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Health Risks from Contaminated Water in the Public Water Distribution System in Rural Area

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Abstract: ***The study carried in the Holula village of Mandya district which is 7 km away from the city. Contamination of drinking water took place due to the leakage of the drainage waste in to WSS and consumption of this contaminated water caused outbreak of diarrhea and vomiting in the village more than 80 people where effected and 1 person died . When the tests conducted the result came out with without of cholera disease. The water samples were collected from the affected areas and the analyses was carried. A survey was carried in the village. According the survey the village as no proper drainage system, unhygienic condition and even the main water source is contaminated .This paper describes how HACCP can be applied to public drinking water supplies and This study was aimed to design comprehensive risk management based on hazard analysis and critical control points (HACCP) in the Holalu drinking water system. It outlines the approaches taken to risk assessment and identification of Critical Control Points and the integration of HACCP within water supply operations .the water samples were collected from affected area and the analysis conducted and the presence of E-coli.***

Keywords: HACCP, Drinking Water, Contamination

1. Introduction

Water is an important source for human life. Safe water is very essential for good health and wellbeing. Drinking water safety is different from general pollution the public health and safety concerns arising from unsafe drinking water are acute and immediate. If water is contaminated, people get sick or die. While waterborne disease and related fatality is commonly associated with lesser developed nations in critical water-related outbreaks [3]. Outbreak cholera took in Holalu village due to contamination of drinking water through the leakage drain water which got mixed in the water distribution system.

Hazard Analysis and Critical Control Point (HACCP) System:

"HACCP is a tool to assess hazards and establish control systems that focus on prevention rather than relying mainly on end-product testing." (FAO/WHO 1996). A Critical Control Point is "a step at which control can be applied and is essential to prevent or eliminate a food safety hazard or reduce it to an acceptable level. The intent of the HACCP system is to focus control at CCPs" (FAO/WHO 1996). [2]

HACCP is a systematic and preventive approach to achieve food safety standards. Originally developed in the United States to guarantee the safety of astronauts' food in space, HACCP is now being adopted worldwide as a scientific, straightforward and effective approach to enhance food safety. HACCP is increasingly being used in the water industry to address everything from routine contamination to security issues. HACCP is a food safety management system that can also be applied to drinking water supply. It has not, as far as we know, been formally introduced for this purpose. However, concepts of total quality management and quantitative risk assessment are increasingly being used to assure safe drinking water.[3] The major microbiological hazards in drinking water supply are pollution of raw water sources, recontamination of storage and distribution facilities for treated water and growth of pathogens in raw and treated waters. [1]

The seven principles of HACCP are:

- Conduct a hazard analysis.
- Determine the Critical Control Points (CCPs).
- Establish critical limits
- Establish a system to monitor control of the CCP.
- Establish the corrective action to be taken when monitoring indicates that a particular CCP is not under control.
- Establish procedures for verification to confirm that the HACCP system is working effectively
- Establish documentation concerning all procedures and records appropriate to these principles and their application.[2][6]

2. Materials and Methods

2.1 The Study Site

The research work was conducted in holalu village which is located around 7Km away from Mandya city and Holalu is a Village in Mandya Taluk in Mandya District of Karnataka State, India. It belongs to Mysore Division. It is located 7 KM towards west from District head quarters Mandya. 7 KM from Mandya Rural. 109 KM from State capital Bangalore Mandya (5 KM) are the nearby Villages to Holalu. Holalu is surrounded by Pandavapura Taluk towards west, Maddur Taluk towards East, Shrirangapattana Taluk towards west, Malvalli Taluk towards East. Mandya, Maddur, Shrirangapattana, Malavalli are the nearby Cities to Holalu.

Salient Features of Holalu village in Mandya Taluk, Mandya District

Located 5 kilometers away from the city Population 7012 Health facilities available in Holalu village are:1 Primary health care center, 1 Sub center , 4 Anaganwadis & , 4 Accredited social health activists Residents of Holalu village on the outskirts of the city admitted to the Mandya Institute of Medical Sciences (MIMS) and other hospitals with symptoms of gastroenteritis have been confirmed to be suffering from cholera. One person died of cholera and at least 50 have been admitted to hospitals since Wednesday. Subsequently, the District Health and Family Welfare Department declared the village as "cholera affected."

