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Bacteriological quality of water and water borne diseases in Bangalore

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RESEARCH

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Abstract

Background
In developing countries diarrhoeal diseases take a big toll which can be prevented by adequate supply of safe drinking water. Thus a longitudinal study was taken up to determine the morbidity due to water borne diseases and bacteriological quality of water

Method
150 homes in two areas, one supplied by bore well and other by tap water was selected by modified cluster sampling. Weekly morbidity details collected. Monthly water samples were assessed for bacteriological quality from main supply, household storage and morbidity reported houses.

Results
The difference in proportion of potable and non potable water storage was statistically significant. Potable water is water which is fit for consumption by humans and other animals. The overall incidence rate of target diseases was 3.58%, majority were diarrhoeal diseases with increased incidence in children less than five years. The incidence in areas with bore well supply was 3.8% and in area with tap water was 3.43%.

Conclusion

There are various ways in which drinking water can be contaminated along the route of distribution to the consumers. The most effective method to prevent infections is surveillance and treatment of drinking water quality at point of consumption.

Key Words
Bacteriological quality, diarrheal, potable water

Background

Water is essential to sustain life, and a satisfactory (adequate, safe and accessible) supply must be available to all. Improving access to safe drinking-water can result in tangible benefits to health. Every effort should be made to achieve a drinking-water quality as safe as practicable. [1] Diarrhoeal diseases kill an estimated 1.8 million people each year. [2]Among children under five years in developing countries, diarrhoea accounts for 17% of all deaths. [3] The World Bank estimates 21% of communicable diseases in India are water related. Diarrhoea alone killed over 700,000 Indians in 1999 (estimated) – over 1,600 deaths each day. The highest mortality from diarrhoea is in children under the age of five, highlighting an urgent need for focused interventions to prevent diarrhoeal disease in this age group. [4] Safe water supplies and environmental sanitation are vital for protecting the environment, improving health and alleviating poverty. Disease, drudgery and millions of deaths every year are directly attributable to lack of these essential services. The poor, especially women and children are the main victims.

Surveillance of drinking-water quality can be defined as “the continuous and vigilant Public health assessment and review of the safety and acceptability of drinking water supplies”. Surveillance of the drinking water quality contributes to the protection of public health by promoting improvement of the quality, quantity, accessibility, coverage, affordability and continuity of drinking water supplies. These are termed “service indicators”. The authority responsible for this type of activity differs in different countries and regions. Such an activity involves a

collaborative multiagency approach for specific areas within the water cycle in the management of water quality. [1]

A good surveillance system requires epidemiological and laboratory inputs and consideration of environmental factors. The ability to identify the environmental antecedents of an outbreak will enable a move to be made towards developing relevant intervention. [5] The diarrhoeal diseases take a big toll in children which can be prevented by adequate supply of safe drinking water. Thus the present study was taken up to determine the morbidity due to water-borne diseases in two geographical areas with different sources of water supply, within the limits of Bangalore city and also to determine the bacteriological quality of water .The period of study from September 2004-october 2005.

Method

An area supplied exclusively by bore well water for drinking purpose and an area exclusively supplied by piped water for drinking purpose situated within the limits of Bangalore city were selected.

Sample size:

On an average an Indian child suffers 6 episodes per year with a standard deviation of 2 episodes. [6] and based on 5% significant level and 0.5 episodes of error.

The sample size came to approximately 65 children in each area. Less than 5 years constitute 12% of total population. [7] Hence 541 populations (approximated to 550) has to be surveyed. Assuming each household consists of 4 persons 150 houses in each area supplied by bore well and piped water respectively were selected. All members who were permanent residents of the identified houses were included after taking their consent. Households not willing to participate in the study were excluded.

Sampling technique:

The houses in the above mentioned areas were selected by modified cluster sampling. Area maps of both the areas were prepared. The piped water supply area had 440 houses and bore well water supplied area had 255 houses in total. Four clusters consisting of 40 houses in areas supplied by piped water (totally 160 houses) and 6 clusters comprising of 25 houses in each cluster (totally 150 houses) in areas supplied by bore well were selected. Baseline information was collected from responsible persons of all selected houses by pre-structured and pre tested questionnaire through personal interviews. Weekly phone calls were made to all the selected houses. Enquiry for morbidity due to water borne diseases (acute diarrhoea, enteric fever, hepatitis as per WHO recommended surveillance definitions) was made. The households with suspected morbidity were personally investigated using pre tested case investigation *pro forma*. Laboratory confirmation of cases was done for suspected typhoid fever, hepatitis A and E.

Bangalore water supply and sewage board (BWSSB) granted permission for assessment of bacteriological quality of drinking water for 15 samples per month.

Monthly water samples, one from each area were collected randomly from main source as per WHO guidelines. [8]Also, 3 water samples were randomly collected from household storage points from each area personally by the investigator. Irrespective of the predetermined periodicity water samples were also collected from the household storage points from where morbidity was reported on the same day. The water samples were collected in 250 ml pre sterilised bottles till the level of marking after sterilizing the tap. Water samples were transported within two hours to the laboratory, analysed for chlorine estimation by ortho-toulidine test using a colour comparator (not done for bore well water) and tested for coli forms by membrane filter technique by incubating at 37 degree centigrade for 24 hours. Appearance of red colonies with a metallic sheen within 24 hours were considered as coliform groups and labelled non potable based on WHO Bacteriological quality on drinking water. [1]

Data was analyzed using epiinfo. Descriptive statistics were obtained and relevant test of significance were applied (chi-square)

