Chapter II

Review of Literature
REVIEW OF LITERATURE

Manja et al., (2001) compared the H₂S test (with cysteine in the medium, different sample volumes, different incubation times and incubation at different temperatures) to MPN tests for coliforms for detecting fecal contamination in 686 water samples in India. The H₂S test gave results comparable to the MPN test (not significantly different), with concordance in 620 (90%) samples, negative H₂S test and positive MPN test (false negative) in 34 samples (4.9%), and positive H₂S test and negative MPN test (false positive) in 32 samples (4.7%). However, 21 of 23 showed "false positive" (negative coliform MPN) samples contain coliforms in H₂S bottles. Agreement of H₂S -positive and coliform positive samples increased from 91% at 48 hours to 95% at 72 hours. The H₂S test results were comparable (not significantly different) for sample volumes of 20, 55 and 100 ml. Positive H₂S results were generally obtained in 18-48 hours of incubation at 25⁰-44⁰C. If incubation temperature below 25⁰C was not recommended. The H₂S method has been extensively studied by a number of investigators in different parts of the world. Such studies include estimation of the original method, studies on modifications of the method and field testing, usually with side-by-side comparison to other water quality tests. In some of these comparison studies the data are limited or have not been subjected to rigorous statistical analysis.
However, the results of most studies suggest that the H$_2$S method detects fecally contaminated water with about the same frequency and magnitude as the traditional methods to which it was compared. In general, the sensitivity of the H$_2$S test appears about the same as other tests for fecal contamination of water, although as already noted, this aspect of the test has not been rigorously tested in some of the reported studies. Testing conditions and format, sample size, incubation temperature and incubation time influences test sensitivity. Because these conditions have differed among the different studies reported in the literature, it is difficult to make consistent comparisons and draw overall conclusions. However when comparisons with other methods of detecting fecal contamination. It also referred that, the H$_2$S method appeared to have sensitivity similar to the other methods, based on finding contaminated samples. In most comparative studies there were always samples that showed positive results for other microbiological tests and negative H$_2$S tests, and vice versa. However, such results are not unexpected. For one, the various tests measure different things and do not always employ the same sample volumes.

Furthermore, when the levels of microbial contamination are low, it is statistically possible for one sample volume to contain bacteria of interest and for another to not contain them. The study data were proceed to statistic analysis most studies found between fecal
indicator bacteria (e.g. *E. coli*) and positive H$_2$S results. It was previously discussed that the ability of a large variety of heterotrophic bacteria to produce a positive H$_2$S test and therefore a false positive result the observed correlations suggest that in most natural and treated waters the majority of the H$_2$S producers come from organisms associated with the human or animal digestive tract. A false positive is less likely to lead to a risk of disease because it would result in the suspect water either not being used or subject to additional testing. Of great concern with the H$_2$S test as with other fecal indicator tests is the potential for false negatives; that is, not detecting fecal contamination when it is present. In this case the test does not identify water that is unsafe and the water could be consumed, leading to pathogen ingestion and to disease. The method, as with the various bacteriological tests, does not detect viruses or parasites. Testing of drinking water for the many viruses and parasites of concern is still impractical and unaffordable and still not done on a routine basis in most countries and regions. However, the H$_2$S test detects bacteria other than coliforms that are associated with fecal contamination, including *Clostridium perfringens*. *Clostridium perfringens* is one of the more resistant indicators of fecal contamination and can be found in drinking waters when no coliforms can be found. Therefore, it is possible for the H$_2$S test to give a positive result when fecal contamination is present even if no coliforms are
present. Such findings have been observed in some comparative studies between the H$_2$S test and other bacteriological tests.

