Journal of Natural Sciences Research
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.7, No.18, 2017

Water Quality and Management Practices among Parents/ Guardians in Households with Children Aged under Five Years in Munyaka Slum Eldoret

Jacqueline Mengech [1*] Njoroge S Mburu[1] Constance Tenge[2]
1. School of public health, Moi University, P.O BOX 4606-30100, Eldoret
2. School of medicine, Moi University, P.O BOX 4606-30100, Eldoret

Abstract
Treating water at the household level has been shown to be one of the most effective means of preventing water-borne disease. Promoting household water treatment and safe storage (HWTS) ensures that vulnerable populations take charge of their own water security by providing them with the appropriate knowledge and tools. The main objective of the study was to assess household water quality management practices among parents/ guardians in household with children aged under five years. The specific objectives were; to establish socio-demographic characteristics of parents/guardians with children aged under five, to establish community's perception and practice towards improving water quality and to determine if there is biological contamination of household water. This was a cross-sectional study of parents/ guardians in the households with children aged under- five years. Interviewer administered questionnaires were used to collect data on socio-demographic characteristics of parents/guardians, level of education, occupation, income, marital status, number of children, age range of children, and household water quality management practices: training on water safety practices, place of training, major source of drinking water for children, practices for water safety and reasons for not practicing water safety. Water samples were collected and analysed for biological contamination. Data was coded and entered using SPSS version 19. A correlation analysis was done between socio-demographic characteristics, and water quality management practice and also relationship between biological quality of water and household water quality management practices. Data were analysed and represented in tables, graphs and pie charts. A total of ninety six (96) households participated in the study. 84 (96.9%) of the respondents were married, 56 (58.3%) had attained primary education while 47(49%) indicated they were in business or unemployed, 82 (85.4%) earned an income of ten thousand shillings or less, 50 (52%) had two or three children. 62 (64.6%) had undergone some form of training on water safety whereby most were trained in schools. 41 (42.7%) of households practiced boiling, 7 (7.3%) chemical treatment, 1 (1%) hand washing before handling drinking water. Most households 91 (94.8%) in Munyaka slum used stored water collected from eight (8) communal piped water points. The samples collected from the 8communal water points tested negative for coliform bacteria. At the household level, 10 (10.4%) samples of water had coliform bacteria contamination above 10 counts/100ml which is not fit for drinking while 15 (16%) of water samples tested positive for E.coli. There was a strong positive correlation between socio-demographic characteristics and household water quality management practices variables whereby Pearson's r was 0.778. There was a strong positive and significant correlation between biological quality of waterand Household water quality management practices.($r = 0.836$, $p= 0.000$) Majority of the households in Munyaka with children aged under five years had parents/guardians who were married, had primary level of education, were either unemployed or in business with an income of less than 10,000 Kenyan shillings. Majority of parents/guardians had received training on water safety but few practiced water treatment. Contamination of drinking water occurred during storage.
Keywords: Water quality, Household water treatment and Storage

1. Background

According to Columbia Basin Trust (2013), Water quality is the term used to describe the condition of water—its physical, chemical and biological characteristics. Measuring those characteristics tells us whether water is suitable for a specific use especially for drinking.

Water treatment is, collectively, the industrial-scale process that makes water more acceptable for an end-use, which may be drinking, industry, or medicine. Water treatment should remove existing water contaminants or so reduce their concentration so that water becomes fit for its desired end-use, which may be safely returning used water to the environment (Boisson&Clasen, 2013).

The processes involved in treating water for drinking purposes include solid separation of solids using physical processes such as settling and filtration, and chemical processes such as disinfection and coagulation. Biological processes are employed in the treatment of wastewater and these processes may include, aerated lagoons, activated sludge or slow sand filters (Daniele & Robert, 2011).

Water quality management can be defined as the management of the physical, chemical and biological, characteristics of water (Sanders *et al.,* 1983).

Unsafe drinking water, along with poor sanitation and hygiene, are the main contributors to an estimated 4 billion cases of diarrhoeal disease annually, causing more than 1.5 million deaths, mostly among children under 5 years of age (WHO 2008).

