

GUIDELINES FOR PREVENTION OF INFECTION AND CROSS INFECTION IN THE DOMESTIC ENVIRONMENT

FOCUS ON HOME HYGIENE ISSUES
IN DEVELOPING COUNTRIES



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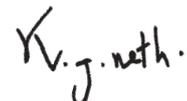
FOREWORD

Guidelines for prevention of infection and cross-infection in the domestic environment were first published by the International Scientific Forum on Home Hygiene (IFH) in 1998.

The publication was, however, mostly in a European and North American context and some of the developing-country concerns on issues of domestic, personal and environmental hygiene were not adequately reflected in these guidelines. It is quite obvious that, primarily due to differences in living standards and quality of life, the perceptions and priorities for prevention of infection in the domestic environment differ to a certain extent between the developed and the developing countries, particularly for the low income groups, although the fundamental and essential scientific elements remain the same.

To obtain the primary objective of improving the health status of the community, health education programmes to improve standards of hygiene practice at home and achieve changes in attitudes must be implemented in conjunction with community water supply and environmental sanitation programmes. Unfortunately, however, in many developing countries community water supply and environmental sanitation programmes have often been undertaken in isolation, without taking appropriate actions to integrate these with the promotion of hygiene at home and its immediate surroundings. As a result, the health benefits from programmes have not been commensurate with the investments made and the countries have to bear heavy burdens of communicable diseases.

It is in this context that a second edition of the *Guidelines for the Prevention of Infection and Cross Infection in the Domestic Environment* has been produced. The document is adapted to the situations of developing countries, to include additional issues, concerns and guidelines for promoting hygiene in the homes of low income groups in these countries. Needless to say, all the fundamental issues included in the original guidelines document have been retained in this edition, since they are equally valid for the developing countries.



(Professor KJ Nath)

Member, IFH Scientific Advisory Board

I. INTRODUCTION & BACKGROUND

I.1. INTRODUCTION

Procedures to prevent infection and the transmission of infection are used in a variety of domestic situations, and collectively may be termed "home hygiene procedures". For the purposes of these guidelines, the practices used in home hygiene are categorised into four main areas, namely:

- GENERAL HOME HYGIENE
- FOOD HYGIENE
- PERSONAL HYGIENE
- HOME HEALTHCARE

However, in developing regions (as discussed hereafter) guidelines for home hygiene practices must also consider the following important issues:

- DRINKING WATER HYGIENE (STORAGE, HANDLING AND DISINFECTION OF DRINKING WATER IN THE DOMESTIC SETTING)
- PERI-DOMESTIC SANITATION AND HUMAN EXCRETA AND WASTE DISPOSAL

The term general home hygiene is used to define the routine (daily or weekly) procedures employed in the home to prevent cross contamination and cross infection via domestic sites and surfaces. Food hygiene and personal hygiene procedures are also routine home hygiene measures performed on a daily basis to reduce the risk of infection and cross infection. In developing countries like India, the use of unsafe water for cleaning of domestic utensils, and contamination of drinking water during handling and storage in the home, are key factors underlying the endemicity of water-borne diseases and need careful examination. The other critical issue is the safe disposal of human excreta, particularly those of children and the sick. This is particularly important for the vast majority of the urban and rural poor, without a latrine at home. Unsanitary conditions in the peri-domestic environment and inadequate drainage and garbage disposal facilitate the transmission of a number of communicable diseases and must therefore be considered.

Home healthcare includes specific situations of increased risk such as the care in the home of neonates and geriatrics. Procedures such as decontamination of areas of faecal contamination or other spillage material, and procedures such as the disinfection of contact lenses, can also be considered as home healthcare. Social and demographic changes now mean that increasing numbers of people who are at risk of infection are cared for at home by a home carer who may be a family member. Increasingly, home healthcare includes infection control measures associated with the use of inhalation or catheterisation equipment, home nursing of immuno-compromised family members, and family members who are carriers of infectious diseases, such as the human immuno-deficiency virus, hepatitis viruses, methicillin resistant *Staphylococcus aureus* (MRSA) and people suffering from a food-borne disease.

