drinking water source used when away from home; water storage practices; water treatment practices; perception of water quality etc.

2.6 Case Definition of Acute Gastroenteritis

The case definition of acute gastroenteritis was based on self-reporting and as used in this report was:

- diarrhoea three or more times in a 24-hour period

OR

- bloody diarrhoea

OR

- vomiting together with at least one other symptom (diarrhoea, abdominal pain/cramps, fever)
 - in the four weeks prior to the interview
 - in the absence of a known non-infectious cause

Respondents were excluded if they considered their symptoms to be due to non-infectious causes of diarrhoea or vomiting such as Crohn's disease, ulcerative colitis, excess alcohol, pregnancy, menstruation, or medication known to cause vomiting (e.g. chemotherapy).

2.7 Collection of Water Sample from Households

During the household visits, the participants were asked to offer some drinking water. 100 ml of water was collected directly from the tumbler offered. It was assumed that the sample will be representative of the water being consumed by the household and the water testing will be able to detect contamination, regardless of whether the contamination occurred at the source, during transit, or during storage. The samples were collected from the households in pre-sterilized bottles at the end of the interview, placed in an ice box with ice packs during transport, and refrigerated in the laboratory until they were analyzed. The required tests were performed at the IHS Water Quality Testing Laboratory on the same day as water sample collection.

A second sample was collected from the source from which the household collects drinking water. If the household had a water supply connection, then the sample was collected at the point of delivery of municipal water to the household. This may be a directly available municipal tap or a tap leading to a sump or an overhead tank. If the household collects water from a street tap, information about the location of tap was obtained and a sample collected from there.

2.8 Laboratory Testing

Given that coliform bacteria and E.coli are the most common microbial contaminants of water in these areas, the water samples were tested for presence of the same. Samples were tested by a standard plate count method using “CHROMagar” as the media. CHROMagar is a chromogenic agar which differentiates between E.coli and other coliforms. The method can enumerate E. coli and total coliform in a single test and report results in CFU/100 ml which will be useful for quantifying human exposure to pathogens and risk characterization to determine probability of infection. Plates were incubated for 24 hours between 37 -44⁰ C. E.coli was identified by blue colonies and other coliforms by mauve colonies. Number of colonies were counted under a colony counter and results reported in colony forming units per ml (CFU/ml).

3. Key Findings

3.1 Coverage of Survey

The survey covered 60 out of 176 Enumeration Blocks in the 3 sites. 25 households were surveyed in each Enumeration Block. 1500 out of the 14538 households in the sites were covered by the survey. In Adikmet and Serlingampally 35% of the households were from slums, whereas in Moinbagh 50% of the households surveyed were from slums. The average household size in the survey was 4.5. In slum areas the average household size ranged from 5.46 in Moinbagh to 3.92 in Serlingampally. In non-slum areas it ranged from 5.18 in Moinbagh to 3.95 in Serlingampally.

Table 3.1: Coverage of the Survey in the Three Sites

Site Particulars	Adikmet			Moinbagh			Serilingampally			All sites
	Slum	Non Slum	Total	Slum	Non Slum	Total	Slum	Non Slum	Total	
Total No. of Enumeration Blocks	20	42	62	33	34	67	17	30	47	176
Total No. of EBs selected for the study	7	13	20	10	10	20	7	13	20	60
Total No. of Households in selected EBs	747	1643	2390	2772	3206	5978	2267	3903	6170	14538
Total No. of Households selected for survey	175	325	500	250	250	500	174	326	500	1500
Total population covered by survey	785	1325	2110	1366	1296	2662	698	1279	1977	6749
Average household size	4.48	4.07	4.22	5.46	5.18	5.32	4.01	3.92	3.95	4.5

3.2 Demographic Profile

About 46.5% of the population covered in the survey was female. Around 7% of the household members covered were in the under 5 age group and around 3% in the 65+ age group.

Table 3.2: Demographic Profile of the Study Households

Age Group	Adikmet				Moinbhag				Serilingampalli				Total S+NS
	Slum	Non Slum	Slum	Non Slum	Slum	Non Slum	Slum	Non Slum	Slum	Non Slum	Slum	Non Slum	
N	384	401	627	698	602	764	594	702	338	360	604	675	6749
	%F	%M	%F	%M	%F	%M	%F	%M	%F	%M	%F	%M	(M+F)
<5	4.95	8.48	6.06	5.44	9.3	5.76	7.58	5.56	8.88	9.17	6.62	6.67	6.83
	39.06	32.67	33.01	30.8	42.36	48.95	44.11	41.45	38.76	38.06	35.93	32.59	38.37
25-44	35.42	34.66	37.32	37.54	34.22	28.66	33.84	31.77	41.12	37.22	39.57	39.11	35.50
45- 64	17.71	21.7	19.14	20.06	12.46	13.87	12.63	19.52	8.28	13.89	16.06	18.52	16.42
65 +	2.86	2.49	4.47	6.16	1.66	2.75	1.85	1.71	2.96	1.67	1.82	3.11	2.87

3.3 General Household Characteristics

About 61% of the households in slum areas lived in pacca³ houses. 26.5% and 12.5% of slum dwellers lived in semi-pacca and kachha houses respectively. In non slum areas about 90% of households lived in pacca houses, 7% in semi pacca houses and 3% in kachha houses. About 63% and 65% of slum and non slum households lived in their own houses.

Table 3.3: Housing Characteristics of Study Households

Area	Adikmet				Moinbhag				Serilingampalli			
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	175	%	325	%	250	%	250	%	174	%	326	%
Type of House												
Pacca	106	60.57	294	90.46	131	52.40	218	87.20	128	73.56	303	92.94
Semi Pacca	35	20.00	28	8.62	108	43.20	22	8.80	16	9.20	10	3.07
Kachha	34	19.43	3	0.92	11	4.40	10	4.00	30	17.24	13	3.99
Ownership of House												
Own	121	69.14	202	62.15	170	68.00	178	71.20	87	50.00	208	63.80
Rented	54	30.86	123	37.85	80	32.00	72	28.80	87	50.00	118	36.20

Overall, about 62% of households in slums and 74% of households in non-slums have a separate room in the house which is used as a kitchen. However in Adikmet slum households, about 70% do not have a separate kitchen. Cooking gas is the main type of fuel used in both slum (79%) and non slum (96%) households. In slums about 20% of households use kerosene as the main type of cooking fuel as compared to 4% of households in non slum areas. In Moinbhag slum around 35% of households rely on kerosene.

Table 3.4 : Cooking Characteristics of Survey Households

Area	Adikmet				Moinbhag				Serilingampalli			
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	175	%	325	%	250	%	250	%	174	%	326	%
Normal Place of Cooking												
In a room of the main house	121	69.14	47	14.46	39	15.60	96	38.40	62	35.63	83	25.46
In a separate room used as kitchen	51	29.14	270	83.08	210	84.00	153	61.20	110	63.22	243	74.54
Others	3	1.71	8	2.46	1	0.40	1	0.40	2	1.15	0	0.00
Main Type of Fuel Used												
Gas	152	86.86	311	95.69	163	65.20	231	92.40	158	90.80	322	98.77
Kerosene	18	10.29	13	4.00	86	34.40	16	6.40	14	8.05	4	1.23
Wood	3	1.71	1	0.31	0	0.00	2	0.80	5	2.87	0	0.00
Others	0	0.00	0	0.00	0	0.00	1	0.40	0	0.00	0	0.00

³ Pacca houses have brick or stone walls, RCC/tiled roof and stone floor. Semi Pacca houses have mud or brick walls, thatched/metal sheet roof and mud/stone floor. . Kachha houses are made of mud or thatched walls with thatched roof and mud floor.