Because diarrhoeal diseases inhibit normal ingestion of foods and adsorption of nutrients, continued high morbidity also contributes to malnutrition, a separate cause of significant mortality; it also leads to impaired physical growth and cognitive function, reduced resistance to infection, and potentially long-term gastrointestinal disorders. Contaminated drinking water is also a major source of hepatitis, typhoid and opportunistic infections that attack the immuno-compromised, especially persons living with HIV/AIDS. Outbreaks of acute watery diarrhoea (AWD) add to the disease burden and require costly diversion of scarce health and other resources to minimize fatalities. Diseases associated with contaminated water also exert a heavy economic load in the developing countries, both on the public health care system for treatment and on persons affected for transport to clinics, medicines and lost productivity. They also adversely impact school attendance and performance, particularly for girls and young women who must care for and assume the duties of ill parents and siblings (Iijima& Honda 2001).

2. Methods

Community entry was done through the local community leaders who were in charge of the six villages within Munyaka area. Questionnaires were administered to parents /guardians in households with children under five to collect data on socio-demographic characteristics of parents/guardians: level of education, occupation, level of income, marital status, and household water quality management practices: training on water safety practices, place of training, major source of drinking water for children, practices for water safety and reasons for not practicing water safety.

Water samples were collected from 96 households of research participants. The samples were then tested for the presence of faecal contamination using the Most Probable Number technique (Cheesbrough, 2000). Hands were washed carefully with soap and water before collecting water sample. Using a sterile 100ml bottle, the bottle cap was removed and water collected from the storage container ensuring that it was well shaken before pouring into the sterile bottle. The bottle cap was then replaced without touching the inside of cap or the mouth of the bottle. The bottles were then clearly labelled according to household identity. Samples were placed in a cool box filled with ice pack, transported to the lab and tested within 24 hours of collection. The double strength sterile media broth (mackonkey broth) was prepared by measuring 40.01g which was suspended in 1000ml of distilled water.

The solution was shaken thoroughly and then distributed into fermentation tubes with inverted durham tubes then sterilized at 121^0C for 15 minutes.

The sampled water were thoroughly mixed by inverting the bottle several times. The fermentation tubes were labelled according to household codes and then tubes were inoculated with water sample whereby 100 ml water sample was distributed (five 10 ml amounts and one 50 ml amount) in bottles of sterile selective culture broth containing lactose and an indicator and incubated at 44^0C for 24 hours. The results were recorded as positive presumptive if there was both acid and gas in any tube showing change of colour of broth from purple to yellow and bubble in the durham tube.

To confirm the positive test, 1ml of water sample was inoculated in a bijou bottle containing 3ml of sterile tryptone water. The tryptone water was prepared by measuring 15g of the medium in 1000ml of distilled water, distributed into a conical flask and sterilised at 121^0C for 15 minutes. The sample was incubated at 35-37 ^oC for 48 hours and tested for indole production by addition 0.5ml of kovac's reagent and shaking the mixture gently. If a red surface layer was observed within ten minutes the test was confirmed as positive for presence of E.coli.

2.1 Ethical consideration

The researcher obtained approval from the Institutional Research and Ethics Committee before commencing the study(IREC NO 0001337)

Research subjects signed an informed consent before enrolment into the study.

3. Results

3.1 Socio-demographic characteristics of the respondents

3.1.1 Marital status

	Frequency	Percentage	Cumulative Percentage
Married	84	87.5	96.9
Single	9	9.4	9.4
Widowed	3	3.1	100.0
Total	**96**	**100.0**	

