Chapter I

Introduction
INTRODUCTION

Water is an important and precious natural resource that needs to be protected and managed, whether for use as drinking water or for recreational purposes. If not monitored or treated, water may be the vehicle for the spread of infectious diseases. The occurrence of waterborne diseases in developed countries is less due to a good system of water treatment, distribution and monitoring. Waterborne diseases are among the leading causes of morbidity and mortality in developing countries. Thus, it is important to improve the availability of potable water and maintain its quality for domestic uses.

The distribution of safe drinking water in the rural areas is the responsibility of the States. Funds are being provided for provision of the facility in the State budgets right from the First Five Year Plan period. The Accelerated Rural Water Supply Programmes (ARWSP) was introduced in 1972-73 by the Government of India (GOI), to assist the States and Union Territories to accelerate the distribution of drinking water supply. To ensure the scientific and technical input into the rural water supply sector to improve the performance, cost effectiveness of the on-going programmes and ensure adequate supply of safe drinking water, the entire programmes was given a Mission approach. The Technology Mission on drinking water and related water management was launched in
1986. It was also called the National Drinking Water Mission (NDWM) and was one of the five Societal Missions launched by the Government of India. The NDWM was renamed Rajiv Gandhi National Drinking Water Mission (RGNDWM) in 1991. It was realised that the objective of supplying safe water would not be achieved unless the sanitary aspects of water and the issue of sanitation are addressed together. The Centrally Sponsored Rural Sanitation Programmes (CRSP) was developed in 1986 with the overall objective of improving the quality of drinking water for the life of the rural people. That the two programmes, the ARWSP and the CRSP, implemented simultaneously would help break the diseases, morbidity and poor health, resulting from water borne diseases and in sanitary conditions.

The useful purpose for measuring the microbial quality of water is education. Teaching the people about the microbial quality of water and the fundamentals of germ theory within the education and other programs for water sanitation and hygiene at the individual, household, community and regional levels is a continuing and long term goal in the global health initiative. During these educational messages the availability of simple, practical, accessible and affordable tests for fecal contamination of drinking water are extremely useful and potentially powerful tools. In some situations the best tests to perform these goals are those that are the simplest to use, understand, visualize and interpret. This tests can be widely
disseminated both directly by the primary educators and then subsequently via communications within households, families, schools and communities and by other means (educational materials such as leaflets, signs and labels). For these purposes the $H_2S$ tests and other simple and affordable tests have great value and even greater potential use for drinking water supply management and health education in the water and sanitation sectors.

An essential goal for the provision of safe drinking water is that it must be free from disease producing microorganisms. Since the beginning of the 20th century, the detection of fecal indicator bacteria in drinking water has been used as the basis of criteria, guidelines and standards for acceptable limits of fecal contamination. The WHO Guidelines for Drinking-water Quality (GDWQ) and many other authorities continue to support the use of bacterial indicator levels and their measurement as a basis for judging and verifying drinking water quality. However, such fecal indicator analysis of drinking water as a measure of end-product quality and determinant of microbial disease risk is only one of many measures and activities for providing safe drinking water. In the updating of the WHO GDWQ, the goal of providing safe drinking water will be to move up through the development and use of a Water Safety Plan. This plan includes risk assessment, water system assessment and process control that examines all aspects of drinking water from its source, through
treatment and distribution (or collection and storage) to the consumer. It uses a management plan that incorporates Hazard Analysis-Critical Control Points (HACCP). In such a plan the measurement of fecal indicator in water is the important tools and not always among the most critical ones for process of collection, production and distribution of drinking water of acceptable microbial quality. Nevertheless, measures of indicators of water quality, particularly those measuring the indicating fecal contamination, are useful if not essential tools in the provision of safe drinking water. The ability to easily, rapidly and affordably detect fecal contamination in drinking water is still a desirable goal and worthy endeavor in the overall effort to provide microbiologically safe drinking water.