3.4 Water Use Practices

Primary Source of Drinking Water:

Metro domestic connection is the major source of drinking water, both in slum and non slum households. About 77% of non slum households and 53% of slum households depend on metro domestic connections for their drinking water requirements. About 33% of slum households and 20% of non slum households depend on pit taps for drinking water. Pit taps are illegal pipe connections established by residents by digging a pit and directly tapping into the underground main pipe lines in areas where there is low pressure in the supply system. Reliance on pit taps was comparatively higher in Moinbhag (39.6%) and Serilingampalli (41.38%) slums. In slum areas there is more reliance on other public water sources such as public stand posts, public bore-wells and public tankers. This is especially the case in Serilingampalli slum households where only about 30% of households have domestic water connections. Few households had their own borewells.

Table 3.5: Distribution of Study Households by Primary Source of Drinking Water.

Area	Adikmet				Moinbhag				Serilingampalli			
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
Source	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Metro Domestic	149	85.14	301	92.62	118	47.20	164	65.60	51	29.31	225	69.02
Public Stand Post	0	0	1	0.31	13	5.20	1	0.40	8	4.60	8	2.45
Pit Tap	25	14.29	23	7.08	99	39.60	69	27.60	72	41.38	91	27.91
Public Bore well	0	0	0	0	0	0	1	0.40	15	8.62	0	0
Public Tanker	0	0	0	0	0	0	0	0	25	14.37	0	0
Own Bore well	1	0.57	0	0	7	2.80	15	6.00	2	1.15	2	0.61
Others	0	0	0	0	13	5.20	0	0	1	0.57	0	0
Total	175		325		250		250		174		326	

Frequency of Drinking Water Supply:

Though Adikmet was expected to have 24X7 water supply only about 30% of the non slum households and 3% of the slum households received round the clock water supply. However compared to other sites, more slum households (49.14%) and non slum households (70%) received daily water supply at fixed timings. While about 79% of slum households in Moinbhag received water at fixed timings on alternate days only 34% in non slum households received water at fixed timings. About 19% of the households received erratic water supply. Frequency of erratic water supply was high in Moinbhag non slum (50%) and Serilingampalli slum (44%) areas.

Table 3.6: Frequency of Drinking Water Supply in Study Households

Frequency of Water Supply	Adikmet				Moinbhag				Serilingampalli			
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	175	%	325	%	250	%	250	%	174	%	326	%
Round the clock	5	2.86	95	29.23	0	0.00	0	0.00	0	0.00	0	0.00
Fixed timing, daily	86	49.14	207	63.69	2	0.80	2	0.80	0	0.00	0	0.00
Fixed timing, Alternate Day	84	48.00	23	7.08	197	78.80	85	34.10	33	18.97	284	87.12
Erratic	0	0.00	0	0.00	51	20.40	125	50.20	76	43.68	31	9.51
Others	0	0.00	0	0.00	0	0.00	37	14.90	65	37.36	11	3.37

Drinking Water Storage:

Households use multiple vessels for storing of drinking water. About 7% of the households store water in overhead storage tanks. Pots, buckets, jerry cans, small bottles and pans are commonly used utensils for water storage.

Table 3.7 Containers Used for Storage of Drinking Water

Containers	Adikmet				Moinbhag				Serilingampalli			
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	175	%	325	%	175	%	325	%	174	%	326	%
Tap water from overhead storage	26	14.86	69	21.23	2	0.80	7	2.80	1	0.57	2	0.61
Buckets	92	52.57	116	35.69	74	29.60	138	55.20	106	60.92	152	46.63
Pots	83	47.43	290	89.23	240	96.00	227	90.80	161	92.53	305	93.56
Jerry can	33	18.86	54	16.62	149	59.60	93	37.20	46	26.44	101	30.98
Bottles	62	35.43	222	68.31	129	51.60	100	40.00	80	45.98	198	60.74
Barrel/Drum	31	17.71	18	5.54	133	53.20	189	75.60	115	66.09	205	62.88
Small pans	62	35.43	73	22.46	119	47.60	85	34.00	68	39.08	150	46.01
Others	2	1.14	3	0.92	0	0.00	0	0.00	0	0.00	3	0.92

In 87% of the households all the drinking water storage vessels were covered. In 13% of the households some of the vessels were not covered. Comparatively more uncovered storage vessels were found in slum households.

Table 3.8 Status of Covering for Storage Containers

Covering for Container	Adikmet				Moinbhag				Serilingampalli			
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	175	%	325	%	175	%	325	%	174	%	326	%
All covered	151	86.29	309	95.08	200	80.00	223	89.20	134	77.01	289	88.65
Some covered	22	12.57	13	4.00	50	20.00	27	10.80	39	22.41	37	11.35
None covered	2	1.14	3	0.92	0	0.00	0	0.00	1	0.57	0	0.00

Perception Regarding Quality of Water Supplied:

Overall about 50% of both slum and non slum respondents felt that it was safe to drink water supplied without any treatment. About 37% felt that it was not safe to drink water without treatment. Comparatively more respondents in slum areas of Moinbhag (58%) and non slum areas of Serilingampalli (47%) felt that the water was not safe for drinking without treatment.

Table 3.9 Perception Regarding Quality of Water Supplied

Perception	Adikmet				Moinbhag				Serilingampalli			
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	175	%	325	%	175	%	325	%	174	%	326	%
Safe to drink without treatment	122	69.71	159	48.92	59	23.60	152	60.80	122	70.11	138	42.33
Not safe to drink without treatment	22	12.57	95	29.23	144	57.60	98	39.20	51	29.31	153	46.93
Do not know	31	17.71	71	21.85	47	18.80	0	0.00	1	0.57	35	10.74

Water Treatment Status

About 60% of households in slum and non slum areas adopt some mechanism of treatment of water before consumption. Comparatively more households in Moinbhag and slums of Serilingampalli do not treat water.

Table 3.10 Status of Water Treatment in Household

Treatment Status	Adikmet		Moinbhag				Serilingampalli					
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	175	%	325	%	175	%	325	%	174	%	326	%
Treat water	135	77.14	211	64.92	146	58.40	140	56.00	76	43.68	215	65.95
Do not treat	40	22.86	114	35.08	103	41.20	110	44.00	98	56.32	111	34.05

About 52% of the total households adopting a water treatment process use candle type filters for water purification. About 18% of households boil water before consumption. Around 12% of the household use a net sieve and 4% use Zero B filter attached to a tap for filtering water. Proportion of households using the aforesaid processes is more or less the same in slum and non slum areas. While use of bleach/chlorine is negligible in non slum areas about 11% of slum households treat water using chlorine liquid or tablets. Use of chlorine for water treatment is especially high in slum areas of Moinbhag (40%). About 11% of the non slum households adopting a water treatment process used Aquaguard type purifiers based on ultra filtration and ultra violet purification. Usage of the same was very limited in slum areas.