2.2 Sampling location and analysis

The objective is to study the source of contamination based on critical control point analysis The water sample were collected from the effect area i.e. from the chikkibidi overhead tank and bhasevara circler overhead tank and from the taps through which the OHT water are distributed, the analysis the water quality parameter and find the risk or the critical control point

According to the HACCP principle [5][4]

- **Conduct a hazard analysis**. The work was carried to analysis the hazard and to identify the critical point were the exactly the water is contaminated. The water samples were collected from the main source and in the distribution system were the leakage and contamination where took.
- **Determine the Critical Control Points (CCPs).** Is finding were the exact problem is arising or step at which control can be applied and is essential to prevent or eliminate the hazard.
- **Establish critical limits:** Since the critical point is analyzed or establishing a system to monitor control of the CCP**.** Control at CCPs. The HACCP plan includes the process steps of the treatment, the identified hazards, the preventative measures, the determined critical control points, a monitoring system, and the critical limits of CCPs' monitoring parameters as well as the necessary corrective actions.
- **Establish A CCP Monitoring System** Control of the critical limits in the CCPs is a dynamic and proper system to measure and present specific quantitative and qualitative parameters as soon as possible, to react quickly, and take the corrective actions required for returning to the normal and desirable mode.
- **Establishing Corrective Actions** Action to be taken if monitoring indicates that a specific CCP is no longer under control Actions need to be taken by the staff of the operation section in the water treatment and distribution system at the time of any deviation from an established critical limit.
- **Establish Verification Procedures** Establish procedures of verification to confirm a successful working of the HACCP system Application
- **Establish Documentation and Recordkeeping -** Develop a record keeping system to track system performance at CCPs Introduce a documentation system taking into account all processes and records in accordance with the principles and their application.

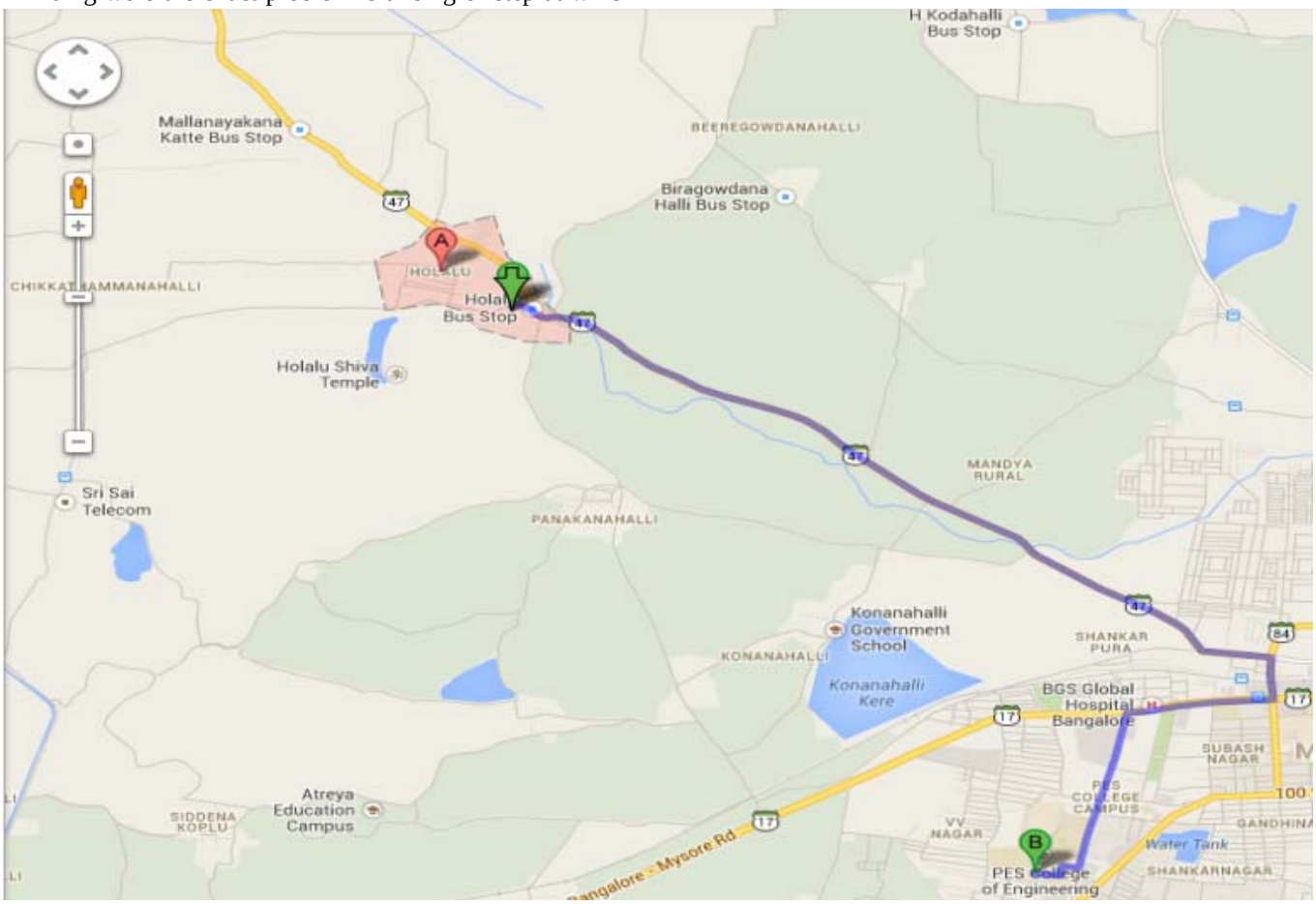

Figure 1: Location Map of Holalu Village In Mandya District

3. Results

After the outbreak of the epidemic, control and preventive measures were initiated. The piped water supply was stopped as transmission was localized to households getting water from a particular water tank. The water was tested by the primary health care and district surveillance office and the water was found not fit for consumption. In the below given tables 1 and 2 the result shows that the water is not suitable for drinking.

