

An evaluation of bacteriological quality of drinking water from the catchment area of a tertiary care teaching hospital

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	International Archives of Integrated Medicine, Vol. 2, Issue 7, July, 2015.	
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	Available online at http://iaimjournal.com/	
	ISSN: 2394-0026 (P)	ISSN: 2394-0034 (O)
	Received on: 29-06-2015	Accepted on: 08-07-2015
	Source of support: Nil	Conflict of interest: None declared.

Abstract

Background: It is well-appreciated that many communities in developing countries face severe public-health problems relating to drinking-water. The supply of safe water is important to protect the health of the community people.

Aim: The study aimed to evaluate the bacteriological quality of drinking water from various active sources of water utilized in the catchment area of a tertiary care teaching hospital.

Material and methods: The present cross sectional study was carried out by the Department of Microbiology and Community Medicine, MSDS Medical College, Fatehgarh during 2013-14. Randomly selected 100 active water sources which were being used for drinking purpose and a fairly good number of people using that water source for drinking purpose were included in the study. National Environmental Engineering Research Institute (NEERI) guidelines for drinking water quality

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assessment were adopted. Culture and bacteriological tests of drinking water were performed as per standard protocols. After compilation of collected data, analysis was done using Statistical Package for Social Sciences, version 21 (IBM, Chicago, USA).

Results: Out of one hundred water samples collected, fifty one, twenty seven and twenty two samples of water were collected from municipal tap water, government hand pump and water cooler respectively. Almost half of the samples were found to be unsatisfactory. *E. coli* was found to be responsible for 26% of samples whereas *Pseudomonas* in 20% of collected samples. *E. coli* and *Klebsiella* tested positive with Methyl Red whereas *Pseudomonas* sp. and *Klebsiella* tested positive with Citrate test reagent. *E. coli* showed positive result with Indole reagent whereas *Klebsiella* tested positive with Urease. Regarding mix population organisms, *Escherichia coli*, *Klebsiella* Sp. and *Pseudomonas* Sp. were found to be positive in 3 samples whereas *Klebsiella* Sp. and *Pseudomonas* Sp. were found to be positive only in 1 sample.

Conclusion: The study highlighted unsafe nature of current active sources in the study area with regard to drinking water purpose which are not fit for consumption of water. Surveillance of water sources and regular bacteriological assessment of all water sources for drinking is recommended on regular basis.

Key words

Drinking water, Bacteriological quality, Culture.

Introduction

India is rich in water resources, being endowed with a network of rivers and blessed with snow cover in the Himalayan range that can meet a variety of water requirements of the country [1]. Recent reports reveal an alarming prevalence of various diseases causing microbes in drinking water and recreational water. The use of this water may lead to several life threatening diseases [2]. Major factors affecting microbiological quality of surface waters are discharges from sewage works and runoff from informal settlements. Indicator organisms are commonly used to assess the microbiological quality of surface waters and fecal coliforms (FC) are the most commonly used bacterial indicator of fecal pollution [3].

It is well-appreciated that many communities in developing countries face severe public-health problems relating to drinking-water. The supply of safe water is important to protect the health of the community people. Scarcity and pollution of water—both microbial and chemical—are major problems faced by rural population in several parts of India [4]. Given the iniquitous water distribution and lack of community control of

this vital natural resource, understanding of issues relating to both quality and quantity of water becomes necessary [5].

The coliforms are indicative of the general hygienic quality of the water and potential risk of infectious diseases from water. Coliform counts in water are usually manifested in the form of diarrhea and sometimes by fever and other secondary complications [6]. Fatehgarh District located in the west of the Uttar Pradesh is endowed with river Ganga. A study on the quality of water of this channel is one of the essential steps as rapid urbanization occurs along the course of this water. Therefore, this study was planned to evaluate bacteriological quality of drinking water from various active sources of water utilized in the catchment area of a tertiary care teaching hospital.

Material and methods

The current survey was planned and executed by the department of Microbiology in collaboration with department of Community Medicine, MSDS Medical College, Fatehgarh.

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Study area: Catchment area of tertiary care teaching hospital located in western Uttar Pradesh.

Study Population: People and households utilizing various sources of drinking water viz government hand pump, water cooler and municipal tap water.

Study design: Cross-sectional study

Study period: July 2013-August 2014.

Sampling technique: Purposive sampling

Sample size: One hundred active sources of drinking water.

Study tool: Culture and bacteriological tests of drinking water.

Inclusion criteria: Any active water source which was being used for drinking purpose and a fairly good number of people using that water source for drinking purpose.

Study strategy: A total of 100 drinking water samples were collected from active sources of drinking water according to National Environmental Engineering Research Institute (NEERI) guidelines [7] for drinking water quality assessment, over a period of one year September 2013 to October 2014.

About 200 ml water samples from Government hand pump, water cooler and Municipal tap water were collected, labeled and transported to the laboratory for bacteriological analysis. Bacteriological analysis was carried out for indicator organisms i.e. total and fecal coliform (E.coli) by most probable number (MPN) method [8]. Ten tubes of MacConkeys broth (Hi media Pvt. Ltd Mumbai) arranged in two rows with a 100 ml blood culture bottle. First row containing 10 ml double strength MacConkeys broth was inoculated with 10 ml of water sample and 50 ml double strength MacConky broth was inoculated with 50 ml of water sample. Second row containing 1 ml single strength MacConkeys broth medium was inoculated with 1 ml water sample respectively. They were incubated at 44°C for 24 hours. After incubation, the number of bottles in which lactose fermentation with acid and gas production has occurred was counted. The MPN of coliform in 100 ml water sample

was been estimated by referring to probability table. Culture and biochemical tests were also performed.