Table 3.11: Distribution of Households According to Water Treatment Process Adopted

Process	Adikmet		Moinbhag				Serilingampalli					
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	135	%	211	%	146	%	140	%	76	%	215	%
Boil	9	6.67	15	7.11	38	26.03	20	14.29	23	30.26	81	37.67
Add Bleach/ Chorine	0	0	4	1.90	58	39.73	1	0.71	3	3.95	1	0.47
Candle Type Filter	104	77	134	63.51	70	47.95	109	77.86	39	51.32	98	45.58
Aqua Guard	3	2.22	50	23.70	2	1.37	1	0.71	3	3.95	14	6.51
Zero B Filter	9	6.67	12	5.69	5	3.42	9	6.43	1	1.32	2	0.93
Net sieve	19	14.1	19	9.00	36	24.66	11	7.86	11	14.47	28	13.02
Others	2	1.48	3	1.42	0	0.00	0	0.00	0	0.00	3	1.40

Retrieving Water from Storage Container

Over 60% of the households, both in slum and non slum areas have a utensil reserved for retrieving water from the storage containers. However, about 36% of the slum households and 31% of the non slum households use the same utensil used for drinking to retrieve water from the storage container.

Table 3.12: Utensil Used to Retrieve Water from Storage Container

Utensil	Adikmet				Moinbhag				Serilingampalli			
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	175	%	325	%	175	%	325	%	174	%	326	%
Container has Tap	3	1.71	54	16.62	4	1.60	20	8.00	11	6.32	29	16.67
Long handed utensil reserved for retrieving water	104	59.43	65	20.00	19	7.60	50	20.00	24	13.79	84	48.28
Other utensil reserved for retrieving water	4	2.29	26	8.00	97	38.80	28	11.20	48	27.59	133	76.44
Same utensil used to drink	18	10.29	48	14.77	10	4.00	58	23.20	41	23.56	23	13.22
Pouring	46	26.29	131	40.31	120	48.00	94	37.60	50	28.74	57	32.76
Others	0	0.00	1	0.31	0	0.00	0	0.00	0	0.00	0	0.00

Periodicity of Cleaning Storage Containers

Over 63% and 30 % of the households reported that they clean their storage containers once in 2-3 days and daily, respectively. About 7% of households reported that they clean their containers weekly.

Table 3.13: Periodicity of Cleaning Storage Containers

Periodicity	Adikmet				Moinbhag				Serilingampalli			
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	175	%	325	%	175	%	325	%	174	%	326	%
Daily	119	68.00	181	55.69	10	4.00	42	16.80	24	13.79	73	22.39
Once in 2-3 days	51	29.14	135	41.54	235	94.00	173	69.20	117	67.24	238	73.01
Weekly	5	2.86	8	2.46	5	2.00	35	14.00	33	18.97	15	4.60
Once in several weeks	0	0.00	1	0.31	0	0.00	0	0.00	0	0.00	0	0.00

3.5 Hygiene and Sanitation Practices

Hand Washing Practices

Respondents were asked when it was necessary to wash hands with soap. Overall, 97% of the respondents felt that it was necessary to wash hands with soap before eating. About 67% respondents felt that it was important to wash hands before preparing food. About 69% felt that washing hands with soap was important after defecation. However, only 35% of respondents from slums of Adikmet perceived hand washing with soap to be important after defecation.

Table 3.14 Respondents Perception Regarding When to Wash Hands with Soap

Perceptions	Adikmet				Moinbhag				Serilingampalli			
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	175	%	325	%	175	%	325	%	174	%	326	%
Before preparing food/cooking	41	23.43	229	70.46	208	83.20	165	66.00	125	71.84	236	72.39
Before eating	163	93.14	307	94.46	247	98.80	245	98.00	172	98.85	322	98.77
Before feeding children	17	9.71	53	16.31	13	5.20	35	14.00	1	0.57	15	4.60
After cleaning /changing child	14	8.00	51	15.69	30	12.00	15	6.00	11	6.32	14	4.29
After defecating	61	34.86	224	68.92	206	82.40	168	67.20	132	75.86	239	73.31
Don't know	0	0.00	6	1.85	0	0.00	1	0.40	0	0.00	0	0.00
Other	2	1.14	2	0.62	0	0.00	3	1.20	1	0.57	1	0.31

Practices Regarding Left-Over Food

About 60% of slum residents said that they would store left over food in a container, compared to 37% of the non slum respondents. While about 40% of the non slum respondents said that they will store left over food in a fridge, only 29% of respondents from slum said that will do the same. However, about 47.5% of the respondents from Adikmet slum said that they would store left over food in the fridge. 19% of non slum respondents said that they will throw away left over food compared to 8% of respondents from slums

Table 3.15 Household Practices Regarding Left-Over Food

Practices	Adikmet				Moinbhag				Serilingampalli			
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	175	%	325	%	175	%	325	%	174	%	326	%
Store in a container	54	30.86	75	23.08	176	70.40	119	47.60	126	72.41	143	43.87
Store in a fridge	83	47.43	166	51.08	62	24.80	75	30.00	31	17.82	111	34.05
Give away	13	7.43	18	5.54	2	0.80	15	6.00	3	1.72	9	2.76
Throw away	25	14.29	66	20.31	10	4.00	41	16.40	14	8.05	63	19.33

Laundry Practices

65% and 49% of slum and non slum households respectively wash clothes in the back yard. About 13% of the households use the front yard for washing clothes. 31% of non slum households wash clothes in bathrooms compared to 18% of slum households. About 7% of non slum households rely on dhobis for washing clothes compared to 3 % slum households.

Table 3.16 Household Practices Regarding Washing of Clothes

Practices	Adikmet				Moinbhag				Serilingampalli			
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	175	%	325	%	175	%	325	%	174	%	326	%
In the bath room	36	20.57	142	43.69	50	20.00	49	19.60	17	9.77	88	26.99
In the back yard	103	58.86	149	45.85	179	71.60	129	51.60	109	62.64	165	50.61
Out in front	35	20.00	18	5.54	18	7.20	53	21.20	33	18.97	42	12.88
Give to dhobi	1	0.57	15	4.62	3	1.20	19	7.60	15	8.62	31	9.51
Others	0	0.00	1	0.31	0	0.00	0	0.00	0	0.00	0	0.00

Practices Regarding Cleaning Utensils

37% and 71% of slum and non slum households respectively clean utensils in the kitchen. 25% of non slum clean utensils in backyard compared to 54% of slum households. About 7% of slum households clean utensils in the bathroom compared to 3% non slum households. Almost 99% of households use detergent for cleaning utensils. The remainder use mud or domestic ash.

Table 3.17 Household Practices Regarding Cleaning Utensils

Practices	Adikmet				Moinbhag				Serilingampalli			
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	175	%	325	%	175	%	325	%	174	%	326	%
In the kitchen	54	30.86	279	85.85	95	38.00	151	60.40	73	41.95	207	63.50
In the bath room	17	9.71	7	2.15	14	5.60	12	4.80	10	5.75	8	2.45
In the back yard	96	54.86	37	11.38	140	56.00	84	33.60	84	48.28	103	31.60
Out on the road	4	2.29	0	0.00	0	0.00	2	0.80	4	2.30	4	1.23
Others	2	1.14	0	0.00	0	0.00	1	0.40	3	1.72	4	1.23

Toilet Facilities

With the exception of 4 slum households in Serilingampalli who carry out defecation in nearby bushes, all other households used a toilet facility. About 84% and 11% of slum households used Pour Flush and Auto Flush WCs respectively, compared to 11% and 33% by non slum households. About 4% of households used other types of toilets like pit latrines.