The essential criteria of an ideal indicator of fecal contamination of drinking water and other waters and the extent to which these criteria were addressed and fulfilled in previously published studies on the H$_2$S test as a method to detect fecal contamination. It is apparent from this compilation of data that most of the key criteria for fecal indicators of water quality were not investigated in the studies reported in the literature to date. This lack of data on the extent to which H$_2$S tests fulfill the essential criteria of an indicator is a major concern. This is because the test has been in use for two decades, it has been repeatedly modified, tested and field applied in many parts of the world, it is now widely promoted by some scientists and other authorities, and yet it has never been subjected to critical testing for its ability to fulfill or meet the essential criteria of a fecal indicator of drinking water quality.

The problems of clean drinking water and lack of proper sanitation are closely related. Pathogen carries human and animal wastes, food and garbage pile up near homes and tube wells and drain into waterways, contaminating the water sources. For example, surface water, such as rivers in the Kathmandu Valley, is polluted by industrial effluent, dumping of untreated waste, and sewage from residential areas (NepalNet, 1999). Sewage
from poorly septic tanks also contributes to the groundwater contamination. Leakage from sewer pipes, which run parallel to the water supply pipes, can also contaminate the supply pipes through cracks. The city water is often inadequately treated due to the lack of maintenance. In addition, since piped water is available for only a few hours a day, residents store water in storage tanks and own privately dug wells so that water is available for use throughout the day. These containers are seldom properly washed and maintained, therefore contaminating water that could be clean originally (Rijal et al., 2000). Water obtained from the wells do not usually undergo any form of treatment before consumption, therefore they are unsafe for drinking.

Despite an increase in use to water supply from 46% in 1991 to about 80% in 2000, there is another problem with the lack of proper sanitation and hygiene practiced among the people (UNICEF, 2000). This also translates into the discharge of at least 1,500 tones of feces onto the fields and waterways everyday (UNICEF, 2000). The combined effect of inadequate handling to a safe water supply, poor environmental sanitation, and personal hygiene has adversely affected the quality of life and health conditions. Sanitation related diseases account for 72% of total ailments and diarrhea continue to be one of the leading causes of childhood deaths (ADB, 2000).
Infectious diseases caused by pathogenic bacteria, viruses, and protozoa or by parasites are the most common and widespread health risk associated with drinking water (WHO, 1993a).

The wide variety of waterborne diseases and their public health impact is an important. Near about 3.4 million people, mostly children, die annually from water related diseases. Out of this number, 2.2 million people die from diarrhoeal diseases (including cholera) (WHO, 2000). Waterborne diseases are typically caused by enteric pathogens, which are mainly excreted in feces by infected individuals, and ingested by others in the form of feacally contaminated water or food. These pathogenic organisms include many types of bacteria, viruses, protozoa and helminths, which differ widely in size classification, structure and composition. Pathogenic organisms are highly infectious and disease causing. They are responsible for many thousands of diseases and deaths every year due to lack of sanitation. In the following discussion, only the human pathogens potentially transmitted in drinking water are considered.

The effect of improving personal and domestic hygiene on water borne diseases are reviewed using data from studies in hospitals, day-care center, and communities. There are evidence that low educational 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 (Feachem, 1984).

In practice, however, there are substantial operational difference between hygiene education programmes and water supply and sanitation project: the two are usually implement by different ministries and agencies, they require different type of personnel and, in particular, they have very different costs. It is useful therefore to review the effectiveness of hygiene education alone as an intervention for reduction of water borne diseases.

The hygiene promotion in Hotels and Restaurants to be effective water borne diseases control intervention it must be as follows:

1. The transmission of enteric pathogens and the incidence of water borne diseases, are increased by specific behaviours

Water borne diseases and educational levels: The literature contains many observation that water borne diseases are highest in the Hotels and Restaurants with lowest levels of education. Hygiene and literacy may closely related (Pacey, 1982). Such observation in themselves are not useful because Hotels owner and worker with lowest education will tend to be those with lowest income, poorest housing, most crowding and worst sanitary facilities. If
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Behaviour and transmission of enteric pathogen. The specific behaviour that have more attention with regard to their role in promoting the transmission of enteric pathogen are water handling behaviours, food handling behaviour and hand washing. Water handling and food handling behaviours will be treated separately in the context of interrupting water borne and food borne transmission and will be discussed later.