Results

Out of 142 water samples collected from both areas, 24 were from main source out of which four were contaminated, 66 were from households without morbidity out of which 17 were contaminated and 52 (36.61%) were from households with morbidity out of which 13 were contaminated . Of the total 142 water samples 70 were collected from bore well areas and 72 were from tap water area.(Figure 1) Of the 66 water samples (table 1) analyzed from household storage, 38.89% (14)of bore well water showed coli forms compared to 10% (3)in piped water. The difference was found to be statistically significant (less than 0.05). Of the 52 water samples (table 1) analyzed from the morbidity reported household storage points, 36.36 %(8) and 16.67%(5) of the water samples were non potable in bore well water and piped water areas respectively, not statistically significant

Table 1: Morbidity associated with type of water available

Point of collection	Bore well water		n	Piped water		n	Total
	P	NP		P	NP		
Main source	9 (75)	3 (25)	12	11 (91.7)	1 (8.3)	12	24 (16.9)
H1	22 (61.1)	14 (38.9)	36	27 (90)	3 (10)	30	66 (46.5)
H2	14 (63.6)	8 (36.3)	22	25 (83.3)	5 (16.6)	30	52 (36.6)
Total			70 (49)			72 (51)	142 (100)

H1-Households without morbidity
H2- Households with morbidity
P-Potable
NP-Non Potable

Majority of the cases of target diseases under surveillance in the study population were diarrhoeal diseases contributing 88.46% (46 cases) followed by hepatitis with 9.61% (5 cases) and 1 case of enteric fever (1.92%) during the study period.

It is seen from the table that the overall incidence of target diseases under surveillance was 3.58 %.The incidence in areas with bore well supply was 3.8% and in area with tap water was 3.43%. However, the overall incidence rate for diarrhoeal diseases was 3.2% in the present study (Table 2).

Table 2: Target diseases under surveillance encountered during the study period

Disease	Total number of cases	Percentage
Diarrhoeal diseases	46	88.46
Hepatitis	5	9.61
Enteric fever	1	1.92
Total	**52**	**100**

Note: Target diseases included diarrhoeal diseases, Jaundice, Enteric fever $\chi^2 = 0.139$ df = 1 p = 0.709

It was noted that incidence of diarrhoea in children in the age groups of 0-5 years was 38.89% and 57.14% in bore well and piped water supply areas respectively. Incidence rates for individuals aged above 60 years were found to be 16.67% and 3.57% respectively. Thus it was inferred that ≤ 5 years age group had a higher predilection for morbidity as compared to other groups. The incidence of Hepatitis A in the present study was observed to be 0.34% which was laboratory confirmed. (Table 3)

Table 3: Incidence rate of target diseases under surveillance and the source of water supply

Source	Incidence rate in Percentage
Bore well (n=579)	3.80
BWSSB (n=875)	3.43
Combined	3.58

Discussion

The study revealed that 25% of the water samples were non potable in areas supplied by bore well water and 8.33% in piped water areas. In household storage, 38.89% of bore well water showed coli forms compared to 10% in piped water. This was similar to the findings of Shibani Bandopadhyay, et al where 10.3% of tap water and 57% from direct hand pump were unsatisfactory. 72.4% of stored tap water and 71.4% from stored hand pump water tested were unsatisfactory. [9] Musa H.A et al in their study on water quality among rural and peri urban communities in Sudan, have observed that both water sources namely at source and point of consumption had faecal coliform counts grossly in excess of WHO standards. [10] Similar findings have been reported by other authors. [11-13]

Majority of the cases of target diseases under surveillance in the study population were diarrhoeal diseases contributing 88.46% followed by hepatitis with 9.61% .Our study revealed an incidence rate of 3.2% for diarrhoeal diseases(Table 2). It was also noted that in children less than 5 years showed an incidence of 38.89% and 57.14% in bore well and piped water supply areas respectively. However Mandal A.K, et al [14]and Lal P et al, [15] observed an incidence rate of 23% and 2.91% respectively for diarrhoeal diseases.

The case specific routes that lead to diarrhoeal diseases are extremely difficult to identify. Furthermore, there are numerous and distinct pathogen types involved in diarrhoeal diseases that can infect a new host via multiple pathways. [16] The incidence of Hepatitis A and E in the present study was observed to be 0.34% which was laboratory confirmed. Studies carried out by National Institute of communicable disease indicate the annual incidence of laboratory confirmed viral Hepatitis may be around one per 1000 population and enterically transmitted

Hepatitis A and E together contribute more than three-fourth of the laboratory diagnosed cases. [17] However, Singh et al in their study have observed an incidence rate of 81 per 1 lakh population (0.081%), laboratory confirmed cases of viral hepatitis. [18]

Bangalore (BWSSB) has a sound water surveillance system where the level of chlorine and bacteriological examination of random water samples done regularly through mobile surveillance units. Apart from this the health department has an integrated disease surveillance programme which includes water borne diseases. The morbidity can still be brought down with sharing of data and intersectoral coordination. In this context, surveillance of drinking-water quality which is the continuous and vigilant public health assessment and review of the safety and acceptability of drinking water supplies assumes great importance. [1]

Conclusion

There are various ways by which drinking water can be contaminated along the line of distribution to the consumers. One effective intervention would be treatment of drinking water at point of consumption. Thus bringing down the morbidity especially in children

Owing to the increased propensity of morbidity in less than 5 years of age, it is strongly advised to undertake suitable steps for ensuring potable quality of water. To augment the existing surveillance system for water borne diseases, based on sound epidemiological principles so as to improve the quality of information, for planning, decision making and action. Also this will enable early recognition of outbreak situations for initiating appropriate control measures.

To supplement and complement the efforts of the regular water monitoring agencies, it is strongly suggested to identify independent external agencies which would act as external quality assurance units.

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CONFLICTS OF INTEREST

No conflicts.

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Figures

Figure 1.Showing details of water samples collected and analysed