At the present time these various components of home hygiene tend to be regarded as separate issues rather than a series of interrelated procedures based on the same underlying microbiological principles. Since all these aspects of home hygiene may be under the control of a single person, the home manager, it is reasonable to expect that an integrated approach to the understanding of these issues, and the implementation of suitable procedures, is likely to be beneficial in achieving and improving standards of home hygiene (Bloomfield and Scott 1997; Jones 1998). It is also essential that the home, and home hygiene, is not viewed in isolation. The home and family are central elements of a community, since there is a dynamic interaction between the home, its occupants, and the community-wide structures, such as day-care centres, schools, work places, eating establishments and healthcare facilities.

I. INTRODUCTION & BACKGROUND

The aim of this document is to provide guidelines on the most appropriate procedures to be used in preventing infection and cross infection in the domestic environment with particular reference to developing countries. It is anticipated that these guidelines will be continually updated to take account of new research in the area of home hygiene. The guidelines are based on a risk assessment approach which specifies that infection prevention through reduced exposure to pathogens is most effectively achieved by identifying the sites and situations in the home which represent the greatest infection transmission risk and targeting practices at these sites, at the appropriate time. The guideline documents (both the original document and this amended version) focus on specifying where and when hygiene procedures should be applied in order to reduce the risk of exposure to pathogens. Following the development of these guidelines, the IFH have also produced a set of recommendations entitled: "*Recommendations for selection of suitable hygiene procedures for use in the domestic environment*", which detail the procedures to be used where a hygiene risk is identified. These recommendations address both general situations in the home and situations of specific risk. Where appropriate these guidelines have been cross-referenced to the recommendations to give more detailed information on specific hygiene procedures.

The objective of the guidelines and recommendations documents is to give guidance to public health engineers, doctors, pharmacists, veterinary surgeons, community nurses, midwives, health visitors, environmental health officers, teachers of home science and other healthcare professionals who are involved in advising the public on all aspects of hygiene in their daily lives.

Where appropriate, these guidelines refer to other published guidelines for healthcare, community water supply and sanitation professionals which provide more detailed information on specific infection control measures that are either not within the scope of this document or are dealt with only briefly.

1.2. DEVELOPING-COUNTRY PERSPECTIVES

The extent of the problems of environmental and domestic hygiene in developing countries are largely and inevitably determined by the extent of the poverty of the population and the generally unsanitary conditions. Most cities and towns in developing countries like India are characterised by over-crowding, congestion, inadequate water supply and inadequate facilities of disposal of human excreta, waste water and solid wastes. Inadequacy of housing for the vast majority of the urban poor invariably leads to poor hygiene at home. Needless to say, optimum standards of personal and domestic hygiene practices cannot be achieved without also improving the basic amenities like water supply, waste water disposal, solid waste management, and, more importantly, the problems of human settlements. But even under the prevailing conditions, there is significant scope for improving hygiene practices at home, thereby reducing the burden of infection and cross-infection.

Unfortunately, however, where public health concerns are expressed in the developing countries they generally relate mostly to public settings and services such as municipal services, hospitals, environmental sanitation, etc. There is reluctance to acknowledge the home as a setting of equal importance along with the public institutions in the chain of disease transmission through the community. What is needed is that persons responsible for promoting home hygiene and the managers of community hygiene must act in unison to optimise return from their efforts to promote public health.

1.2.1. PRACTICE AND PERCEPTION

In general, the level of personal and household hygiene in rural areas and in the peri-urban and urban under-served areas is extremely poor, although it is relatively better among the urban middle class and richer populations. In a sample survey in India it was found that 24% of the rural population wash their hands (after defecation) with water only, 61% use water/ash/mud, and only 14% use water with soap. Among the urban population with higher economic status, the picture is somewhat better. Here, almost 100% use water with soap for washing their hands after defecation, but only 75% wash their hands with soap and water before having a meal.

I. INTRODUCTION & BACKGROUND

Mud plastering of the kitchen and cooking stove is a common practice in rural areas (often with cow dung). Cleansing of the floors of living rooms and courtyards in the rural homes is done inadequately and infrequently. Use of disinfectants and germicides for washing of floors is almost non-existent in the rural areas. Unpaved courtyards of the rural homes and also peri-urban and urban unserviced settlements are often characterised by waste dumping and collection of dirty water which breeds vectors and also facilitates the spread of infections. Among the urban middle class and higher income population, use of disinfectants and germicides for cleansing of floors, bathrooms and kitchens is a common practice. However, the dose of disinfectants or germicide is not scientifically determined. Less than 5% of the surveyed people among the higher income group of the urban population were found to be using vacuum cleaners for cleaning of rooms and more than 70% used disinfectants and germicides for cleaning of bathrooms and kitchen appliances.