The principle objectives of the UN International Drinking Water Supply and Sanitation Decade was to provide safe drinking water. Water sources in most of the areas of the world remain untested because of the cost of conventional method for assessing water quality. In the Indian society there is no knowledge about hygienic condition. So the water gets contaminated by several ways. Due to this there is high increase in the risk of infection in the community. To overcome this problem the International Development Research Centre (IDRC) has supported research in the development of simpler and cheaper test (IDRC, 1990).
In addition to these purposes and needs, analysed the microbial quality of water for presence of fecal contamination is for community involvement and empowerment in the provision, management and monitoring of drinking water, including its sources and treatment. The great efforts are being made to encourage local participation in the provision of safe drinking water and in the oversight or monitoring of its provision by other responsible parties (governments, privatized water companies, water supply contractors, water vendors, etc). The ability to test drinking water for fecal contamination is a powerful and empowering tool for these purposes.

Around 2.2 million people die due to water borne disease like typhoid, dysentery, diarrhoea etc. every year. Interventions in hygiene, sanitation and water supply proved to control theses diseases. For decades, universal access to safe water and sanitation has been promoted as an essential step in reducing this preventable diseases (WHO, 2000). Nevertheless the target of “universal access” to improved water sources and basic sanitation remains elusive. The “Millenium Declaration” established the lesser but still ambitious goal of halving the proportion of people without access to safe water by 2015. The sole responsibility of Public health and Engineering Department to ensure the safety of public water supply and to eliminate the agents of water borne infectious diseases. Water is recognized as an important factor in the transmission of
many diseases. It is therefore, of great importance to remove all the pathogenic organisms from drinking or polluted water. Polluted waters, especially those polluted by domestic sewage and discharge from slaughter houses which are the potent source of infectious diseases.

In India 80% of the infectious diseases are water borne and 50% death of children due to water borne diseases. The most common water borne diseases are typhoid, cholera, shigellosis, viral associated water borne diseases and infectious hepatitis (WHO, 1993). Infectious hepatitis outbreak of New Delhi in 1955-56 was one of the largest epidemic of waterborne infection is due the faecal pollution of drinking water (Dennis, 1959).

According to WHO not all potential waterborne human pathogens are equal in public health significance. Some of them present a serious risk of disease whenever they are present in the drinking water and are given high priority for health significance. They include organisms like Escherichia.coli, Salmonella typhimurium typhi, Shigella dysenteriae, Vibrio cholerae. On the other hand some organism may cause disease opportunistically. These organisms cause infection mainly among people with reduced natural defense mechanism.

The pathogens of origin, drinking water are the main route of transmission. Unhygienic practices during the handling of food, utensils and clothing also play an
important role. Humans are typically the carriers of large populations of these bacteria, protozoa, and viruses (WHO, 1996). Pathogens originating from human sources, often from human feces, are called enteric. (of intestinal origin) pathogens. The intestine of many domestic and wild animals, their meat, milk and dairy products, are sources of the bacteria Yersinia enterocolitica and Campylobacter (WHO, 1996). The persistence of a pathogen in water also affects their transmission to humans. A more persistent pathogen that can survive longer outside the host body is more likely to be transmitted to other people. The infective dose (ID) of the pathogen determines the number of organisms needed to produce an infection in humans.

The transmission of disease caused by pathogenic microorganisms in drinking water represents a health risk in all societies. Therefore, unpolluted safe drinking water is usually considered one of the primary requests for healthy human life (Pillai et. al., 1999). However, in developing countries, there is often a lack of resources to reliably test the performance of water treatment and distribution systems. In response to this need, a simple test developed by Manja et. al., (1982) detects potentially pathogenic microorganisms in water by using hydrogen sulfide (H₂S) producing bacteria as indicators.

There are many other causes of waterborne disease outbreaks. They include treatment deficiencies and
the consumption of contaminated groundwater. Therefore, improvements in the of water, sanitation facilities, and general hygiene education will all contribute to the reduction of morbidity and mortality rates due to waterborne diseases (Munasinghe, 1990).

