The quality of water served in the Orotta National Referral Hospital

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Abstract

Background: The principal risks to human health associated with the consumption of unsafe drinking water are microbiological. According to the WHO and UNICEF report 2.6 billion people do not have access to good quality of water. About 1.1 billion people globally do not have access. About 2 million people mostly of less than 5 years children also die as a result of diarrheal diseases related to consumption of water that is microbiologically contaminated.
Objective: The objective of this study was to measure the quality of water served to the different sections of Orotta National Referral Hospital using WHO protocols.
Methods: Water samples were collected from different sources in the National Referral Orotta Hospital compound according to the WHO guidelines and the multi-tube method or most probable number method was used for the microbiological count.
Results: The findings from the study showed that some of the samples of water from National Referral Pediatric Hospital, and National Medical and Surgical Referral Hospital reservoirs did not meet some of the WHO guidelines for safe drinking water.
Conclusion and recommendations: The water contamination emanated from the reservoirs of the Orotta Hospital, because the samples taken as a control from outside the Hospital compound were free of contamination. Water reservoirs should be washed on regular basis. Chlorination and other treatment modalities for the water in the reservoir should also be considered and applied. Water quality surveillance should be done several times in a year not only just once.

Introduction

Access to safe drinking water is one of the basic human rights and is enormously crucial to health. Drinking water quality is a public health concern equally for developed and developing countries. For a nation to maintain optimal health and development there has to be continual supply of safe drinking water to its population [1].

According to the WHO guideline values for bacteriological quality, all water intended for drinking, treated water entering the distribution system, and treated water in the distribution system should not have detectable levels of Escherichia coli (E. coli) or thermotolerant coliform bacteria in any 100 ml of the water sample [2]. Immediate investigative action must be taken if either E. coli or total coliform bacteria are detected. The minimum action in the case of total coliform bacteria is repeat sampling; if these bacteria are detected in the repeat sample, the cause must be determined by immediate further investigation[1,2].

According to the presence of thermotolerant (fecal) coliform or E.coli, samples could be classified on color code scheme. A count of 0 E. coli per 100 ml of sample in conformity with the WHO guidelines is as category A (blue), 0-10 E. coli as category B (green) with low risk, 10-100 E.coli as category C (yellow) with intermediate risk, 100-1000 E. coli as category D (orange) with high risk, and >1000 E. coli as category E (red) with very high risk for drinking water[1].

Safe drinking water is the water that does not pose significant risk to health over a lifetime of consumption and is suitable for all usual domestic purposes, including personal hygiene.[1] Unsafe drinking water is a source of wide spread water borne diseases, be a recreational, agricultural or drinking, in a direct or indirect way have an effect on the human health[1].

The principal risks to human health associated with the consumption of unsafe drinking water are microbiological. Drinking-water is a vehicle for disease transmission. Some agents may be transmitted primarily from person to person and, for bacteria capable of multiplication in food, foodborne transmission may be more important than transmission by drinking-water. Other agents, however, such as Salmonella typhi, Vibrio cholerae, Giardia lamblia and hepatitis A virus, are frequently transmitted via contaminated drinking-water[1].

Drinking water could be contaminated at any point from the source up to the level of consumers [3]. The contaminants of water could be classified as biological, chemical, and radiological[1]. According to the WHO and UNICEF report 2.6 billion people do not have access to acceptable sanitation facility and about 1.1 billion people globally do not access to improved water source receive improved water source. About 2 million people mostly under 5 year children die as result of diarrheal diseases [2].

Public water systems have to undergo through a regular testing to ensure the safety of water. Since it is almost impractical to test for the wide variety of

pathogens in the water on regular basis for it is being very expensive, time consuming, water contamination is measured using bacteria which normally constitute flora in the intestinal tracts of warm blooded animals referred to as indicator bacteria [4]. The significance of coliform presence in drinking water implies contamination and /or animal feces [1,4-6].