In the rural areas, washing of utensils and clothing is often done in pond water, which is grossly polluted (faecal coliforms, MPN count >100/100 ml). The cloths used for wiping floors and utensils are mostly dirty and could be a source of infections and promote cross-infections. Among the urban middle class and higher income group populations, utensils are cleaned with potable water and detergent in the majority of cases, while use of disinfectants or germicides and heat for making utensils germ free is practised by less than 2%. On the whole, the present level of personal and domestic hygiene in the rural areas is extremely poor and could be one of the significant causes of infection transmission of diseases which are spread through the faecal-oral route or by skin contact.

The picture is not much different in the urban unserviced areas. Collection, storage and handling of drinking water is one of the major risk areas with respect to domestic hygiene. In a sample survey, it was found that in 68% of rural households in India, water is taken out of storage pots using a container without handles, causing hands to be dipped in water. Observations show repeated hand contact with drinking water during collection, storage and serving among all groups of people in rural areas as well as the urban community. Though the standard is somewhat better among the middle and higher income urban population, the risk of infection still exists.

People's perception regarding the link between community health with personal, household and environmental hygiene is also not scientifically based. In a sample survey among the rural population, it was found that 75% were unaware of the link between exposure to excreta and health. A study in an African community shows that people were not rigorous in ensuring that children's faeces were removed from the home (Curtis, 1998). There was a general gradation of attitudes to the different aspects of hygiene, with most people attempting to practise a rudimentary amount of personal hygiene, with some having a lesser emphasis on household hygiene, and almost no effort directed towards environmental hygiene, which is seen to be beyond the individual or collective responsibility.

Most people are aware of a link between hygiene and health, but there is a lack of conviction about the need for change that probably results from years of tolerance of unhygienic surroundings. In a recent sample survey, it was found that the majority of the surveyed population believed that personal hygiene, and to some extent household hygiene, influence health but failed to see the possibility that environmental hygiene was also an important factor. Most people are unaware about the scientific aspects of personal, domestic and environmental hygiene and the risk of infection (Nath 2000, Curtis 1998).

1.2.2. LINKAGE OF HOME HYGIENE WITH ENVIRONMENTAL SANITATION AND COMMUNITY WATER SUPPLY: THE NEED FOR AN INTEGRATED APPROACH

For the protection and promotion of the health of a community both hygiene behaviour in the domestic setting and the quality of the environment are essential factors. Of these, the key factors which are involved in the control of infectious diseases are water quality, water availability, excreta disposal and treatment, personal and domestic hygiene, drainage and solid waste disposal, food and sanitation.

I. INTRODUCTION & BACKGROUND

The results of a study by Feacham (Table I) showed that of all the measures needed to control communicable diseases prevalent in the developing countries (bacterial/viral/protozoal/helminthic/vector-borne), domestic and personal hygiene is perhaps the most crucial. It should be noted that of these six key control

measures, five of them, i.e. personal and domestic cleanliness, water quality, excreta disposal, drainage and sullage disposal and food hygiene are linked to personal hygiene behaviour, while the sixth, water availability also influences hygiene behaviour.

TABLE I. IMPORTANCE OF HYGIENE, WATER QUALITY AND SANITATION CONTROL MEASURES IN PREVENTING WATER
- AND SANITATION-RELATED INFECTIONS

INFECTIONS	IMPORTANCE OF ALTERNATIVE CONTROL MEASURES					
	WATER QUALITY	WATER AVAILABILITY	EXCRETA DISPOSAL	PERSONAL AND DOMESTIC CLEANLINESS	DRAINAGE AND SULLAGE DISPOSAL	FOOD HYGIENE
1. DIARRHOEAL DISEASES AND ENTERIC FEVERS						
VIRAL AGENTS	2	3	2	3	0	2
BACTERIAL AGENTS	3	3	2	3	0	3
PROTOZOAL AGENTS	1	3	2	3	0	2
2. POLIOMYELITIS AND HEPATITIS A	1	3	2	3	0	1
3. HELMINTHIC INFECTIONS						
ASCARIS AND TRICHURIS	0	1	3	1	1	2
HOOKWORMS	0	1	3	1	0	1
4. SKIN, EYE AND LOUSE-BORNE INFECTIONS	0	3	0	3	0	0
5. INFECTIONS SPREAD BY WATER-RELATED INSECTS						
MALARIA	0	0	0	0	1	0
YELLOW AND DENGUE FEVERS	0	0	0	0	1	0
BANCROFTIAN FILARIASIS	0	0	3	0	3	0
TOTAL	7	17	17	17	6	11