As the IDWSSD progressed, further studies suggested that water supply, even when combined with sanitation, was relatively ineffective as a health improvement measure without a well-integrated hygiene education programmes. Still, however, most projects continued to measure water supply alone with sanitation and hygiene education as relatively minor and under funded components. The main reason for this was that most sector professionals were engineers and hydrogeologists with little experience that could be applied to the design and implementation of meaningful sanitation and hygiene education programmes. In addition, health impact studies yielded few definitive conclusions that could "prove" in quantitative terms the relative importance of water, sanitation and hygiene education. Even to date, comprehensive and conclusive health impact studies of water, sanitation and hygiene education have proven to be notoriously difficult to design and interpret, and expensive to implement.

In the 1990s, experience from many projects, and the cumulative results from an increased number of health impact studies (taken together to compensate,
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partially, for the inconclusiveness of most individual studies), have led to a consensus among most sector professionals that: isolated water supply interventions are not effective in the prevention of disease; sanitation alone has a larger impact on health than does water alone; hygiene education, together with sanitation, has more of an impact on the reduction of water borne diseases than does water (because many of the causes of water borne diseases are not water-borne); improvements in the quality and quantity of water in communities continues to be important for public health, if implemented together with effective sanitation and hygiene education programmes.

To build up a human resource base of appropriately trained personnel to serve the needs of the water supply and sanitation sector the National Human Resource Development Programme (NHRDP) was launched in 1994. The major objectives of the NHRDP to introduce orientation in technical education sector coupled with publication of manuals on water supply and sanitation. The implementation of the NHRDP involves:

Grassroots Level Training Programmes.

- Operation and Maintenance of hand pumps.
- Construction of sanitary toilets and other rural sanitation facilities.
- Motivation for community support mobilization.
- Health education and hygiene promotion.
The main objective of the campaign programme is to impress upon persistently hygiene sense and bring about a change in the concept attitude of the people towards water and sanitation. Slogans/messages related to water and sanitation have been printed on post cards and inland letter cards in Hindi, English and ten other regional languages. The Doordarshan is telecasting spots relating to sanitation (hand washing and latrine construction).

As a consequence of this thinking, sanitation and hygiene education are now becoming at least as important as water supply in UNICEF-assisted programmes, and resources are being allocated (and appropriately qualified professionals posted) accordingly. Water continues to be important in public health programmes as a component of integrated WES programmes, and as a necessary precondition to all hygiene education programmes (which are impossible without water) and most sanitation programmes (especially in societies where water is culturally necessary for excreta disposal).

Impact of personal and domestic hygiene on the transmission of diarrhoeal diseases.

A number of control measures based on specific behavioural changes or on simple technologies that can be used in the home have the potential to interrupt the transmission of diarrhoeal diseases. For example, the promotion of hand-washing can reduce the incidence of
diarrhoeal diseases in certain settings. Behavioural research is needed to clarify the relationship between specific practices that may promote the transmission of enteric pathogens (such as the unhygienic handling of food, careless disposal of infants’ stools, or the improper use of containers for water storage in the home) and the risk of diarrhoea of known etiology. Studies should also be conducted in various cultural and socio-economic settings to measure the impact of carefully designed education programmes. These studies should be etiology-specific and document the impact on diarrhoea severity as well as incidence. They should also document the feasibility, acceptability, and cost of the intervention, and assess its dependence on pre-existing resources (e.g., abundant water supplies, availability of soap).

Interest in the role of education in disease control has increased considerably in recent years. It is probable that better education communities enjoy relative protection against several diseases compared to less educated, but otherwise similar, communities. The protection may be conferred both by general education and by diseases specific education. Diseases specific education can preventive or therapeutics in content.

The effects of improving personal and domestic hygiene on water borne diseases morbidity were reviewed using data form studies in hospitals, day-care centers and communities (Feachem 1984). There is evidence that low
educational attainment and certain religious customs predispose to water borne diseases, presumably because of behavioural factors. The specific hygiene related behaviour that has been most studied is hand washing. The studies suggest that enteric pathogen can spread via contaminated hands and that hands can be decontaminated by washing with soap and water. Three studies from Bangladesh, the USA and Guatemala on the impact of hygiene education programmes on water borne diseases are reviewed in detail. Reductions in water borne diseases incidence rates of between 14% and 48% were documented in these studies. Little is known on the impact of hygiene education programmes on water borne diseases of specific aetiology or of their impact on water borne diseases mortality. Information is lacking on the optimal design of such programmes, on their costs and on their dependence on pre-existing levels of sanitary facilities.