Studies on the occurrence and survival of enteric pathogens on the hand of hotels owner and workers. The hands of owner and workers in the hotels and restaurants commonly contaminated and contamination take place easily during a variety of method of handling, storage of drinking water, serving of water procedures. The hand of workers were readily contaminated by enteric pathogen. Enteric bacteria on hands survive for at least 3 hours in detectable numbers and can be transferred to food and to other hands. A study in Dhaka (Samadi, 1983) found that
the hands of workers in the hotels and restaurants with enteric pathogen were commonly contaminated with pathogen and that this contamination was more likely among those who handle the water in the hotels and restaurants.

Studies on the cleansing of hands by washing with water and soap are as follows:

Hand washing with water and soap removes 90-100% enteric pathogen. Washing with water alone remove a considerable but lesser proportion. Some washing procedure with disinfectant do not achieve greater bacterial removals than washing with water and soap. The opinion is often expressed in the literature that the effectiveness of hand washing is determined more by its thoroughness (time taken and attention to all parts of the hands) than by the types of soap or water used. No data have been located on the effectiveness of hand washing in the home, or in developing countries, or using other procedures such as rubbing the hands with sand or soil.

The studies are mainly conducted in hotels and restaurants. They indicate that knowledge of the importance of hand washing does not necessarily lead to adequate hand washing that hand become easily contaminated by fecal bacteria even under condition of good hygiene and high awareness that enteric bacteria on hands can survive for atleast 3 hours and can be
transferred to food and other hands and that washing with soap and water is an effective method of cleansing the hands.

Low educational attainment and certain religions customs predispose to water borne diseases, presumably because of behavioural factors. The specific behaviour that has been most studied in hand washing procedure of storage and handling of water. Hotels and restaurants study suggest that enteric pathogen can spread via contaminated hands and that hands can be decontaminated by washing. Thus it is probable that certain specific behaviours do promote the transmission of enteric pathogen that failure to wash the hand is one such behaviour.

Specific behaviour can be approach by appropriate hygiene education programmes to hotel owner and workers.

The literature on the methods and efficacy of hygiene education is mainly comprised of discussion. (Isely, 1982; Ogionwo, 1973; Tonon, 1978). The given hygiene education programme on a specific set of personal or domestic hygiene behaviour have been located.

Torun (1982) reports an evaluation of hygiene education programme in a village in the Pacific lowlands of Guatemala during 1979-80. The programme was directed at 106 mothers, all of whom had a child under 6 years old 32 similar mothers acted as controls. The programme
consisted of nine one hour session between educators and groups of mothers using stories and discussions assisted by radio plays and evocative. The mothers were encouraged to reflect upon their hygiene problems and to commit themselves to specific action.

The content of the educational programme covered the recognition and treatment of water borne diseases, hand washing, food hygiene, care of drinking water and diet. The proportion of mothers giving correct answer to questions on prevention were 56% before the programme, 90% immediately after the programme and 88% six weeks later. A significant increase was observed in the proportion of target hotels and restaurants that were judged to have correct hygiene behaviour with respect to kitchen hygiene, water storage, garbage disposal and worker cleanliness. Hygiene practice that would have required expenditure were not significantly changed. Water borne diseases incidence was reduced in the human being.

The demonstration strongly suggest that the adoption of hygiene behaviour can be achieved by sustained and culturally appropriate educational programmes. Research is urgently needed to measure of behavioural impact of various type of hygiene education in various cultural and socioeconomic settings. Such research should not prove unduly difficult or expensive.
3. Appropriate hygiene education programmes can caused behavioural change which can reduce the transmission of enteric pathogen and thereby reduce water borne diseases, morbidity or mortality rates. Three studies (from Bangladesh, USA and Guatemala), documenting the impact on water borne diseases rates of hygiene education programme, have been located. In two cases, Bangladesh and USA education focused exclusively on hand washing, while in the third, in Guatemala, the programme sought to improve several aspects of personal and domestic hygiene. (Khan, 1982; Black, 1981; Tonon, 1978).