Table1 showed 84(87.5%) married, 9(9.4%) single while 3(3.1%) widowed

3.1.2 Education level

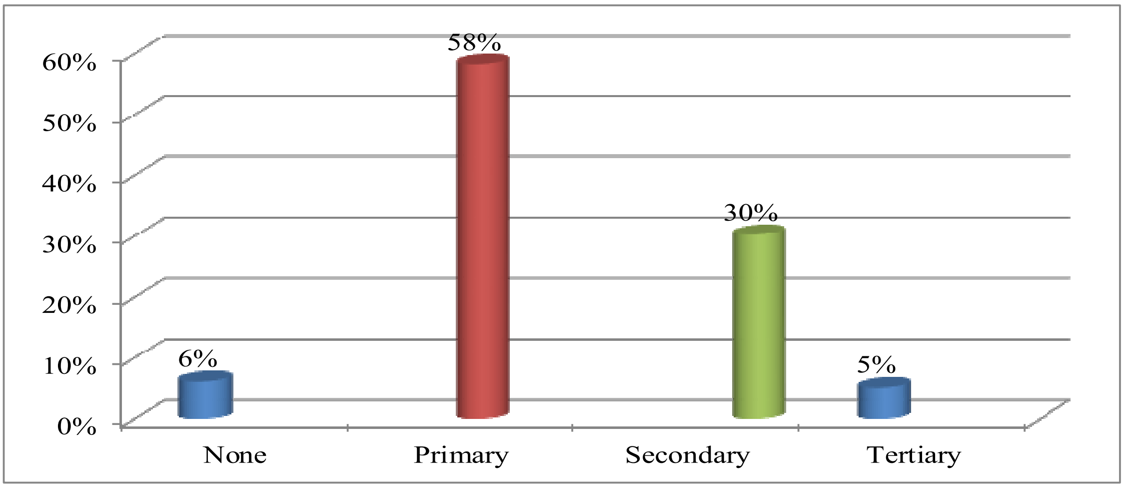


Figure1 shows the level of education of the participants, 56 (58.3%) had primary education, 29 (30.2%) had secondary education while 6 (6.2%) had no education and 5 (5.2%) said tertiary education.

3.1.3 Respondent's Occupation

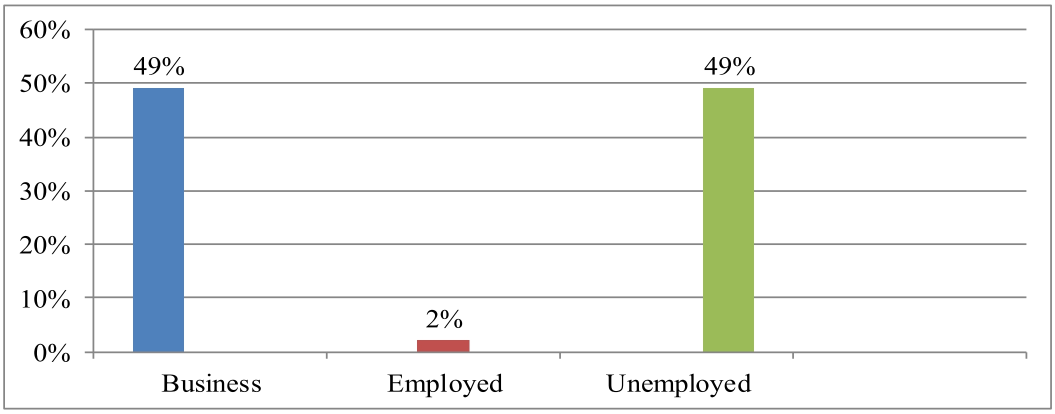


Figure 2 showed 47(49%) were business person, 47 (49%) unemployed and 2 (2.1%) were employed.

3.1.4 Household income

Ksh	Frequency	Percentage	Cumulative Percentage
0-10,000	83	86.5	86.5
10,001-20,000	11	11.5	97.9
20,001-30,000	2	2.1	100.0
Total	**96**	**100.0**	

Table 2 shows 82 (85.4%) indicated between ksh 0 to 10,000, 11 (11.5%) stated between ksh 10,001 to 20,000 and 2 (2.1%) indicated ksh 20,001 to 30,000. However, 1 (1%) didn't respond to that question.