Total coliform bacteria are commonly found in the environment (e.g., soil or vegetation) and are generally harmless. If only total coliform bacteria are detected in drinking water, the source is probably environmental. However, if environmental contamination can enter the system, there may also be a way for pathogens to enter the system. Therefore, it is important to find the source and resolve the problem [5]. Fecal coliform bacteria are a sub-group of total coliform bacteria. They appear in great quantities in the intestines and feces of people and animals. The presence of fecal coliform in a drinking water sample often indicates recent fecal contamination – meaning that there is a greater risk that pathogens are present than if only total coliform bacteria is detected [5]. E. coli is a sub-group of the fecal coliform group. Most E. coli bacteria are harmless and are found in great quantities in the intestines of people and warm-blooded animals. Some strains, however, can cause illness. The presence of E. coli in a drinking water sample almost always indicates recent fecal contamination – meaning there is a greater risk that pathogens are present [1].

In Eritrea 90% of the urban and about 70% of the rural population have access to safe drinking water supply. A nationwide survey done in 2006 showed that 60.5% of the test results from protected water sources revealed absence of bacterial contamination, 39.5% had contamination, where as one third of the samples from the water trucks were safe and two thirds of the samples indicated contamination [7].

The quality of water supplied to different sections of Orotta National Referral Hospital has not been systematically studied. The objective of this study is to measure the quality of water using WHO protocols.

Materials and Methods

This study is prospective study which examined samples of water which were collected from eight different sites within the Orotta National Referral Hospital complex according to the WHO of collection procedure standards. Two samples of water were collected from each of the eight sites with the first sample subjected to biological analysis whereas the second sample was for physicochemical analysis.

Microbiological and chemical analyses were done. The microbiological component had the qualitative and quantitative enumeration of the organisms identified. The principal methods used in the isolation of indicator organisms from water used by the WHO are the membrane-filtration (MF) method, the multiple-tube (MT) or most probable number (MPN) method and presence–absence test1. In this study the multiple tube method or most probable number was employed.

Laboratory confirmation of E. coli:

In the traditional method for detecting E. coli the water sample was inoculated to the laurly sulphate tryptose lactose broth for 24 hours in the presumptive test. E. coli ferments lactose to produce acids and gases. A positive test was production of gas and had to proceed to the next step to confirm that the gas producing organism in the water was E.coli. The sample from the positive presumptive test was inoculated to a selective culture media, brilliant green lactose broth and inoculated for 24 hours. After an appropriate incubation time, the tubes were examined for gas formation as before. The most probable number (MPN) of bacteria present estimated from the number of tubes inoculated and the number of positive tubes obtained in the confirmatory test, using specially devised statistical tables[4]. Then culture media with a special broth selective for individual or group of bacteria were prepared and allowed to grow for identification by biochemical identification.

Results

Microbiological Examination

The following sampling sites are coded National Referral Pediatric Hospital as 01, National Referral Medical Surgical Hospital, non kitchen water as 02, National Referral Medical Surgical Hospital, kitchen water as 03, from the truck directly as 03, Maternity Hospital as 04, Gynecology Hospital as 05, Nursing School kitchen water as 06, National Blood Bank, direct municipality water as 07, and Nursing School, kitchen water, Bladder water as 08.

The first sample of water from sites 01, 02 and 03 were all significantly contaminated especially site 01 (Table 1)

Table 1: Microbiological analyses for the first sample

Parameters	Results		
	01	02	03
Total coliforms/100ml at 370 C	15000	1100	1100
Feacal colifroms/100ml at 440 C	15000	1100	1100
E. coli/100ml at 440 C	15000	1100	1100

Shigella, salmonella, staphylococcus Aureus and yeast cells were not isolated from the above sampling sites where as Streptococcus group D was isolated from samples coded from 02 and 03 which signify a recent fecal contamination.