Table 3.18 Type of Toilet Used by Households

Type of Toilets	Adikmet				Moinbhag				Serilingampalli			
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	175	%	325	%	175	%	325	%	170	%	326	%
Pour Flush WC	134	76.57	158	48.61	214	85.60	221	88.40	150	88.23	201	61.66
Auto Flush WC	14	8.00	142	43.69	36	14.40	29	11.60	18	10.58	125	38.34
Others	27	15.43	25	7.69	0	0.00	0	0.00	2	1.18	0	0.00

About 70% of non slum households have toilets inside their dwellings compared to 48% slum households. 40% of slum households have toilets elsewhere in premises compared to 24% non slum households. About 7% households use toilets outside their premises. 1.6% of households, primarily slum households in Adikmet use public toilets.

Table 3.19 Location of Toilets Used by Households

Location of Toilets	Adikmet				Moinbhag				Serilingampalli			
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	175	%	325	%	175	%	325	%	170	%	326	%
Inside, attached to dwelling	117	66.86	233	71.69	107	42.80	139	55.60	64	37.65	254	77.91
Elsewhere in Premises	31	17.71	65	20.00	129	51.60	87	34.80	81	47.65	63	19.33
Out side premises	9	5.14	22	6.77	13	5.20	24	9.60	25	14.70	9	2.76
Use public toilet	18	10.28	5	1.54	1	0.40	0	0.00	0	0.00	0	0.00

Sewerage System

About 95% of households have an underground drainage connected to the city's sewerage system. Around 3% of the slum households and less than 1% of non slum households have an open drainage system. About 10% of the non slum households in Serilingampalli have their own septic tanks. In about 1% of slum households, sewerage system was blocked and overflowing.

Table 3.20 Type of Sewerage System

Sewerage System	Adikmet				Moinbhag				Serilingampalli			
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	175	%	325	%	175	%	325	%	170	%	326	%
Open Drainage	9	5.14	5	1.54	5	2.00	0	0.00	3	1.72	0	0.00
Under Ground Drainage	165	94.29	315	96.92	243	97.20	250	100	168	96.55	281	86.20
Own septic tank	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	34	10.43
Don't Know	1	0.57	5	1.54	2	0.80	0	0.00	3	1.72	11	3.37

Sanitary Status

About 7.5% of households in slums and 4.5 % households in non slums had visible animal or human excreta in the household premises.

Table 3.20 Sewerage Status in Study Households

Visible Excreta in Premises	Adikmet				Moinbhag				Serilingampalli			
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum	
N	175	%	325	%	175	%	325	%	170	%	326	%
Yes	13	7.43	21	6.46	11	4.40	17	6.80	20	11.49	3	0.92
No	162	92.57	304	93.54	239	95.60	233	93.20	154	88.51	323	99.08

3.6 Quality of Water

Overall, 13.33% household source water samples were contaminated with coliforms. E.Coli was isolated in 4.33% of the household source water samples. With exception of Moinbhag, prevalence of source water contamination was higher in slum households than in non slum households. Non slum households in Moinbhag (27.6%) and slum households of Serilingampalli (23.56%) had the highest prevalence of household source water contamination.

About 29% of household stored water samples were contaminated with coliforms. E.Coli was isolated in 8.13% of stored water samples. Prevalence of stored water contamination was higher in slum households (34%) compared to non slum households (25%). In all sites prevalence of stored water contamination was higher in slum households than in non slum households.

Table 3.21: Distribution of Contamination of Household Water Samples

Sample/ Contamination With	Adikmet		Moinbhag		Serilingampalli		Overall		Total
	Slum	Non Slum	Slum	Non Slum	Slum	Non Slum	Slum	Non Slum	
N	175	325	250	250	174	326	599	901	1500
Source Water Sample									
Coliforms	12	10	22	69	41	46	75	125	200
E. Coli	2	2	7	42	6	6	15	50	65
Stored water Sample									
Coliforms	39	50	112	106	52	71	203	227	430
E. Coli	0	2	42	55	13	10	55	67	122
% Samples Contaminated									
Source Water Sample									
Coliforms	6.86	3.08	8.80	27.60	23.56	14.11	12.52	13.87	13.33
E. Coli	1.14	0.62	2.80	16.80	3.45	1.84	2.50	5.55	4.33
Stored Water Sample									
Coliforms	22.29	15.38	44.80	42.40	29.89	21.78	33.89	25.19	28.67
E. Coli	0.00	0.62	16.8	22.00	7.47	3.07	9.18	7.44	8.13

3.7 Acute Gastroenteritis Episodes

Incidence of Acute Gastroenteritis

150 cases of Acute Gastroenteritis were reported during the survey with an overall weekly incidence of 22.23 per 1000 population ($CI \pm 3.50$). Compared to other two sites, incidence of gastroenteritis was significantly lower in Adikmet (5.21 ± 3.10). Incidence was significantly higher in slum areas compared to non slum areas (Table 3.22). Slum areas of Moinbhag (39.53 ± 10.30) and Serilingampalli (40.11 ± 14.6) reported highest incidence rates.

Table 3.22 - : Weekly Incidence of Acute Gastroenteritis in Study Sites

Area	AGE Cases	Population Covered	Incidence Rate per 1000 Pop	95 % CI
Adikmet	11	2110	5.21	2.11 to 8.31
Slum	7	785	8.92	2.30 to 15.5
Non Slum	4	1325	3.02	1.12 to 5.92
Moinbhag	81	2662	30.43	23.9 to 36.9
Slum	54	1366	39.53	29.2 to 49.8
Non Slum	27	1296	20.83	13.00 to 28.63
Serilingampalli	58	1977	29.34	21.9 to 36.7
Slum	28	698	40.11	25.5 to 54.7
Non Slum	30	1279	23.46	15.2 to 31.8
Total	150	6749	22.33	18.7 to 25.7

Frequency of Acute Gastroenteritis by Age and Sex

57% of the cases were females. 13.33% of the cases were in the under five age group. Nearly 50% of the cases were in the 5-24 years age group.

Table 3.23: Age and Sex wise Frequency Distribution of Acute Gastroenteritis Cases

Age Group	Adikmet				Moinbhag				Serilingampalli				All Sites		
	Slum		Non Slum		Slum		Non Slum		Slum		Non Slum		F	M	Total
	F	M	F	M	F	M	F	M	F	M	F	M			
< 5yrs	1	1	1	0	4	4	2	1	3	2	2	2	13	10	23
5-24 yrs	1	1	0	0	18	15	8	7	4	6	10	4	41	33	74
25-44 yrs	3	0	2	0	4	4	4	3	5	4	5	3	23	14	37
45 -64 yrs	0	0	0	0	4	1	1	1	1	2	1	2	7	6	13
65+	0	0	1	0	0	0	0	0	1	0	0	1	2	1	3
Total	5	2	4	0	30	24	15	12	14	14	18	12	86	64	150

Respondent's Perception Regarding Cause of Illness

Respondents attributed about 48% of the cases to water contamination. 1.33% of cases were attributed to food poisoning. 5.33% of cases were attributed to other conditions such as pregnancy, alcoholism and bowel disorders. In about 45% of the cases, respondents said that they did not know what caused the episode of gastroenteritis.

Table 3.24: Respondents Perception Regarding Cause of Acute Gastroenteritis

Suspected Cause	Adikmet				Moinbhag				Serilingampalli			
	Slum N=7		Non Slum N=4		Slum N=54		Non Slum N=27		Slum N=28		Non Slum N=30	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Food poisoning	0	0.00	0	0.00	0	0.00	0	0.00	2	7.14	0	0.00
Water	1	14.29	3	75.00	17	31.48	19	70.37	17	60.71	15	50.00
Others	0	0.00	0	0.00	4	7.41	3	11.11	0	0.00	1	3.33
Unknown	6	85.71	1	25.00	33	61.11	5	18.52	9	32.14	14	46.67

In about 66% of the cases which was attributed to food or water contamination respondents felt that consumption of the same occurred in their own homes (Table 3.25). In

about 16% of cases, respondents did not know where they consumed contaminated food or water.

