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DRINKING WATER;
BACTERIOLOGICAL QUALITY AT SOURCE AND ITS DISTRIBUTING SUPPLY LINES IN LAHORE

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ABSTRACT... Introduction: World Health Organization, (WHO) estimates that more than 80% of poor health conditions in developing countries, is related to water and sanitation condition. The supply water and sanitary lines often overlap in our water supply system and water contaminated by fecal contents and become a major cause of GIT infections and outbreaks in human populations. **Objective:** The Objective of the study was to determine the fecal contamination level in tube well water across the distributing supply lines. **Study Design:** The study design was observational. **Settings:** Fatima Memorial Hospital, College of Medicine and Dentistry Shadman Lahore. **Period:** February 01, 2012 to May 29, 2012. **Method:** The study did not engage any ethical issues and conducted in five specific regions of Lahore. A 100 ml of water sample was collected in sterile container, from the tube well and after every 100 meter distance till 500 meters. The sample size was 250 from 45 tube wells and their distributing supply lines. It was then observed for fecal coliforms using prescribed scientific methods. **Result:** The results indicated that bacterial growth at baseline was 42.2%, and at extremity was 73.3%. The A Category water obtained at baseline is 60.0% and at the extreme level it is 26.7%. So by increasing distance from source of water the risk of fecal contamination and low quality of drinking water increases. **Conclusion:** It is concluded that as the distance increased from the main source of water, the frequency of bacterial growth increases and the quality of water become poor.

Key words: Sanitation, Contamination, Fecal Coliforms, Bacterial growth, Risk Factors.

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INTRODUCTION

World Health Organization, (WHO) estimates that more than 80% of poor health conditions in developing countries, is related to water and sanitation condition.[1,10] Since the International Drinking Water and Sanitation Decade (1981 – 1990) of significant progress in water supply and sanitation coverage departments, the access to adequate water and sanitation has not increased due to population growth pattern, inadequate management systems, and lack of training in water and sanitation coverage and inadequate working order to maintain system.

According to WHO world health report (1998), only 61 % people in developing countries have got access to proper water and sanitation system (that was greater in rural than urban areas).[1] Fecal contamination of water supplies is more hazardous for human health than unwanted chemical contamination from natural and agricultural activities. Water becoming contaminated from feces that is being passed into rivers, streams or pools or being allowed to seep into wells or boreholes becomes seriously dangerous for normal health conditions.[3] Fecal contamination estimation is the most important aspect to measure the water quality. Fecal contamination can be confirmed by Bacteriological analysis of water. A sanitary inspection often cannot detect problems occurring during water distribution in water piping system, e.g. underground buried pipes might be damaged allowing in water pollution. This analysis is also beneficial to check the efficiency of disinfection system. This kind of analysis keeps the communities interested in their water supplies and authorized their requests to health authorities to improve water quality

system.[5] The growth of normal fecal organism shows whether a water supply is polluted by fecal coli forms or not. For routine control purposes, it is useless to search directly in water samples for the presence of specific enteric pathogens. It is probable that enteric pathogens (usually present in much smaller number) are also absent, when no normal fecal bacteria are detected in a water sample. So fecal pollution can only be indicated by estimating fecal coli forms in water.[7,14,15] Total coliforms are not directly related to the presence of fecal contamination and so not to the risk of disease. E. coli count is the most valuable test for the routine quality control of water supplies.[8] With the provisions of the National Environment Policy and Pakistan Environmental Protection Act-1997, progressive measures have to be done to protect and conserve surface and groundwater resources as well as coastal waters.[2] The study is designed to evaluate the bacterial contamination levels in drinking water supplies with respect to distance from the main source i.e. tube well.

METHODOLOGY

As study units, WASA tube wells for water supply at designated areas of Lahore city including their distributing supply lines at specified distance and direction were included. 250 water samples from 45 tube wells and their distributing supply lines were obtained. Aseptic conditions were adopted to collect water samples from the Main source i.e. tap connected directly to the main bore pipe of tube well. The next samples were collected from the tap connected directly with WASA supply line in or outside a house or other building at a distance of 100 meters, then at 200 meters, 300 meters and finally at 400 meters in the Southern direction. A 100 ml of water sample was collected in a sterile water container. After collection, the samples were immediately transferred to the laboratory for further processing. The water specimen was filtered on 0.45 mm pore size Cellulose Nitrate water culture filter, with the help of a suction pump.[4] The funnel assembly was sterilized by dry heat method after every specimen filtration. This was done by using a hot air oven at 156°C for 1 hour. After filtration, the filter was aseptically transferred from the funnel assembly unit using a red hot sterilized forceps and put to culture on McConkey's agar. The culture plate was then placed in an incubator at 44°C for 24 hours. The culture plates were examined after proper incubation time. If a growth of large, shiny, raised and pink colored colonies was obtained, the results were noted and then colony count was performed accordingly.[4,11] The Quality of Water was interpreted using table-I[8,12,14];.

The data was entered in SPSS software version-17 (SPSS Inc, Chicago) for statistical analysis.