3.2 Respondent's perception and practice towards improving water quality

3.2.1 Respondent's perception on safe water

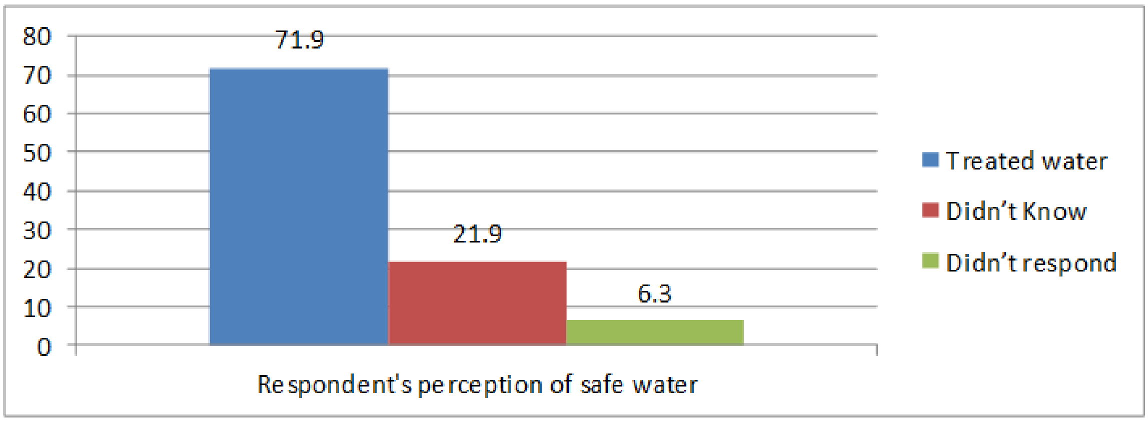


Figure 3 shows 69(71.9%) of respondents said that safe water is treated water while 21(21.9%) did not know what safe water is and 6 (6.3%) did not respond to the question

3.2.3 Training on water safety practices

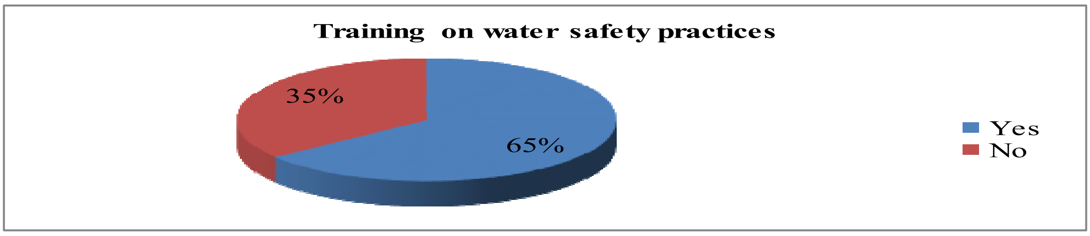


Figure 4 showed 62 (64.6%) had undergone training in water safety practices while 34 (35.4%) had not undergone any training on water safety practices.

3.2.4Place of Training

	Frequency	Percentage	Cumulative Percentage
School	29	30.2	46.0
Health centre	13	13.5	66.7
Health campaign	3	3.1	71.4
Seminars	6	6.2	81.0
Media	7	7.3	92.1
Social gatherings	4	4.2	98.4
Others	1	1.0	100.0
Total	63	65.6	
No response provided	33	34.4	
Total	**96**	**100.0**	

Table 3 showed 29 (30.2%) were trained in school, 13 (13.5%) trained at the health centre, 7 (7.3%) trained through the media, 6 (6.2%) trained in seminars, 4 (4.2%) social gatherings and 1 (1%) said other. However, 33 (34.4%) didn't respond since they have not undergone any training.

3.2.5 Practice for water safety

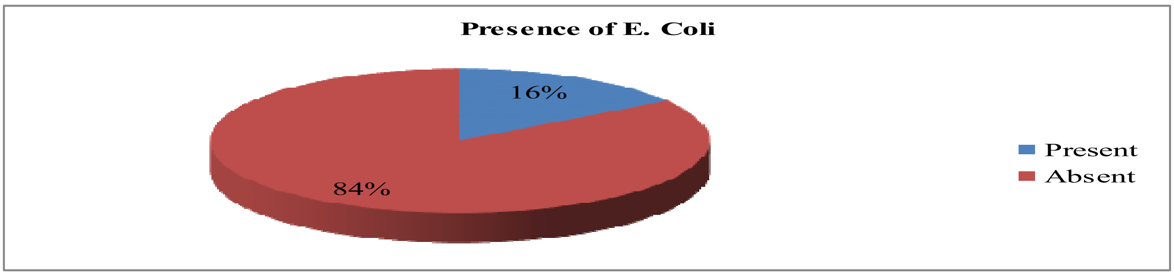
		Frequency	Percentage	Cumulative Percentage
	Boiling	41	42.7	75.9
	Chemical treatment	7	7.3	88.9
	Hand washing before handling drinking water	1	1.0	90.7
	Total	49	51.2	
No response		47	49.0	
Total		**96**	**100.0**	