These 3 studies from Bangladesh, USA and Guatemala provide 5 measure of the impact of hygiene education on the water borne diseases:

A 35% reduction in the incidence rate of shigellosis among all ages in urban families in Bangladesh.

A 37% reduction in the incidence rate non water borne diseases among all ages in urban families in Bangladesh.

A 48% reduction in the incidence rate of all water borne diseases among children aged 6-29 months in day care center in the USA.

A 14% reduction in the incidence rate of all water borne diseases among children aged 0-71 months throughout the year in a Guatemalan village.
A 32-36 % reduction in the incidence rate of all water borne diseases among children aged 0-71 months during the peak water borne diseases season in a Guatemalan village.

Thus the reduction of water borne diseases to be anticipated from hygiene education lies in the range 14-48%. Other studies support the hygiene education can reduce water borne diseases. But do not allow a calculation of the reduction in incidence achieved by a clearly defined educational intervention (Kopman 1978; Nutting 1975; Odumosu 1982).

It might be supposed that the commonness of direct person-to-person transmission of water borne diseases reduce by hand washing.

The three studies summarized above suggest that hygiene education, especially hand washing promotion, has marked impact on the water borne diseases these studies should be repeated in different socioeconomic, environmental setting and should also quantify the impact on water borne diseases due to enteric pathogen and other agent that are of known local importance.

There is such little documented experience of hygiene education programmer that their feasibility is difficult to judge and their costs are unknown. Experience with other type of health education suggest that such programme are feasible on either a national or local level
and that they can employ a combination of mass media technique and direct interaction between Hotel and restaurants and hygiene promoter. Costs of hygiene education are probably low compared to some other interventions for water borne diseases. Such as the provision of improved water supplies and sanitation facilities. The effectiveness of hygiene education may depend, however, upon the presence of Hotel and restaurants.

Interest in the role of education in disease control has increased considerably in recent years. It is probable that better educated communities enjoy relative protection against disease compared to less educated, but otherwise similar communities. This protection may be conferred both by general education (as measure, for instance, by hotel worker, education of owner and by disease specific education. Disease specific education can be preventive of therapeutic in content.

The evidence marshaled in this paper suggests that hygiene education can improve hygiene and can reduce the water borne diseases morbidity rates by 14-48%. These are hopeful finding.

Hygiene education programme are being conducted in many countries and should continue. Countries not having such programmes should seriously consider launching them. Research is necessary however, to
improve the cost effectiveness of hygienic education. This research is of three main types. First more information is needed on the association between specific behaviours and risk of water borne diseases, morbidity and mortality of known etiology. Second, operational research is needed to clarify the most effective and feasible types of hygiene education programme, to detail their costs and to assess their dependence on pre-existing levels of sanitary facilities. Third, impact studies should be conducted to clarify the impact on water borne disease of carefully designed hygiene education programmes. These impact studies should etiology specific and, where possible, should document impacts on water borne diseases mortality rates as well as morbidity rates.

The results of the present study on interrupting the transmission of *V. cholerae* infection within the household strongly suggest a causal relationship between contamination of the stored water and the high infection rate in the hotels and restaurants as observed during the intra familial transmission study (Deb 1982). Other factor capable of interrupting the transmission of cholera infection remaining the same in our three group, it can be reasonably concluded that the two intervention measures in our two study group were responsible for lowering the transmission of *V. cholerae* from an infected to other persons in the household.
By using our two interventions it was possible to reduce the spread of *V. cholerae* infection among household contacts to the extent of 74.6% and 57.8% in sorai and chlorinated groups respectively. This suggests that in our study group the infection outside the home was relatively less important so far as spread of *eltor* cholera infection was concerned.