Water borne diseases control can also be attempted by promoting the use of specific water purification or protection technologies in the home. The secondary transmission of water borne diseases in Calcutta was reduced by encouraging families to add chlorine tablets to stored water and was reduced still further by providing families with earthenware water storage vessels having a narrow inlet and a spout (NICED 1985). The secondary transmission of cholera was also reduced in Dhaka by encouraging families to treat stored water with alum potash.
which promotes sedimentation and lowers the pH (Khan et. al., 1984). However, home chlorination of stored water in a rural area of north-eastern Brazil did not reduce water borne diseases incidence rates, although it greatly reduced the faecal contamination of the water (Kirchhoff et. al., 1985).

Determining the microbial quality of drinking water by measuring the presence, absence or concentrations of indicator bacteria continues to be used worldwide to:

- Proper water quality standards and guidelines.
- To determine source water quality, treatment system and distribution system integrity.
- To inform Water Safety Plans, risk assessments and management systems. In some countries and regions and for international commerce (commercial bottled water) and transportation (airplane, rail and other travel conveyances), such analysis of drinking water may be required by law or governance.

Over more than 100 years, bacteriological tests have been used to detect fecal contamination of drinking water, other waters and other media, such as wastewater and foods. During this time, there has been an evolution in the bacterial indicators used and the articulation of the criteria for an ideal or reliable indicator of fecal contamination in drinking water and other waters (Olivieri,
1983; Sinton et al., 1998). The current criteria of an ideal or preferred indicator of fecal contamination have been defined and stated by WHO and other authorities. According to these the essential criteria of a fecal indicator are the following (WHO, 2002):

- To determine if a given water supply is safe, the source needs to be protected and monitored regularly. There are two broad approaches to water quality monitoring for pathogen detection.
- The first approach is direct detection of the pathogen itself, for example, the protozoan *Cryptosporidium parvum*. While it will be more accurate and precise if specific disease-causing pathogens are detected directly for the determination of water quality, there are several problems with this approach.
- First, it would be practically impossible to test for each of the wide variety of pathogens that may be present in polluted water.
- Second, even though most of these pathogens can now be directly detected, the methods are often difficult, relatively expensive, and time-consuming (WHO, 1996). Instead, water monitoring for microbiological quality is primarily based on a second approach, which is to test for indicator organisms. The indicator organism should fulfill the following criteria (Stetler, 1994):
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- An indicator should always be present when pathogens are present.
- Indicators and pathogens should have similar persistence and growth characteristics.
- Indicators and pathogens should occur in a constant ratio so that counts of the indicators give a good estimate of the numbers of pathogens present.
- Indicator concentrations should far exceed pathogen concentration at the source of pollution.
- The indicator should not be pathogenic and should be easy to quantify.
- Tests for the indicator should be applicable to all types of water.
- The test should detect the indicator organisms thus not giving false-positive reactions.

Standard methods used in the monitoring of bacteriological water quality and its related health risks have the number of disadvantages. They are costly, time consuming and requiring trained personnel (e.g. the multiple tube MPN estimations would take between (48-72 hours to process). They generally require well-equipped laboratories and trained personnel, which are limited in most developing countries. Such methods are also difficult
to employ in the field. These restrictions have made it difficult to attempt regular drinking water quality monitoring or to carry out any extensive survey of water sources and to classify them. This is particularly true for developing nations, where financial and manpower resources are often limiting and where a significant number of communities and their water sources are often isolated and difficult to reach. The development of an alternative method which could be used more easily in the field as well as being relatively cheap and easy to carry out would be of great advantage to such nations.