Table 4 showed 41 (42.7%) practiced water safety through boiling, 7 (7.3%) practiced water safety through chemical treatment, 1 (1%) practiced water safety through hand washing before handling drinking water. However, 47 (49%) didn't respond to the question

3.3 Biological quality of water

3.3.1 Presence of E.coli

From the figure 5 below 15(16%) of water samples tested positive for E.coli while81 (84%) tested negative



3.3.2 Water quality category in Munyaka

Mean Count 44^{0}C, 100ml E.coli count	CATEGORY	Number of the tubes	Percentage of tubes	Comments
0	A	(44)	45.83	EXCELLENT
1-10	B	(42)	43.75	ACCEPTABLE
10-50	C	(10)	10.42	UNACCEPTABLE
>50	D	(0)	0	GROSSLY POLLUTED

Table5 shows that 44(45.83%) of households had 0 counts/100ml which is excellent while 42(43.75%) had 1-10 counts/100ml which is acceptable and 10(10.42%) had 10-50 counts/100ml which is unacceptable.

3.4 Correlation Analysis

3.4.1Relationship between socio-demographic characteristics and household water quality management practices

		Household water quality management practices Index
Socio-demographic characteristicsIndex	Pearson's Correlation Sig.(2 -tailed) N	0.778 .000 96

Correlation significant at the 0.01 level (2-tailed)

Table 6 indicate a strong positive and significant correlation between Community's perceptionand the Household water quality management practices(r=0.778, p= 0.000)

3.4.2Relationship between respondents' perception and household water quality management practices

		Household water quality management practicesIndex
Community's perceptionIndex	Pearson's Correlation Sig.(2 -tailed) N	0.601 .000 96

Correlation significant at the 0.01 level (2-tailed)

Table 7 indicate a moderately strong positive and significant correlation between Community's perceptionand the Household water quality management practices(r=0.601, p= 0.000).

3.4.3Relationship between biological quality of water and Household water quality management practices.

		Household water quality management practices. Index
Biological quality of water Index	Pearson's Correlation Sig.(2 -tailed) N	0.836 .000 96

Correlation significant at the 0.01 level (2-tailed)

Table 8 results of the correlation test indicated that biological quality of water is strongly affected by the Household water quality management practices (r = 0.836, p= 0.000).

4. Discussion

4.1 Socio demographic characteristics

4.1.1 Education level

The adoption of Household Water Treatment and Storage requires changes in behaviour (Figueora and Kincaid, 2010; Mosler, 2012; Mosler and Kraemer 2012). Majority of respondents indicated they have attained primary education.

Therefore, most of the respondents being fairly educated, they are able to act responsibly in the sense that they can be able to take charge of their drinking water by using the knowledge acquired in school to treat and store drinking water in clean covered containers at household level. Furthermore, information acquired from schools is vital for an educated household to have a changed mindset and perception regarding promotion of Household Water Treatment and Storage.

4.1.2Respondent's Occupation

One's occupation determines the level of income one gets and subsequently the type of water treatment option (Sobsey, 2002). In this study, majority (49%) of respondents indicated they are in business or unemployed. This could be as a result of have basic education which cannot secure them a job. In Kenya, most formal jobs require a minimum of a secondary school certificate.

Therefore, because of lack of jobs, it might lead them to opt to start up small scale businesses that can sustain their livelihood.

4.1.3 Household income

A household's income determines their lifestyle and if they can sustain protective measures towards their lives in this case of water treatment since this can be influenced by the amount of money spent. Majority (85.4%) of households in this study indicated that they earned an income of ten thousand shillings or less. This may be associated with that they have low level of education, with low paying jobs, reside in slums and therefore water quality is compromised.