Table 3.25: Probable Place Where the Attributed Contaminated Water and Food was Consumed

Place	Adikmet		Moinbhag				Serilingampalli					
	Slum N=1		Non Slum N=3		Slum N=17		Non Slum N=19		Slum N=19		Non Slum N=15	
	%	%	%	%	%	%	%	%	%	%	%	
Own home	1	100.00	0	0.00	8	47.05	12	63.16	14	73.68	14	93.33
Others private house	0	0.00	0	0.00	0	0.00	2	10.53	2	10.53	0	0.00
Hotel / Restaurant	0	0.00	0	0.00	0	0.00	1	5.26	1	5.26	0	0.00
School	0	0.00	0	0.00	0	0.00	0	0.00	1	5.26	0	0.00
Work place	0	0.00	0	0.00	0	0.00	0	0.00	1	5.26	0	0.00
Public Functions	0	0.00	0	0.00	1	5.88	0	0.00	0	0.00	0	0.00
Others	0	0.00	1	33.33	3	17.64	0	0.00	0	0.00	0	0.00
Unknown	0	0.00	2	66.66	5	29.41	4	21.05	0	0.00	1	6.67

Health Seeking Behaviour

About 85.3% of the gastroenteritis cases had consulted a doctor. 8% of the cases were hospitalized. Comparatively higher proportion of cases in slum areas (10.1%) was hospitalized than cases from non slum areas (4.9%).

Table 3.26: Frequency of Cases Who Consulted a Doctor and/or was Hospitalized

	Adikmet		Moinbhag		Serilingampalli		Overall (%)		Total
	Slum	Non Slum	Slum	Non Slum	Slum	Non Slum	Slum NS		
N	7	4	54	27	28	30	89	61	150
	%	%	%	%	%	%	%	%	
Consulted A Doctor									
Yes	7	3	46	25	22	25	84.3	86.9	85.3
No	0	1	8	2	6	5	15.7	13.1	14.7
	100	75	85.18	92.59	78.57	83.33			
	0	25	14.81	7.41	21.43	16.67			
Was Hospitalized									
Yes	5	1	3	1	1	1	10.1	4.9	8.0
No	2	3	51	26	27	29	89.9	95.1	92.0
	28.57	75	94.44	96.29	67.86	83.33			

Reported mean expenditure on medical care for a case of acute gastroenteritis was Rs.742. On an average, expenditure per case was higher in non slum households (Rs.970) compared to slum households (Rs. 411). About 69% of the cases from slum areas incurred an expenditure of less than Rs.500 on medical care. About 42% of cases from non slum areas incurred expenditure between Rs.500 and Rs.1500 on medical care. 23% of cases from non slum households spent more than Rs.1500 on medical care

Table 3.27: Mean Amount Spent on Medical Care for Acute Gastroenteritis

Amount (Rs)	Adikmet		Moinbhag		Serilingampalli		Overall		Total
	Slum	Non Slum	Slum	Non Slum	Slum	Non Slum	Slum	Non Slum	
N	7	2	25	47	19	25	51	74	125
Mean (Rs)	379	2000	531	1088	264	666	411	970	742
<500	3	0	17	18	15	8	68.6	35.1	49
500 to <1500	4	1	5	13	4	17	25.5	41.9	35
>1500	0	1	3	16	0	0	5.88	23	16

About 93% of the gastroenteritis cases sought care from private providers. Comparatively more cases from non slum households sought care from government providers. About 65% of cases in slum households sought treatment from a local private doctor and 34% from private hospitals. Comparatively higher proportion of non slum cases sought care from private hospitals (44.23%)

Table 3.28: Distribution of Gastroenteritis Cases by Source of Medical Care

Source of Care	Adikmet		Moinbhag		Serilingampalli		Overall %		Total
	Slum	Non Slum	Slum	Non Slum	Slum	Non Slum	Slum	Non Slum	
N	6	2	46	25	22	25	74	52	126
Govt. Dispensary	1	0	0	5	0	0	1.35	9.62	4.76
Govt. hospital	0	0	0	0	0	3	0.00	5.77	2.38
Private hospital	4	1	10	13	11	9	33.78	44.23	38.10
Private doctor	1	1	36	7	11	13	64.86	40.38	54.76

Loss of Work/School/College Days due to Acute Gastroenteritis

About 45% of the cases resulted in loss of work, college or school days. Mean days lost was about 4.78 days per case. About 25% of these cases resulted in loss of 1 to 2 days of work/education. In 68% of these cases, the loss of work/school days was greater than 5 days.

Table 3.29 Loss of Work/School/College Days due to Acute Gastroenteritis

Days	Adikmet		Moinbhag		Serilingampalli		Overall %		Total
	Slum	Non Slum	Slum	Non Slum	Slum	Non Slum	Slum	Non Slum	
N	1	1	25	12	16	13	42	26	68
Mean	2	2	5.12	3.5	4.81	5.69	4.93	4.54	4.78
Median	2	2	3	3	4	4			
1 to 2 Days	1	1	7	5	4	1	23.8	23.1	23.53
3 to 5	0	0	9	4	7	7	9.52	7.69	8.824
6 to 10	0	0	6	2	4	4	28.6	26.9	27.94
>10 days	0	0	3	1	1	1	38.1	42.3	39.71

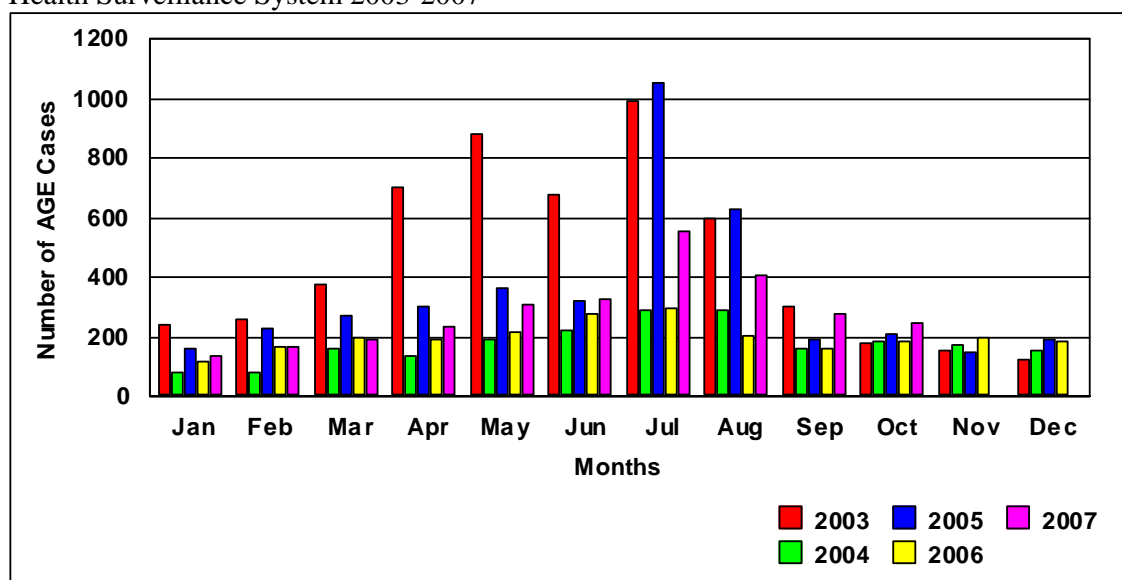
4. Analysis and Conclusions

4.1 Burden of Gastroenteritis

The survey indicates that acute gastroenteritis is an important public health problem in study sites. The survey reported a mean weekly incidence of 22.23 per 1000 population (CI \pm 3.50). On extrapolation based on seasonal trends available from surveillance data, the annual community incidence rate of acute gastroenteritis in the survey sites is estimated to be around 875 per 1000 population. In addition to the disease burden, acute gastroenteritis entails a significant financial burden. About 85% of the cases had received medical care from a doctor. The mean expenditure on treated cases of gastroenteritis was estimated to be around Rs.732. Further, 45% of the cases resulted in loss of work, college or school days. Mean days lost was about 4.78 days per case.