Table 1: Tested Result Value Of during outbreak

S. No	Parameters	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
1	pH	7.46	7.57	7.36	7.7	7.25	7.12	7.18	7.96	7.55	7.70
2	TDS	1100	500	500	700	1000	1000	800	800	200	200
3	Total hardness	1400	680	720	940	840	640	920	840	240	396
4	Chloride	728	224	224	560	252	140	476	420	56	84
5	Nitrate	75	60	60	80	100	75	75	100	85	50
6	Iron	0.6	0.4	0.4	0.4	0.6	0.4	0.4	0.4	0.2	0.2
7	Fluoride	0.4	0.4	0.4	0.6	0.4	0.4	0.6	0.2	0.4	0.2
8	Bacteria	P	p	P	P	p	P	P	p	p	P

Table 2: Tested result value of after the outbreak

S. No	Parameters	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
1	pH	7.45	7.63	7.36	7.64	7.29	7.05	7.06	7.50	7.47	7.26
2	Electrical conductivity, µS/Cm	658	656	661	666	657	647	654	659	663	687
3	Total dissolved solids, mg/L	329	328	330.5	333	328.5	323.5	327	329.5	331.5	343.5
4	Total hardness, mg/L	240	274	242	260	276	266	262	272	262	220
5	Calcium hardness, mg/L	188	256	226	258	218	202	240	206	204	206
6	Magnesium hardness, mg/L	52	18	16	02	58	64	22	66	58	14
7	Total alkalinity, mg/L	334	374	368	340	368	352	390	378	394	396
8	Calcium , mg/L	75.2	112	90.4	103.2	87.2	80.0	96	82.4	81.6	82.4
9	Magnesium , mg/L	50.81	53.72	54.78	55.2	53.32	56.45	54.24	35.61	35.53	35.47
10	Sodium, ppm	62. 9	57.4	66.5	64.2	62.4	65.2	67.3	35.9	36.3	43.8
11	Potassium, ppm	3.2	3.1	3.3	3.2	3.4	3.1	3.2	5.2	5.1	5.4
12	Chloride, mg/L	64	46	50	60	64	45	58	57	49	45
13	Sulphate, mg/L	25	28.2	26.2	26.2	18.8	21.3	25	62	65	78
14	Nitrate, mg/L	71	68	52	45	58	60	45	65	70	55
15	Ortho-phosphate, mg/L	0.258	0.186	0.184	0.181	0.194	0.143	0.172	0.278	0.334	0.305
16	Fluoride, mg/L	1.2	0.8	0.9	0.6	0.7	0.5	0.6	0.8	0.9	0.6
17	Iron, mg/L	0.2	0.3	0.4	0.2	0.2	0.4	0.3	0.2	0.2	0.2
18	E-Coli, No/100ml	10	11	9	12	8	10	13	12	11	12

3.1 Health Risk Caused In the Rural Drinking Water System

An epidemic of acute of Dearrial diseases occurred in holalu between 19 October to 4 no 9 was. A total of 252 Mandya institutes of medical sciences, and K R hospital, Mysore higher no of41 cases were reported .on 25 oct 2013. After the outbreak of the epidemic, control and prevent measures were taken. The piped water supply was stopped as the transmission was localized to household getting water from particular tank. The water was tested by Primary Health Care (PHC) and the district surveillance office and the water was found not fit for drinking.

Water supply was provided by tankers. Street food were stopped the team went to Holalu village and a spot map of add cases that occurred in the past 24 hours. The water source of the street was enquired and the water supply was stopped through which the residents were getting from the borewell. The street does not have drainage system in the village. The sullage is let into the road side to form puddles. The people practice the open air defecation and do not have clean Some of the adjacent street drainage system into which sewage is discharge. Collects on and around the valves of the water supply pipes. Even the hand pumps found the stagnations the sewage also the presence of cows and ox inside the houses and the presence of cow dung in the houses, beside the houses and the street help the breeding of houseflies.

4. Recommendations

- Regular cleaning of the over head tanks is necessary.
- Training and safety precaution should be given to the water man.
- Water samples should be tested frequently.
- Educating and Awareness of health, hygiene and environment should be carried.
- Separate sheds for animals and adequate measures to manage the cow dung.
- The increase in the number of cases is due unhygienic practice.
- Underground drainage system should be constructed as soon as possible to prevent such out breaks in future.

5. Conclusion

The outbreak of cholera took mainly due to improper maintains of the water distribution and Lack of drainage facility and pits. After all primary precaution and the measure taken the situation was in control. According to the HACCP the critical point is main water source which shows the presence of nitrates and E-coli since the source of groundwater is nearer to the stream and surrounded with the agriculture land and other poultry forms of pig is duly subjected to contamination.

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