This study concurs with a study by (Hutton, 2007), whereby the coverage of improved water and sanitation has been found to strongly correlate to household income as well as dwelling location. Also, (WHO, 2008), the affordability of water has a significant influence on the use of water and selection of water sources. Households with the lowest levels of access to safe water supply frequently pay more for their water than households connected to a piped water system. The high cost of water may force households to use alternative sources of water of poor quality that represent a greater risk to health. Furthermore, high costs of water may reduce the volumes of water used by households, which in turn may influence hygiene practices and increase risks of disease transmission Therefore, slum dwellers who mainly earn 10,000 shillings or less may find water treatment to be expensive.

4.2 Community perception and practice towards improving water quality

4.2.1 Training on water safety practices

Majority (64.6%) of households in this study indicated they have undergone the training. It is clear from the findings that good number of parents/ guardians in households have undergone training of water safety practices hence ensuring clean and safe water consumption hence reduce consumption of contaminated water. (WHO, 2008), recommends that support should be provided by a designated authority to enable community members to be trained so that they are able to assume responsibility for the operation and maintenance of community drinking-water supplies.

This can be attributed to the findings whereby majority of households had attained primary level of education. Therefore, training was acquired from schools.

4.2.2 Practice for water safety

The number of households that practiced water safety in this study concurs with the (Kenya national census report, 2009) that 50% of households in Kenya treated their drinking water. This study found out that Water treatment by boiling and chemical treatment were frequently practiced by respondents as methods of water treatment, fewer reported hand washing before handling drinking water. This is similar to studies whereby boiling has been the most common form of water safety practice (Clansen, 2008; Doocy and Burham, 2006). On the contrary, in Langas slum Eldoret, boiling was not a common practice despite contamination of water (Murage, 2007). The low percentage of chemical treatment concurs with (Harris, 2005), whereby there have been several attempts to utilize a purely commercial approach for household POU water treatment systems, but most have met with low levels of adoption and use. It may be costly for the low income earners to purchase chemical treatment and would rather boil since fire is readily available for cooking.

From the findings majority (22.9%)of those who did not practice point of use water treatment said the reason was time, while few indicated chemical availability. The major cause for not practicing water safety as time concurs with a study by (Cherunya *et al.,* 2015), in Ngoliba, Maguguni and Kangemi Gichagi mentioning inconveniences of time.

Chemical availability is a factor that can be explained by (Hystra, 2011), findings where there is low adoption rates of chlorine in retail context. This is because of donors availing the product and therefore its access from other sources is not promoted.

The proportion of water treatment recorded by this study was higher than that in a study done in Arusha in 2009,(51%) but within the range indicated in the Tanzania Demographic Health Survey of 2010 (Lijima, 2001). In Egypt it was found that 5.9% of households treated their water with any method (95%CI 5.2-6.7%) filtration and let it stand and settle were the common methods practiced. Also in study done by Ghislaine Rosa by extracting data from national surveys and reports on scope of HWT in 67 countries indicated that the proportion of water treatment by boiling in Uganda were 39.8% and Zambia (15.2%) whereby in Latin America chlorine is practiced by 17.1% of the households while Guinea Bissau (70.9%) and Mali (24.0%) strain drinking water through cloth.

4.3 Biological quality of water in Munyaka slum

In this study some (10.42%) of water samples collected had coliform bacteria contamination above 10 counts/100ml while few(16%) of water samples tested positive for E.coli. This concurs with a study in Koumassi district of Abidjan where E. coli was detected in 36(41%) of 87 stored water samples (Dunne *et al.,* 2001), and faecal contamination of drinking water containers being very high in developing countries even when the source was of good quality(Jensen *et al.,*2004).

The WHO guidelines states E. coli or thermo tolerant coliform bacteria should not be detectable in any water intended for drinking. Presence of E.coli in the tested water samples is an indicator of poor water quality and management practices at household level. This is because water samples collected at the communal water taps were all negative for E.coli and thermo tolerant coliforms.