There are number of technique such as Multiple tube dilution technique (APHA, 1998), coliform by membrane filtration technique (WHO, 1993), coliphage indicator (Wentzel et al., 1982), radiometric method for detection of coliform (Bachrach and Bachrach, 1974), Presence / Absence for the detection of coliform and potability of drinking water (Clark, 1990). But these tests required skilled person, sophisticated laboratory and long time. These tests can be use at the site of collection of water and require 48-72 hours to test the quality of water.

Developing countries would benefit greatly from the development of rapid and cheap methods for the determination of the bacteriological quality of water. Such methods would enable the monitoring and classification of all available water sources, even those in remote areas or areas of difficult access. This would allow for better
monitoring of health risk from existing water sources and
the identification of new sources suitable for use as potable
drinking water, as well as enabling better water resource
management.

The objective of IDRC project is to conduct trials
on a bacterial monitoring method (P/A method) using the
hydrogen sulphide (H₂S) test. This test, which was
developed in India, is based on using blotting paper to
measure the amount of hydrogen sulphide produced by
bacteria in an incubator. It does not require much
equipment (mainly a small incubator) and a minimum
amount of training for the operator.

In response to this there is to developed a simple
test by Manja et. al., (1982) detect potentially pathogenic
microorganisms in water by using hydrogen sulfide (H₂S)
producing bacteria as indicators.

The H₂S producing bacteria have been shown to
be present when the traditional indicator bacteria, total
coliform bacteria and fecal coliform bacteria, are present
(Kromoredjjo and Fujioka, 1991; Kaspar et. al., 1992; Grant
and Ziel, 1996; Pillai et. al., 1999). Also, this test is
recommended as one of several tests used to evaluate
drinking water quality in tropical countries (Kromoredjjo and
Fujioka, 1991; Martins et. al., 1997). The test for H₂S
producing bacteria is inexpensive, easy to operate, and
reagents can be prepared locally and don't need nay
refrigeration. In addition, this test can be incubated at ambient temperatures in the tropics. Pillai et. al., (1999) found that this test could detect bacteria at a temperature range of 20-40°C, and the temperature need not be constant. Thus, developing countries may find this test more appealing than the membrane filtration test or multiple tube fermentation tests recommended in standard methods for water and wastewater treatment.

The drinking water in most of the hotels and restaurants is available for drinking purpose and produces enteric infections in the people. The hotels/restaurant owners do not properly store and handle the water and while serving to the customers. Therefore, approach is planned to evaluate in the potability of drinking water available in hotels and restaurant and make behavioural changes in storing and handling of drinking water by owners and workers of the hotels.

Objectives:

1) To verify efficacy of above mention non-expensive simple method to evaluate quality of drinking water in hotels and restaurants of Akola city.

2) To study the process of storage of drinking water.

3) To study the handling of drinking water while serving to the customer.

4) Hygienic condition prevailing in hotels and hotel owner and the worker working in the hotels.
5) To suggest the proper remedy to control the secondary contamination due to improper storage and handling of drinking water, behavioural change in the hotels owner and workers.

The purpose of this project is to evaluate the potability of drinking water available in the hotels and restaurants in the Akola. The Akola is the district place in the Vidharbha region of Maharashtra state, having the population 4.0 lakhs. There are about 400 various types of hotels and restaurants of with uneducated to highly educated owners. The workers are also from children to adult with no to little knowledge of hygienic. The hotel owners stored the drinking water in the overhead tank, watercooler with filter drum (iron / PVC / aluminium / steel) rajan, mataka and served unhygenically to customers. During most of the time the water supplied from the Jeevan Pradhikaran or from deep well or bore well is free from the pathogen and potable but due to improper handling of water by workers, unhygienic serving method makes the potable water become non potable and serve as a source of water borne diseases. To verify such factors or making the potable water become non potable, we selected the hotels and restaurants in Akola to provide the proper remedy to control the secondary contamination due to the improper storage and handling of drinking water, behavioural changes in the hotel owners and workers, and to make the citizens in aware about the quality of drinking water provided in the hotels and restaurants.