RESULTS AND DISCUSSIONS

The study was carried out in five specified regions of the city of Lahore, among which nine areas per region was taken. We selected five regions of Lahore and took 45 tube wells, 10 tube wells were taken from North region, 9 from East region, 8 from West, 9 from South and 9 from the Central region of the city. The temperature of the atmosphere was noted at the time of collection that was ranged from 26°C up to 38°C. The mean temperature at baseline was 33.32°C ± 2.53°C (SD) and the mean temperature at 400 meters from the baseline was 33.49°C ± 2.51°C (SD). The data collection was started in the month of February 2012. The weather conditions were normal and mean temperature noted was 27°C. In the next three months the temperature started rising and during the end days of study, the temperature reached up to 38°C. So the mean temperature for the whole four months study duration was about 33°C. The frequency of bacterial growth (E. coli as fecal coliforms) at baseline was 19 out of 45 (42.20%) while at 100 meters was also 19 (42.20%), at 200 meters it was 21 (46.70%), at 300 meter it was 29 (64.40%) and at 400 meters it was 33 out of 45 (73.30%). The bacterial contamination level increases with the distance from the source because of either mixing of sewerage pipeline with the water supply line or due to seepage from the nearby open drain system or by old rusted pipes.[7]

Mean Count 44°C, E.coli count / 100 ml	Category	Comments
0	A	**Excellent**
1 - 10	B	**Acceptable:** But make Regular Sanitary Checks
10 - 50	C	**Unacceptable:** Look for and correct structural faults and poor maintenance of pump and supply lines.
> 50	D	**Grossly Polluted:** Look for alternative source, or carry out necessary repairs, and disinfect.

Table-I. Recommended water quality according to colony count

Source	Frequency		Percentages
Base line	No Growth	26	57.8
	Growth	19	42.2
100 meter	No Growth	26	57.8
	Growth	19	42.2
200 meter	No Growth	24	53.3
	Growth	21	46.7
300 meter	No Growth	16	35.6
	Growth	29	64.4
400 meter	No Growth	12	26.7
	Growth	33	73.3

Table-II. Frequency of growth of bacteria obtained at different levels

Source	Frequency		Percentages
Base line	Category A	27	60.0
	Category B	11	24.4
	Category C	7	15.6
100 meter	Category A	26	57.8
	Category B	5	11.1
	Category C	14	31.1
200 meter	Category A	24	53.3
	Category B	7	15.6
	Category C	14	31.1
300 meter	Category A	16	35.6
	Category B	11	24.4
	Category C	16	35.6
	Category D	2	4.4
400 meter	Category A	12	26.7
	Category B	16	35.6
	Category C	14	31.1
	Category D	3	6.7

Table-III. Frequency of growth of bacteria obtained at different levels according to water category

The frequency of category "A" water (as defined by the WHO pure water criteria[1]) obtained at the base line sample was 27 out of 45 (60.00%), at 100 meters it was 26 (57.80%), at 200 meters it was 24 (53.30%), at 300 meters it was 16 (35.6%) and at the end level it was 12 out of 45 (26.70%). So the quality of water decreases as we are away from the source of water and as it has been discussed that it may be due to improper piping of the supply lines of potable water by the authorities. (Figure 1 & 2).

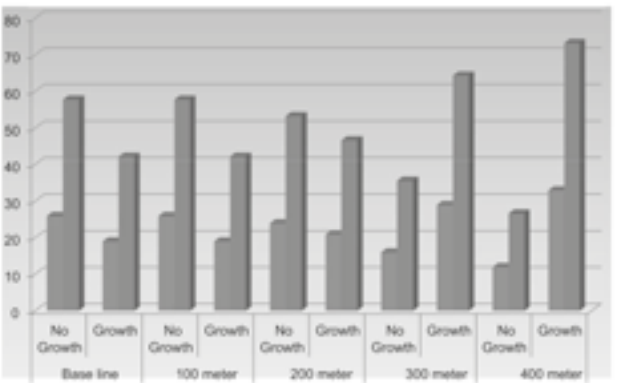

Figure-1. Frequency of growth of bacteria obtained at different levels

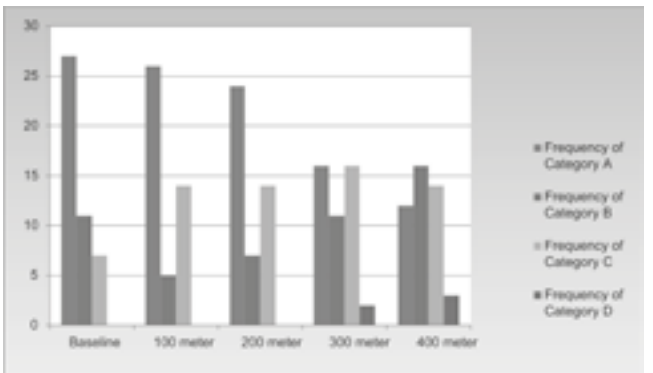

Figure-2. Frequency of growth of bacteria obtained at different levels according to water category

CONCLUSION

It was concluded that the main cause of fecal contamination in drinking water at the source is may be due to either by the use of very old tube wells or the carelessness in the maintenance of the tube wells.[9] The water quality is worse in under-developed areas than in the privileged areas, so these results may compare with the study of Muhammad Saeed Anwar et al, that bacteriological quality of water is exaggerated

by poor socio-economic status of the area.[6] It is also concluded that as the distance increase from the main source of water, the frequency of bacterial growth increases and the quality of water become poor.[13] This may be due to inadequate water supply, bad sanitation system, and low level of hygiene, uncontrolled treatment parameters and very old supply line system of fresh water. The same is concluded by the Tabor M, Kibret M, Abera B of Amhara Region Technical and Vocational Bureau, Bahir Dar, Ethiopia in their study.[9]

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