0 = no importance
1 = little importance
2 = moderate importance
3 = great importance

Overall, it can be concluded that, for a developing country, the potential for reducing the risk of infection and cross-infection through the promotion of improved home hygiene will largely depend on the following factors:

1. Level of general sanitation including quality of public water supply and ambient environment, municipal sanitation practices, agricultural practices, and waste disposal practices.
2. Socio-economic status including quality of housing, living standards and level of literacy.
3. Risk perception prevailing in the community - level of awareness in respect of hygiene practices and its relation to health.

It is also concluded that, within these constraints, achieving the primary objective of improving the health status of the community depends on the implementation of an integrated strategy aimed at improving hygiene practice at home through changes of attitudes and higher levels of health education, in conjunction with community water supply and environmental sanitation programmes. Almost all the water-borne, water-based and water-washed diseases are spread through exposure of food and drinking water to human faeces. Hence, the rate of infection may be reduced by improving human waste disposal practices as well as home hygiene practices, along with water quality and food hygiene. Supply of safe water provides little advantage if water becomes contaminated because of unhygienic practices at home. Storage and handling of food and drinking water should be an important component of any programme for promoting domestic hygiene. On the other hand, improvement in the hygienic behaviour of a community cannot be sustained without concurrent improvement in the quality of environmental sanitation and drinking water.

Unfortunately, however, in many developing countries community water supply and environmental sanitation programmes have often been undertaken in isolation, without taking appropriate actions to integrate these with the promotion of hygiene at home and its immediate surroundings. As a result, health benefits from the community water supply and sanitation programmes have not been commensurate with the investments made and the countries have to bear heavy burdens of communicable diseases (Nath 1999). It may not be out of place to mention that promotion of hygiene behaviour in the domestic setting is possibly the most cost effective among preventive public health measures in the developing country context.

1.3. INFECTION POTENTIAL IN THE HOME

Fundamental to the formulation of a strategy for improving hygiene at home is the recognition, as stated in Section 1.1, that home hygiene is the sum total of measures for preventing cross-infections which includes food hygiene (cooking, storage and handling of food and drinking water), personal hygiene, general domestic and peri-domestic hygiene and hygiene related to medical care.

In developing effective guidelines for home hygiene, microbiological and epidemiological principles of disease causation and transmission must be taken into account. In developing countries, poor personal, domestic and peri-domestic hygiene contribute to the spread of a whole range of infections including all of the faecal-oral microbial infections, skin and eye infections and parasitic worms given below:

A. Faecal-oral microbial infections

Cholera, bacillary dysentery (*shigellosis*), amoebic dysentery (*amoebiasis*), gastro-enteritis, enterovirus infections (some), diarrhoeal diseases, rotavirus infection, enteropathogenic + toxigenic *E. coli* infection, giardiasis, balantidiasis, viral hepatitis, poliomyelitis, etc.

B. Skin and eye infections

- i) Infections and infestations: Trachoma, conjunctivitis, other infectious diseases, skin ulcers, scabies, other infectious skin diseases.
- ii) Fevers spread by ectoparasitic insects: Louse-borne typhus, louse-borne relapsing fever.

C. Parasitic worms

- i) Intestinal helminths: Ascariasis, enterobiasis, trichuriasis
- ii) Water based infections developing in aquatic hosts: *Schistomiasis*, urinary schistomiasis, intestinal guinea worm.

D. Vector-borne diseases

The lack of general sanitation and drainage in the peri-domestic environment has given rise to insect and vector-borne diseases in tropical developing countries. Mosquito breeding in the domestic and peri-domestic environment helps in propagation of the following diseases: yellow fever, dengue, other arboviruses, malaria, filariasis, onchocerciasis, trypanosomiasis, etc.

I. INTRODUCTION & BACKGROUND

There is substantial evidence in the literature to establish that food and water-borne infections represent a significant social and economic problem both in developed and developing areas of the world (Todd, 1997, 2001; Schmidt 1998). Although the methods used to gather these data give limited information about the extent to which food borne infections originate in the domestic environment, Schmidt (1998) concluded that in European countries most infectious intestinal diseases (IID) that are food-borne occur in the home.