Survey findings indicate that the magnitude of acute gastroenteritis is much higher than suggested by the existing surveillance system. The number of Gastroenteritis cases captured by the public health surveillance system every month from January 2007 to September 2007 is given in Figure-1. The survey was carried out during May 20 – July 10 2007. The monthly incidence rates extrapolated from surveillance data for the period corresponding to the survey ranges from 0.06 to 0.11 per 1000 population. Obviously, there is a wide discrepancy between community incidence rates reported by the survey and surveillance incidence data.

Figure 4.1 Monthly Acute Gastroenteritis Cases in Hyderabad City as Reported by the Public Health Surveillance System 2003-2007



The reasons for such a large discrepancy can be mostly explained by the health seeking behaviour of the people living in Hyderabad and the coverage of the surveillance system. Currently the surveillance system covers only large public hospitals in the city. Findings from the current study indicate that some people may not seek medical treatment if

symptoms are not very serious. Even when they seek treatment, they tend to approach private providers. Only 2.38% of the cases who accessed medical care sought treatment from government hospitals which are covered by the surveillance system. 93% of cases who accessed medical care sought treatment from the private sector. About 55% sought treatment from private doctors and 38% from private hospitals. Reliance on private doctors is especially high in slum areas. Given that local private doctors are the primary point of contact for those seeking medical care, there is need to involve them in routine surveillance especially in the context of monitoring of Water Safety Plans. The Integrated Disease Surveillance Programme (IDSP) of the Government of India is currently being implemented in the State. The IDSP seeks to enlist support of private providers for surveillance of common diseases. Operationalization of the programme in the pilot sites on a priority basis is likely to provide incidence data for monitoring of WSPs on a routine basis.

4.2 Risks for Acute Gastroenteritis

Key variables were assessed to understand their possible role in risk for gastroenteritis. Though the data did not indicate statistically significant risk for gastroenteritis on account of many socioeconomic variables, the risk for gastroenteritis in slum areas was almost twice that of non slum areas (RR 1.99, 95% CI 1.44-2.75). Relative Risk for Acute Gastroenteritis on account of some of the key variables is given in Table 4.1.

Table 4.1: Relative Risk for Acute Gastroenteritis

Risk Factors	Slum			Non Slum			Overall		
	RR	95% CI		RR	95 %CI		RR	95 % CI	
Contamination of Source water with E.Coli	0.708	0.124	3.27	4.377	2.21	8.265	2.453	1.362	4.325
Contamination of Storage water with E.Coli	1.413	0.669	2.83	4.417	2.32	8.17	2.541	1.569	4.027
Contamination of Source water with Coliforms	1.905	1.048	3.35	2.483	1.31	4.64	2.108	1.361	3.23
Contamination of Storage water with Coliforms	1.084	0.645	1.81	2.491	1.4	4.442	1.715	1.165	2.517
Not having a metro domestic connection	2.389	1.409	4.08	3.597	2.02	6.416	3.235	2.194	4.78
Having Pit Tap as Main Drinking Water Source	2.95	1.793	4.87	3.567	2	6.342	3.484	2.388	5.083
Using utensil used for drinking for retrieving water from container	1.67	0.878	3.06	2.683	1.44	4.946	2.017	1.293	3.11
Not Treating Water	1.373	0.837	2.25	1.396	0.78	2.504	1.415	0.966	2.07
Respondent's Perception that water is not safe to drink without treating	1.76	1.05	2.93	0.842	0.46	1.52	1.971	1.35	2.873
Poor sanitary status	2.494	1.459	4.3	2.439	1.37	4.357	2.735	1.853	4.045

Findings of the study indicate a statistically significant risk for gastroenteritis in the sites as a whole on account of contamination of drinking water source. Overall, 13.33%

household source water samples were contaminated with coliforms. E.Coli was isolated in 4.33% of the household source water samples. However, the risk was not significant in slum areas. Compared to other sites, prevalence of source water contamination in slum areas of Moinbhag which accounted for more than third of the gastroenteritis cases was lower than that in non slum areas. This may be on account of significant improvements in water and sanitation infrastructure and third party monitoring in slums following an epidemic of gastroenteritis in 2005. A statistically significant risk for gastroenteritis in the sites as a whole on account of contamination of stored drinking water was established by the study. However, the risk was not significant for slum areas.

Risk of Gastroenteritis is significantly lower in households having Metro domestic connections and significantly higher in households using pit taps as a drinking water source. About 33% of slum households and 20% of non slum households depend on pit taps for drinking water. Pit taps are illegal pipe connections established by residents by digging a pit and directly tapping into the underground main pipe lines in areas where there is low pressure in the supply system. Pit taps pose a significant risk for gastroenteritis (RR 3.484, 95% CI 2.388-5.03) as they are more vulnerable to contamination. Their base is not cemented and there is water stagnation around the tap. In many instances the surroundings are unsanitary. Since water supply is intermittent, surrounding water is sucked into the pipes during periods where there is no supply. Significant risk for source water contamination with E. coli was associated with not having a metro domestic connection (RR 2.543 95% CI, 1.585- 4.084) and using pit taps as a drinking water source (RR 2.383 95% CI, 1.486- 3.814). Steps to phase out pit taps and provide functional domestic connections need to be considered.

While some water use practices such as using the same utensil used for drinking for retrieving water from container were seen as risk for gastroenteritis, others such as not treating water did not appear to be a risk factor for gastroenteritis. In the sites as a whole, using the same utensil used for drinking for retrieving water from storage container was associated with a statistically significant risk of gastroenteritis (RR 2.017 95% CI 1.29-3.11). However, the risk was not significant in slum households. Treating water was not found to be associated with a statistically significant lowering of risk for gastroenteritis. More than half (52%) of the households treating water used locally available candle filters. Efficacy of these filters in preventing contamination need to be further studied.

About 37% of the respondents felt that it was not safe to drink water without treatment. Respondents' perception that water is not safe to drink without treating was associated with a risk for gastroenteritis (RR 1.971 95% CI 1.351-2.873) in the survey sites. The risk was not significant in slum areas. Respondents attributed about 48% of the cases to water contamination. Over 60% of these cases were attributed to consuming contaminated water at home. A mechanism to gather client feedback and provide prompt attention may have an impact on improving water quality and bringing down incidence of gastroenteritis.