The physic-chemical properties

Table 2: Physicochemical Analyses for the first sample

Parameter	Results		
	01	02	03
Total hardness as caco3 (ppm)	108	608	110
Calcium hardness as caco3 (ppm)	70	330	74
Magnesium hardness (ppm)	38	278	36
Total alkalinity(ppm)	26	116	32
Chloride (cl-) concentration (ppm)	7.09	14.18	7.09
Total dissolved solids (ppm)	120	840	80
PH at 200 C	7.91	7.59	7.98
Conductivity (µ/cm)	251	1154	237
Calcium as ca++ in ppm	28.056	132.264	29.659
Magnesium as Mg++ in ppm	9.234	67.554	8.784

Table 3: Microbiological analysis for the second sample

Parameters	Results							
	01	02	03	04	05	06	07	08
Total coliforms/100ml at 370 C	23	48	23	0	0	0	0	0
Feacal colifroms/100ml at 440 C	23	48	23	0	0	0	0	0
E. coli/100ml at 440 C	23	48	0	0	0	0	0	0

Shigella, salmonella, staphylococcus Aureus, streptococcus group D, and yeast cells were not isolated from the above 8 sampling sites.

Table 4: Physicochemical Analysis for the second sample

Parameters	Results							
	01	02	03	04	05	06	07	08
Total hardness as caco3 (ppm)	104	600	100	100	98	92	104	108
Calcium hardness as caco3 (ppm)	74	328	70	72	70	66	80	72
Magnesium hardness (ppm)	30	272	30	28	28	26	24	36
Total alkalinity (ppm)	32	114	34	34	36	38	40	40
Chloride (cl-) concentration (ppm)	7.09	21.27	7.09	7.09	7.09	7.09	7.09	14.18
Total dissolve solids (ppm)	200	980	180	160	80	160	120	60
PH at 200 C	7.44	7.51	7.44	7.5	6.84	7.12	7.68	7.53
Conductivity (µ/cm)	232	1121	250	232	232	225	234	235
Calcium as ca++ in ppm	29.66	131.47	28.06	28.06	28.06	26.45	32.06	28.86
Magnesium as Mg++ in ppm	7.29	66.09	7.29	7.29	6.8	6.32	5.83	8.75

Table 5: Microbiological analysis for the third sample

Parameter	Results			
	01	02	03	03*
Total coliforms/100ml at 370 C	7	150	0	0
Feacal colifroms/100ml at 440 C	7	150	0	0
E. coli/100ml at 440 C	7	150	0	0

Shigella, salmonella, staphylococcus Aureus, streptococcus group D, and yeast cells were not isolated from the above sampling sites. The bacterial organism, E. coli was isolated from the sample coded 03 on biochemical analysis.

Table 6: Potability Report

Name of Institution	Type of samples	Code	Date	Bacteriology	Chemical
Pediatric hospital	Tap water from the reservoir after reaching high above the building but its source is underground reservoir connected to the municipality main line	01	22/01/08 28/02/08 10/03/08	All types of coliform have been isolated Not potable	potable

Medical surgical hospital	Drill water, water found close to the pediatric hospital. The water is pumped through electric Pump to medical surgical campus garden. Some times this water is used by outpatients, and kitchen purposes.	02	22/01/08 28/02/08 10/03/08	All types of coliform have been isolated Not potable	Not potable
Medical surgical hospital	Water is pumped into the 500 Meter cube, capacity reservoir built at the slope of forto.	03	22/01/08 28/02/08 10/03/08	The samples show coli forms Not potable	potable
MCH Maternity hospital	The reservoir is built at the slope Of forto close to residents, from this water reaches the hospital gravitationally.	04	28/02/08	potable	potable
Gyne cology hospital	Direct municipality water in their own reservoir.	05	28/02/08	potable	potable
College of Nursing and health technology	Municipality water in their own reservoir.	06	28/02/08	potable	potable
Water truck plate NO.3-04287 with a capacity of 18.5cubic meter.	Water hydrant near the coca-cola factory	03*	10/3/08	potable	potable
Collage of nursing and health technology	Water bladder with capacity of 50 barrels is permanently laid above a clean area.	08	10/3/08	potable	potable
National Blood Bank	Municipality water pipe entering the National Blood bank main building. Before entering a reservoir.	07	10/3/08	potable	potable