There are strong indications, both in the developed and developing world, that IIDs are by no means all food or water borne, and that hand to mouth transmission, either directly or via other surfaces, is quite often the cause. An estimate from the UK Food Standards Agency states that the proportion of total IID cases that are food borne is between 17 and 50%, which means that between 50 and 80% are not food borne (FSA 2000). In addition, data from the UK Communicable Disease Surveillance Centre (CDSC) indicates that maybe 19% of *Salmonella* outbreaks are transmitted not by food but by other means (Le Baigue et al. 2000). The data also suggest that fewer than half of *E. coli* O157 outbreaks are food borne and less than 3% of the very large numbers are of small round structured viruses (SRSV). Another important infection known to be associated with poor hygiene is dysentery associated with *Shigella sonnei*.

Increasingly, there is evidence that cross contamination is responsible for spread of viral infections including rotavirus, SRSV and rhinovirus infections. Viruses can survive in the environment for significant periods (as can bacterial pathogens such as *Campylobacter* and *E. coli* O157) and the infectious dose may be very small. Although many of the respiratory and gastrointestinal infections (particularly those caused by viruses) can be asymptomatic or relatively mild and self-limiting (coughs and colds, etc.), they still represent a significant economic burden. In addition, increasing numbers of people with reduced immunity to infection are now cared for at home, and for this group the consequences of infection can be much more serious and may result in hospitalisation with the associated additional costs. Higher risk groups include not only the immuno-

compromised such as individuals using immunosuppressive drugs, those using invasive systems (indwelling catheters), inhalation systems or devices, but also those with a weaker immune response (immuno-deficient), such as the elderly, neonates, pregnant women and hospital patients discharged into the community. As the population structure ages, infection risk in the home and its consequences can be expected to increase. For most people the quality of life (their health expectancy) is at least as important as their life expectancy.

Despite advances in the fight against infectious diseases, the risk posed by old and new pathogens is likely to increase. The emergence of new pathogens, such as *E. coli* O157:H7, has implications for community and home hygiene (Anon 1996). Antibiotic resistance is now considered as a major health threat (Anon 1997). The implication from this is that greater emphasis must now be placed on preventive hygiene practices as opposed to an increasing reliance on antibiotic therapy. This situation in turn demands that complacency about home hygiene is no longer acceptable. Although antibiotic resistance has largely been considered as a hospital-based problem, control of MRSA, for example, is now a community as well as a hospital problem. This also highlights the dynamic interaction between the community and the home.

In addition to statistics derived from surveillance data, significant evidence indicating the impact which good hygiene practice can have in the prevention of disease transmission in the community comes from case control studies in which the effects of the hygiene intervention procedures on infection rates were monitored. It has been reported from developing countries that improvement in personal hygiene (hand washing) can prevent 40 to 60% of the diarrhoeal diseases. In India the unabated endemicity of all water- and excreta-related diseases are believed to be due to neglect of water quality at home (Anon 2001a) (see Chapter 6, Figure 2).

A detailed review of the scientific data assessing the infection potential in the home has been prepared by the IFH (Beumer *et al.* 2001).

1.4. TRANSMISSION OF INFECTION IN THE DOMESTIC ENVIRONMENT

1.4.1. SOURCES OF INFECTION

The main sources of infection in the home are people, domestic animals, raw food and water. There is also evidence that certain areas or sites in the home environment where stagnant water and organic residues accumulate, such as sinks, sink and basin U-tubes, toilets, wet cleaning cloths and facecloths will readily support the growth of potentially pathogenic species and thus become a source or “reservoir” of infection.

1.4.2. TRANSMISSION OF INFECTION IN THE DOMESTIC ENVIRONMENT

Transmission of infection in the home can occur in a number of ways:

1. In many cases infection arises as a result of direct contact with infected people or animals. Prevention of these infections is related to patterns of social behaviour and it is the responsibility of the healthcare professional to ensure family members and the public are aware of the mechanisms of transmission. The importance of measures to prevent the transmission of these infections cannot be overemphasised but are outside the scope of this document.
2. A proportion of infections arise by self-infection from the body's own flora, such as cystitis, and personal hygiene plays a major role in reducing this risk of infection.
3. Gastrointestinal infections usually arise by ingestion of contaminated food but sometimes also occur as a result of direct hand-to-mouth transmission (Linton *et al.* 1977). In addition, other infections, such as hepatitis A, can occur through ingestion of contaminated food or through direct hand to mouth contact (Hadler 1991).