Poor sanitary environment as assessed by sewerage overflows, excreta in the vicinity and garbage accumulation in household premises pose a significant risk for gastroenteritis (RR 2.735 95% CI 1.853-4.045). Poor sanitary environment was associated with a significant risk for E.Coli contamination of stored water samples (1.975 95% CI 1.408-

2.771). About 7.5% of households in slums and 4.5 % households in non slums had visible animal or human excreta in the household premises. About 31% of respondents did not perceive washing hands with soap was important after defecation. Only 35% of respondents from slums of Adikmet perceived hand washing with soap to be important after defecation. 29% of household stored water samples were contaminated with coliforms. E.Coli was isolated in 8.13% of stored water samples. Prevalence of stored water contamination was higher in slum households (34%) compared to non slum households (25%). Contamination of stored water samples is significantly higher than source samples indicating intra-household contamination. These findings indicate need for making residents aware of basic hygiene practices.

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Assessing Risks Associated with Water Quality and Sanitation for Establishing Health Based Targets for Drinking Water Safety in Hyderabad

Cover Sheet

I. Identification of Sample Household

0001. Site: 1 Adikmet 2 Moinbagh 3 Serlingampally

0002. Sampling Fraction 1 Slum 2 Non Slum

0003. Municipal Ward _____

0004. Enumeration Block ID _____

0005. House Number _____

0006. Household ID _____

0007. Name of Household Head _____

0008. Name of Respondent _____

II. Particulars of Survey

No:	Particulars	Field Investigator				Field Supervisor				Field Coordinator									
0009.	Name:																		
	Code:																		
0010.	Dates of :	D	D	M	M	Y	Y	D	D	M	M	Y	Y	D	D	M	M	Y	Y
	First Contact with Household																		
	Second Contact with Household																		
	Third Contact with Household																		
	Survey/Inspection																		
	Collection of "source water sample"																		
	Collection of "stored water sample"																		
	Receipt																		
	Scrutiny																		
	Despatch of questionnaire																		
	Despatch of source sample																		
	Despatch of stored sample																		
Signature:																			

III. Data Entry

No:	Particulars	Data Entry Operator				Data Supervisor				Coordinator									
0011.	Code																		
0012.	Dates of :	D	D	M	M	Y	Y	D	D	M	M	Y	Y	D	D	M	M	Y	Y
	Data Entry/Verification																		
	Data Entry/Verification																		
Signature:																			

Section B: Household Characteristics

2001. Record Type of House

- 1 Slum House
- 2 Small House
- 3 Apartment
- 4 Independent Bungalow
- 5 Others

2002. Is this house your own or have you taken it on rent?

- 1 Owner
- 2 Tenant

2003. What type of cooking stove is used in the house?

- 1 Open fire/stove without chimney
- 2 Open fire/stove under chimney/hood
- 3 Closed stove with chimney/flute
- 4 Others (Specify) _____

2004. Where is cooking usually done?

- 1 In a room of the main house
- 2 In a separate room used as kitchen
- 3 In a separate shed/building used as a kitchen
- 4 Outdoors
- 5 Others (Specify) _____

2005. What type of fuel does the household mainly use for cooking?

- 1 Gas
- 2 Electricity
- 3 Kerosene
- 4 Charcoal
- 5 Fire Wood
- 6 Agricultural/crop residues
- 7 Animal dung
- 8 Others (Specify) _____

2006. Do you have a refrigerator in your household?

- 1 Yes
- 2 No

2007. Thinking over the past year, can you tell me what the average earnings of the household have been per month or per week or per year? Please tell me whichever period that is easier for you.

- 1 Rs _____ per Week
- 2 Rs _____ per Month
- 3 Rs _____ per Year
- 4 Refuse
- 5 Dont Know

2008. How much did the household spend on food last month?

- 1 Rs _____ per Month
 2 Refuse
 3 Dont Know

2009. How much did the household spend on accommodation last month?

- 1 Rs _____ per Month
 2 Refuse
 3 Dont Know

2010. Are you covered by any public or private health insurance funds?

- 1 Only for inpatient care (where you stay overnight, usually hospitals)
 2 Only for outpatient care (all other types of care)
 3 For both
 4 For neither
 5 Dont Know

2011. If covered by health insurance, what is the premium amount you have paid in the last year?

Rs _____

Section C: Water Supply, Storage and Usage

3001. What are the sources of water for members of this household and their uses? Please also tell me what is the main source of drinking water for the household? Check all boxes that apply. For major drinking water source check only one box.

No.	Source Type		Use				
			Drinking/ Cooking	Laundry/ General Cleaning	Bath/ Toilet	Other Purposes	Main Drinking Water Source
1.	Metro Domestic Connection						
2.	Public Stand Post						
3.	Pit Tap						
4.	Borewell	1. Own					
		2. Public					
		3. Neighbour					
5.	Tanker	1. Public					
		2. Private					
6.	Open Well	1. Own					
		2. Public					
		3. Neighbour					
7.	Others	1.					
		2.					

3002. What is the frequency of supply of the main source of drinking water?

- 1 Round the Clock
- 2 Fixed Timing, Daily
- 3 Fixed Timing, Alternate Day
- 4 Erratic
- 5 Others (Specify)

3003. How long it take to go your main drinking water source, get water and come back?

- 1 On Premises (Skip To 3005)
- 2 Less than 15 minutes
- 3 15-30 minutes
- 4 More than 30 minutes

3004. Who usually goes to this source to fetch the water for this household? (Check all mentioned)

- 1 Adult Woman (Age 15 years and above)
- 2 Adult Man (Age 15 years and above)
- 3 Female Child (Under 15 years of age)
- 4 Male Child (Under 15 years of age)

3005. With what container do you collect the water you use in the household? (Check all that apply)

- 1 Directly from House Tap
- 2 Plastic Buckets
- 3 Metal Bucket
- 4 Earthen Pots
- 5 Plastic Pots
- 6 Metal Pots
- 7 Jerry Can
- 8 Others (Specify) _____

3006. How many water taps are there in this house

- 1 None (Skip to 3009)
- 2 One
- 3 More than One

3007. How do you get water in the tap? (Check all that apply)

- 1 Direct Metro Supply
- 2 Over Head Tank

3008. (If Over Head Tank) How is the water collected in the Overhead Tank?

- 1 Direct Metro Supply to Tank
- 2 Pumped from Sump
- 3 Pumped from Borewell
- 4 Pumped from Open Well

3009. What type of container do you use to store water for drinking in the house? (Check all that apply)

- 1 Direct metro supply from house tap
- 2 Tap water from Overhead Storage Tank
- 3 Buckets (Metal/Plastic)
- 4 Pots (Earthen/Metal/Plastic)
- 5 Jerry Can
- 6 Bottles (Plastic/Glass)
- 7 Barrel/Drum
- 8 Small Pans
- 9 Others (Specify) _____

3010. Are the storage vessels covered?

- 1 All covered
- 2 Some Covered
- 3 None Covered

3011. Where are the storage vessels kept?

- 1 On the floor
- 2 Elevated

3012. Do you think this water is safe to drink without any treatment?

- 1 Yes
- 2 No
- 3 Dont Know

3013. Do you process this water in any way to make it safer to drink?

- 1 Yes
- 2 No
- 3 Dont Know

3014. If yes, what do you do the water make it safer to drink? (Check all that apply)

- 1 Boil
- 2 Add bleach/chlorine
- 3 Candle Type Water Filter
- 4 Electric Filter Devices (Aquagaurd)
- 5 Filter Attached to Tap (Zero B)
- 6 Homemade cloth/net sieve
- 7 Others (Specify) _____

3015. In case of using Candle Type Filter: 1. Frequency of Cleaning _____ (months)
2. Frequency of Changing _____ (months)

