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Original Article

Revelations of an overt water contamination

Maj Gurpreet Singh [a,*], Col S.K. Kaushik [b], Air Cmde S. Mukherji [c]

[a] Assistant Professor, Department of Community Medicine, Armed Forces Medical College, Pune 411040, India
[b] Associate Professor, Department of Community Medicine, Armed Forces Medical College, Pune 411040, India
[c] Professor & Head, Department of Community Medicine, Armed Forces Medical College, Pune 411040, India

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ABSTRACT

Background: Contaminated water sources are major cause of water borne diseases of public health importance. Usually, contamination is suspected after an increase in patient load.
Methods: Two health teams investigated the episode. First team conducted sanitary survey, and second team undertook water safety and morbidity survey. On-site testing was carried out from source till consumer end.

Investigation was also undertaken to identify factors which masked the situation. Prevention and control measures included super chlorination, provision of alternate drinking water sources, awareness campaign, layout of new water pipeline bypassing place of contamination, repair of sewers, flushing and cleaning of water pipelines, and repeated water sampling and testing.
Results: Multiple sources of drinking water supply were detected. Water samples from consumer end showed 18 coliforms per 100 ml. Sewer cross connection with active leakage in water pipeline was found and this was confirmed by earth excavation. Water safety and morbidity survey found majority of households receiving contaminated water supply. This survey found no significant difference among households receiving contaminated water supply and those receiving clean water. Average proportion of household members with episode of loose motions, pain abdomen, vomiting, fever, and eye conditions was significantly more among households receiving contaminated water.
Conclusion: The present study documents detailed methodology of investigation and control measures to be instituted on receipt of contaminated water samples. Effective surveillance mechanisms for drinking water supplies such as routine testing of water samples can identify water contamination at an early stage and prevent an impending outbreak.

Introduction

Health of a population can be determined by evaluating the quality of drinking water supply.[1] Contaminated water sources are major cause of transmission of diseases of public health importance. Globally, at least one-fifth of population is using drinking water sources which are implicated to be contaminated with feces. Diarrhea, due to consumption of contaminated water results in more than 5 lakh deaths

* Corresponding author.
E-mail address: drgurpreet.md.afmc@gmail.com (G. Singh).
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annually worldwide.[2] In developing regions, the situation is much worse and contaminated water supplies are one of the major sources contributing to high morbidity and mortality.[3]

All efforts should be made to avoid deficiencies in water supply distribution systems. Drinking-water supply surveillance is ''the continuous and vigilant public health assessment and review of the safety and acceptability of drinking-water supplies''.[4] Early identification of contaminated water supplies and prompt institution of control measures are of utmost importance in water systems security for maintenance of public health.[5,6] Foundation for prevention and control of waterborne illnesses is laid through assurance of safe and wholesome drinking water supplies.[1] Inadequate treatment facilities, malfunctioning disinfection systems, and inappropriate treatment practices have been found to be related to occurrence of outbreaks.[7] Besides this, the water transmission system till consumers is also equally important. All the gains of earlier handling of water have potential to nullify if contamination occurs enroute.[8]

Identification of contaminated water supplies can be missed when contamination is intermittent and physical characteristics are unaffected.[9] In fact, usually water contamination is suspected after an increase in patient load due to water borne diseases reporting to a health set up.[5] The present study was carried out to investigate and control an overt water contamination but as the investigation proceeded, it revealed a covert increase in disease burden due to water related diseases and factors which had masked the situation.

Background situation

In the setting of a tertiary care teaching institution having multiple residential complexes for teaching faculty, paramedical staff, postgraduates, undergraduates, and paramedical trainees are located inside the campus. Additionally, canteens, cafeterias, mechanical laundry, religious temples, and cook houses are co-located in the campus. Newer expansion, like in most old institutions, has been done in available vacant spaces. As a result, underground water, electricity, and sewage systems are either burdened with additional load or a new system is put in place with little concern for the older one. Further because of the transferable nature of the job, the staff working in water works department is unaware of the layout of pipelines. Multiple health care establishments (HCE) in the form of Medical Inspection Rooms and hospital are present in close vicinity to these complexes. With this background, a water sample from one of the households was received in the department for examination which was foul smelling, turbid, brown colored, and contained larval forms and maggots.

Material and methods

Formulation of health teams

On receipt of water sample, individual carrying the sample was interviewed about the details of water sample. Two health teams were constituted to investigate the situation and concurrently institute control measures. The teams consisted of faculty, post-graduate trainees, and health assistants undergoing paramedical training. Team members had been trained earlier (as a part of routine teachings) on all aspects related to 'Water'. However, the teams were briefed about the situation and emphasis was placed on conduct of sanitary surveys, water sampling and testing, and conduct of household surveys. Water sampling and testing kits and household survey questionnaires were provided to the health team members at the end of the session. First team carried out sanitary survey of water pipelines to affected residences and second team undertook water safety and morbidity survey.

Pipeline sanitary survey

Multiple site visits were undertaken by the health team to assess the extent of contaminated water supply and identify likely source of contamination. During the survey, at consumer end, starting from the affected household the members of the team tested water quality fanning out in a centrifugal manner till they either reached a house with clean water supply or they located the defect in the pipeline. On-site water sampling and testing was carried out from source till consumer end. They also tested water at the inlet and outlet from overhead water tanks on top of each multistoried building. At the source end, water samples were tested at inlets to pump house, in stored sump water and at outlet of pump house. Onsite testing of water samples included physical examination of the quality of water supplies and testing for presence of free residual chlorine level using Orthotolidine test. Water samples were also collected in sterile bottles using aseptic precautions and sent to Department of Microbiology for Presumptive Coliform Counts.

Manual tracing and earth excavation of water and sewer pipelines were carried out for identification and visual confirmation of contamination sources and to update 'layout' maps. Route along the pipelines was looked for presence of features suggestive of leakages, deliberate break in the lines, water lines crossing the drains, and sewer line cross connections.

Water safety and morbidity survey

Water safety and morbidity survey was conducted among households in paramedical residential complexes to determine any increase in incidence of water borne illnesses and if so, to identify factors which masked the situation. Data were obtained from female heads of households after receiving informed consent. Pre-structured, interview based questionnaires were administered. Data collection was carried out to determine socio-demographic factors, water treatment practices, water storage practices, handwashing practices, occurrence of water related diseases, and treatment seeking behavior during the episode of illness. These factors were compared among those households receiving clean water supply and those who were not to rule out effect of factors other than contaminated water supply which might have led to significant differences in morbidity profile among the groups. Data were entered into excel and were analyzed using SPSS version 21.0.