The possibility of pollution of water between collection and use especially where communal taps are used, has long been recognised in a study done in Rwanda where low contamination of water was measured at source but significantly higher contamination levels at Point of use, a similar study found a substantial contamination in household water compared to source water arguing that the recontamination is due to both household collection of water from multiple water sources and partial recontamination of water in transport and storage (Jensen, and Dalsgaard, 2003). The microbial water quality frequently declines after collection (WHO, 2007).

Therefore, it is evident that Munyaka slum is not on track in terms of attaining access to sustainable safe water and sanitation facilities by 2030 according to sustainable development goals.

5. Conclusions

Majority of the households in Munyaka with children aged under five years had parents/guardians who were married, had primary level of education, were either unemployed or in business with an income of less than 10,000 Kenyan shillings. Majority of parents/guardians had received training on water safety but few practiced water treatment. Contamination of drinking water occurred during storage

6. Acknowledgements

Sincere thanks goes to Kenya Medical Research Institute in collaboration with the Terik Essential Program

Agency for Development (KEMRI/TEPAD) management and team for all support they offered.

7. References

1. Cheesbrough M (2000): District laboratory practice in tropical countries part 2
2. Cherunya P, Janezic C, Leuchner M (2015) Sustainable supply of safe drinking water for underserved households in Kenya: Investigating the viability of decentralised solutions.
3. Clasen T (2008). Scaling Up Household Water Treatment: Looking Back, Seeing Forward.Geneva: World Health Organization.
4. Columbia Basin Trust (2013) available at https://ourtrust.about.ourwork.communities
5. Daniele S. Lantagne, Robert Quick, and Eric D. Mintz, (2011) Household Water Treatment and Safe Storage Options in Developing Countries: A Review of Current Implementation Practices
6. Doocy S, Burham G (2006). Point-of-use water treatment and diarrhoea reduction in the emergency context: an effectiveness trial in Liberia. Trop Med Int Health. 11(10):1542-52
7. Figueora ME, Kincaid DL(2010). Social cultural and behavioural correlates of household water treatment and storage . Baltimore, MD, USA, John Hopkins Bloomberg school of public health, Centre for communication programs . Centre publication HCI 2010-01: Health communication insights; http://www.jhuccp.org/resource_centre/publications/centre/socialcultural-andbehavioral-correlateshouseholds
8. Harris J (2005). Challenges to commercial viability of point of use water treatment systems in low –income settings. MSC thesis, school of geography and environment, oxford university,UK.
9. Hutton G.(2007): Unsafe water and lack of sanitation. In solutions for the world's biggest Problems: Costs and benefits, Lomberg, B, Ed, Cambridge university press: Cambridge UK
10. Hystra (2011). Access to safe water for the base of pyramid: Lessons learned from 15 case studies; Hystra report: Paris, France.
11. Jensen PK, Jayasinghe G, Van der Hoek W, Cairncross S, Dalsgaard A (2003): Is there an association between bacteriological drinking water quality and childhood diarrhoea in developing countries
12. Kenya National Census Report(2009) available at: https//international.ipums.org.resources
13. Iijima Y, Karama M, Oundo JO, Honda T (2001): Prevention of bacterial diarrhoea by pasteurisation of drinking water in kenya
14. MoslerHJ(2012). A systematic approach to behaviour change interventions for the water and sanitation sector in developing countries: a conceptual model,a review, and a guideline. International journal of environmental health research, 22(5): 431-439
15. Murage E.W Kimani and Ngindu AM (2007): Quality of water the slum dwellers use: The case of a Kenyan slum. J.Urban Health
16. Sanders TG, Ward RC, Loftis JC, Steele TD, Adrianne DD and YevjehV(1983): Design of networks for monitoring water quality. Water Resour.pub., Littleton, Co.
17. Sobsey MD (2002). Managing water in the home: accelerated health gains from improved water supply. Geneva: The World Health Organization (WHO/SDE/WSH/02.07).Available at http://www.who.int
18. WHO (2007). Combating waterborne disease at the household level; World Health Organization; International Network to promote household water treatment and safe storage: Geneva Switzerland
19. WHO (2008): Guidelines for drinking –water quality, third edition, incorporating the first and second addenda, Vol 1 Geneva.