Results

Out of one hundred water samples collected, fifty one, twenty seven and twenty two samples of water were collected from municipal tap water, government hand pump and water cooler respectively. Almost half of the samples were found to be unsatisfactory. E. coli was found to be responsible for 26% of samples whereas Pseudomonas in 20% of collected samples. (Table - 1)

For species identification the biochemical tests were performed. E. coli and Klebsiella tested positive with Methyl Red whereas Pseudomonas sp. and Klebsiella tested positive with Citrate test reagent. E. coli showed positive result with Indole reagent whereas Klebsiella tested positive with Urease. (Table - 2)

Regarding mix population organisms, Escherichia coli, Klebsiella Sp. and Pseudomonas Sp. were found to be positive in 3 samples whereas Klebsiella Sp. and Pseudomonas Sp. were found to be positive only in 1 sample. (Table - 3)

Discussion

The bacteriological testing of water quality in this study is not to be considered a technological intervention but rather a facilitating approach supplemented by health education, interactions with local governance, and more effective networking within the community. Much of the ill health which affects humanity, especially in developing countries can be traced to lack of safe and whole water supply. There can be no state of positive health and well being without safe water. Since water is vital for our life we expect it to be safe. Even water that appears clear may not necessarily be safe or acceptable [9].

The bacteriological analysis of water determines the potability of water. According to Indian

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standard (BIS, 1981) throughout the year 95% of samples should not contain any coliform organisms or should not be detectable in 100 ml of any two consecutive samples and no sample contains E. coli in 100 ml. The desirable limit of coliform in water is 10 MPN/100ml (ISI) [10].

Table - 1: Profile of micro-organisms according to source of water collected.

Source of water sample	No. of Sample collected	No. of Unsatisfactory sample (%)	Organism grown		
			Escherichia coli	Pseudomonas Sp.	Klebsiella Sp.
Municipal Tap Water	51 (51%)	32 (62.7%)	24	5	11
Government Hand Pump	27 (27%)	3 (11.1%)	-	3	-
Water Cooler	22 (22%)	14 (63.6%)	2	12	3
Total	100	49	26 (26%)	20 (20%)	14 (14%)

Table - 2: Species identification with biochemical tests in water samples.

Organism	MR	VP	Indole	Urease	Citrate
Escherichia coli	+	-	+	-	-
Klebsiella	+	-	-	+	+
Pseudomonas sp.	-	-	-	-	+

MR: Methyl Red, **VP:** Voges-Proskauer.

Table - 3: Distribution of mix population organisms with reference to sample numbers of drinking water.

No. of Sample	Organisms			
	Escherichia coli, Klebsiella Sp., Pseudomonas Sp.	Escherichia coli, Klebsiella Sp.	Escherichia coli, Pseudomonas Sp.	Klebsiella Sp., Pseudomonas Sp.
3	+	-	-	-
5	-	-	+	-
4	-	+	-	-
1	-	-	-	+

The water intended for human consumption must be free of pathogenic and chemical agents, pleasant to taste and usable for domestic purposes since water is the most important potential source of infectious diseases. Water purification is the most important potential available for ensuring public health. The survey report also revealed that every year several deaths particularly among children occurred due to water-borne disease. Even after more than 60 years of independence, access to safe water and

sanitation facilities remains a formidable challenge in developing countries including India [11].

In this study, fifty one, twenty seven and twenty two samples of water were collected from municipal tap water, government hand pump and water cooler respectively. Almost half of the samples were found to be unsatisfactory. E. coli was found to be responsible for 26% of samples whereas Pseudomonas in 20% of collected

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samples. MPN of coliform in case of water sample collected from municipal tap water was estimated to be very high (≥ 180) and in case of water from water cooler, it was 90, not portable, no coliform was detected from government hand pump supply for drinking.

E. coli and *Klebsiella* tested positive with Methyl Red whereas *Pseudomonas* sp. and *Klebsiella* tested positive with Citrate test reagent. *E. coli* showed positive result with Indole reagent whereas *Klebsiella* tested positive with Urease. According to Central Pollution Control Board India, total coliform organism MPN/100 ml shall be 50 or less in drinking water source. The consumption of drinking water contaminated with pathogenic microbes of fecal origin is a significant risk to human health [12].

This study has several strengths. We evaluated bacteriological quality of drinking water from various active sources of water which is a very vital point to study. In-depth analysis of this aspect has not been closely investigated by microbiology fraternity and experts in the field. The study has some limitations as well. Some may argue that the results obtained may not be applicable to general population. I agree because these findings are based on a single centre study from a western Uttar Pradesh. More multi-centric studies need to be carried out.

Conclusion

On the basis of findings of this study it can be concluded that the current active sources in the study area are not safe with regard to drinking water purpose. Surveillance of water sources and regular bacteriological assessment of all water sources for drinking should be conducted on regular basis.

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