Discussion

The Orotta National Referral Hospital has several sources of drinking water and water for other purposes. Public water sources have to undergo through regular tests to ensure the safety of drinking water. The focus of this study was on the biological component of water contaminants which could be introduced at any point from its source to the level of individual reservoir in households or handlers. There was water sampling conducted on annula basis. Some samples of water had microbiological contamination. There is need to conduct water sampling as per WHO guidline in order to prevent water borne infections spreading to consumers of the contaminated water.

According to the WHO guideline values for bacteriological quality, all water intended for drinking, treated water entering the distribution system, and treated water in the distribution system should not be detected any by any E.coli or thermotolerant coliform bacteria in any 100 ml of sample. Immediate investigative action must be taken if either E. coli or total coliform bacteria are detected. The minimum action in the case of total coliform bacteria is repeat sampling; if these bacteria are detected in the repeat sample, the cause must be determined by immediate further investigation[1]. According to the presence of thermotolerant (fecal) coliform or E.coli, samples could be classified on color code scheme. A count of 0 E. coli per 100 ml of sample in conformity with the WHO guidelines is as category A (blue), 0-10 E. coli as category B (green) with low risk, 10-100 E.coli as category C (yellow) with intermediate risk, 100-1000 E. coli as category D (orange) with high risk, and >1000 E. coli as category E (red) with very high risk for drinking water[1].

The first set of tests was done as a yearly surveillance by the environmental health unit of the Orotta Hospital and the level of contamination was very high. According to the classification and color coded scheme for the thermotolerant E. coli it was category E red colored which was very high risk for drinking. Streptococcus group D was also identified in samples coded 02 and 03 which signified recent contamination. Then in the second round we increased the number of samples from different reservoirs in the Orotta Hospital compound and as a control outside from the hospital compound to study their safety. After the second results there were differences with the first results for the first 3 samples which were previously positive. Variation in microbiological test results of water sampling has been frequently reported finding making the quality of water fluctuating periodically hence the need for point of use treatment [8,9].

The main reservoir of Orotta Medical Surgical National Referral Hospital was found to be free of thermotolerant coliforms even though positive for feacal coliforms. The first five samples during the second round of tests were reached the laboratory 3 hours after their collection which may have contributed to the low count for the second time results.

In the third sample test the results showed that the contamination level is low and similar to the second sample tests but the kitchen water from the Orotta Medical Surgical National Referral Hospital were negative for the traditional methods of identification

even though it had shown the growth of E. coli on biochemical analysis. The values of sample 02 were relatively elevated in respect to the second set of tests.

During the third sample tests the water from Orotta Medical and Surgical National Referral Hospital got free based on the traditional method of identification. This could be explained that one day before the sampling date the remaining stagnant water at the bottom of the reservoir was eliminated.

Conclusion and recommendation

From this study it can be concluded that the biological quality of water of the National Referral Pediatric Hospital, and National Medical and Surgical Referral Hospital reservoirs did not meet the WHO guidelines for safe drinking water. Reservoirs should be washed on regular basis and underground reservoirs are prone to sanitary contamination and inconvenient to wash. It is advisable to change those underground and old reservoirs of Orotta National Referral Pediatric Hospital to another type of reservoir above the ground. In such situations chlorination of the reservoir should also be considered. There is also a possibility that the water trucks contaminating the reservoir, so the environmental health unit of Orotta Hospital had to control these water trucks strictly. The drilled water meant for garden purpose should not be used for kitchen purposes under any conditions and the screw for the tap should be held by the gardeners. Water surveillance should be done several times in a year not only just once as the current practice. The response to such alarming problems should be an emergency, since a hospital meant to treat patients is actually a source of diseases.

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