3016. In case of using Aquagaurd Type Filter: 1. Frequency of Cleaning _____ (months)
2. Frequency of Changing _____ (months)

Enter DK for Dont Know or "0" for Never



3017. What do you use to remove water form storage container?

- 1 Container has tap
- 2 Long handed utensil reserved for retrieving water
- 3 Other utensil reserved for retrieving water
- 4 Same utensil (cup/glass) used to drink from
- 5 Pouring
- 6 Others (Specify) _____

3018. Who takes the water from these containers?

- 1 Only Adults
- 2 Both Adults and Children

3019. How often do you clean the storage containers?

- 1 Daily
- 2 Once in 2- 3 days
- 3 Weekly
- 4 Once in several weeks
- 5 Never

3020. (If the household has a sump and/or overhead tank) How often do you clean the

- 1. Sump: Once in _____ (months). Enter DK for Dont Know or “0” for Never
- 2. Overhead Tank: Once in _____ (months) DK for Dont Know or “0” for Never

Section D: Hygiene and Sanitation

4001. When do you think it is important to wash hands with soap? **Do Not Prompt** (Check all that Apply)

- 1 Before preparing food /cooking
- 2 Before eating
- 3 Before feeding children
- 4 After cleaning/changing baby
- 5 After defecating
- 6 Dont Know
- 7 Others (Specify) _____

4002. What do you do with left over food?

- 1 Store in Container
- 2 Store in Fridge
- 3 Give Away
- 4 Throw Away

4003. What do you do with damaged food?

- 1 Remove Damaged Part and Use
- 2 Give Away
- 3 Throw Away

4004. Where do you wash your clothes?

- 1 In the bathroom
- 2 In the backyard
- 3 Out in Front
- 4 Give to Dhobi
- 5 Others (specify) _____

4005. Where do you clean your utensils

- 1 In the kitchen
- 2 In the bathroom
- 3 In the backyard
- 4 Out on the road
- 5 Others (specify) _____

4006. What is the medium used for cleaning utensils

- 1 Commercial Detergent
- 2 Mud
- 3 Domestic Ash
- 4 Others (specify) _____

4007. What facility does the household members use for defecation?

- 1 In a latrine/toilet
- 2 In bushes/ground
- 3 Others (Specify) _____

4008. If latrine/toilet, specify type

- 1 Pour Flush WC
- 2 Auto Flush WC
- 3 Pit Latrine
- 4 Others (Specify) _____

4009. If latrine/toilet, where is its location

- 1 Inside or attached to dwelling
- 2 Elsewhere on premises
- 3 Outside Premises
- 4 Use Public Toilet

4010. How far is the toilet facility from your living quarters? (If not in the premises)

- 1 Less than 10 metres
- 2 10-50 metres
- 3 Over 50 metres
- 4 Dont Know

4011. What type of sewerage system do you have in the house

- 1 Open drainage
- 2 Underground drainage
- 3 Own Septic Tank
- 4 Draining to city sewerage system
- 5 Dont Know
- 6 Others (specify) _____

4012. If Pit or Septic Tank, how frequently it is emptied

- 1 At least once a year
- 2 Every couple of years
- 3 Never
- 4 Dont Know

4013. Sewerage Status (Observation Only)

- 1 Underground and no leakage
- 2 Surface/open drainage but clean
- 3 Sewerage overflowing and leaking
- 4 Clogged drains

4014. Is there any visible excreta in the yard (Observation Only)

- 1 Yes
- 2 No

4015. If Yes, which type (Check all that apply)

- 1 Human faeces
- 2 Animal faeces
- 3 Unknown

4016. Investigators assessment of overall sanitary status of surroundings

- 1 Clean
- 2 Moderate
- 3 Dirty

Section E: Illness and Treatment

5001. Did any of your household members have any of the following symptoms in the past 7 days

1. Diarrhoea Yes No
 2. Vomiting Yes No

If YES to Diarrhoea or Vomiting CONTINUE. If No END Interview

5002. Srl.No of member reporting vomiting or diarrhoea (As in Col. 1 of Qn 1000)					
5003. Age in years (as in Col. 4 of Qn 1000)					
5004. Did the member have Diarrhoea? Yes-1, No 2					
5005. If Yes, 3 or more times per day? Yes-1, No 2					
5006. Did the member have bloody diarrhoea? Yes-1, No 2					
5007. Did any member have Vomiting? Yes-1, No-2					
5008. Did the member have fever? Yes-1, No 2					
5009. Did the member have abdominal pains or cramps? Yes-1, No 2					
5010. Status of Symptoms 1. Started more than 7 days ago and is continuing 2. Started more than 7 days ago and has ended 3. Started within 7 days and is continuing 4. Started within 7 days and has ended					
5011. If the symptoms have ended, total duration of symptoms (in days)					
5012. What do you think caused these symptoms (Do Not Prompt) 1. Food poisoning 2. Person-to-person 3. Water 4. Animal contact 5. Non-specific infection 6. Pregnancy/menstruation 7. Medication 8. Alcohol 9. Bowel disorder 10. Chemotherapy/radiotherapy 11. Other, specify _____ 12. Unknown					
5013. If food poisoning or water, where do you think that the member has got the food/water that has caused these symptoms 1. Own Home 2. Other Private House 3. Hotel/Restaurant 4. Street Vendor 5. School 6. Hospital 7. Work Place 8. Public Functions 9. Other (specify) _____ 10 Unknown					
5014. Was this premises in the city of Hyderabad? Yes-1, No 2					
5015. Was a medical doctor consulted? Yes-1, No 2 (Skip to 5024)					
5016. If Yes in Item 5015 what is the source of treatment (Enter all that apply with name (s) of institutions) 1. Government Health Centre/Dispensary 2. Government Hospital 3. Private Hospital 4. Private Doctor					
5017. Was the member admitted to a hospital? Yes-1, No 2 (If yes enter name of hospital)					
5018. How many days did the member spend in the hospital?					
5019. Was the member asked to submit a stool sample? Yes-1, No 2					

5002. Srl.No of member reporting vomiting or diarrhoea (As in Col. 1 of Qn 1000) <i>(If No skip to 5023)</i>					
5020. If Yes, did the member have a stool sample taken <i>Yes-1, No 2</i> <i>(If no skip to 5022)</i>					
5021. What was the result of the test? <i>(Enter result if known or enter NK for Not Known)</i> <i>(Skip to 5023)</i>					
5022. Why was a stool sample not provided? <i>1. Recovered</i> <i>2. Felt not necessary</i> <i>3. Could not afford</i> <i>4. Others (specify)</i> <i>5. Dont know/Not sure</i>					
5023. What was the expenditure on medical treatment (Rupees)					
5024. Did the member take any other measure for recovery/relief of the symptoms other than treatment by doctors <i>Yes-1, No 2</i> <i>(If no skip to 5026)</i>					
5025. If Yes to above what measures were taken (Enter all that apply along with approximate expenditure for each item) <i>1. Home Remedies</i> <i>2. Medicines on advice of Self/Household Members/Friends</i> <i>3. Medicines on advice of a pharmacist at a medical shop</i> <i>4. Treatment by local practitioner (unqualified)/RMP</i> <i>5. Others (Specify)</i>					
5026. Did the member miss work or school/college on account of these symptoms? <i>Yes-1, No 2</i>					
If Yes to the above, enter the total number of days missed from work or school/college					

End of the Interview: Thank the Respondent

Check List

- Water source verified
- Sewerage status verified
- Sanitary status of surroundings
- Source water and stored water sample collected and water collection record filled up.