4. A proportion of infections is transmitted indirectly, for example, via surfaces. Although bacteria do not grow in the absence of water, and will eventually die on a dry surface, most species can survive on surfaces in sufficient numbers for a sufficient period of time to represent an infection hazard (Bloomfield and Scott 1997). Organisms transferred in small numbers via surfaces to cooked foods can multiply rapidly if the food is stored at ambient temperature. This also applies to organisms picked up onto wet cleaning cloths, which are then left at ambient temperatures (Scott and Bloomfield 1990a). Viruses and parasites may also survive long enough on inanimate surfaces to cause infections. As far as domestic hygiene is concerned the most important of these surfaces are the hands, hand and food contact surfaces and cleaning utensils. Currently, there is insufficient awareness of the potential for cross contamination via, not only hands, but also apparently clean surfaces and apparently clean cloths in the home.
5. Insects, other household pests and also pets can also act as a vector for transfer of infection.
6. Airborne transmission of infection can occur, most particularly via contaminated skin scales and aerosol droplets.

1.4.3. TRANSMISSION OF GASTRO-ENTERIC AND DIARRHOEAL INFECTION IN THE DOMESTIC ENVIRONMENT IN THE DEVELOPING COUNTRIES

Diarrhoeal diseases are still one of the top three killers in the developing countries. Diarrhoeal and gastro-enteric diseases could be effectively prevented by interrupting the transmission of the organism responsible for gastro-enteric infection. Human hygienic behaviour holds the key to effectively interrupting the transmission.

I. INTRODUCTION
& BACKGROUND

FIGURE 1. THE TRANSMISSION AND CONTROL OF DIARRHOEAL DISEASE AND ENTERIC FEVERS
(SOURCE: TRAINING MANUAL ALL INDIA INSTITUTE OF HYGIENE & PUBLIC HEALTH)

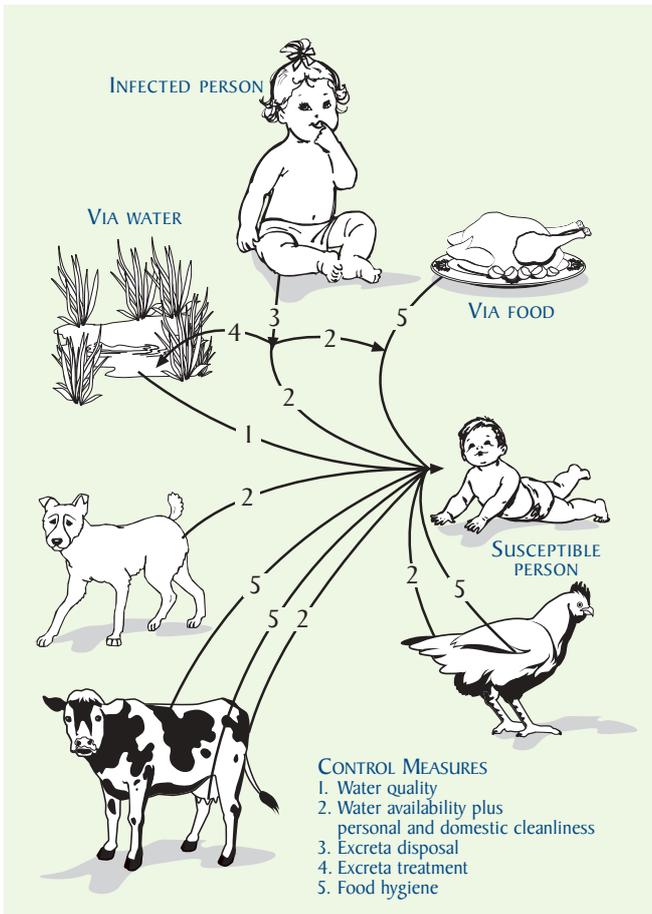


Figure 1 shows a number of potential transmission routes. The faecal pathogen has to pass through the environment to reach a new host. Under usual circumstances most pathogens could die in the environment. However, given the poor personal and domestic hygiene in the developing countries, they could easily get onto the fingers, in food and water, and ingested by a new host. Flies landing on excreta can carry them to food or to utensils used for food preparation and eating. Faecal matter deposited in fields (open defecation is practised by the majority of the rural population in India and in many other developing countries) could be carried by human or animal feet into the domestic environment. Children playing on faecally contaminated surfaces or eating faecally contaminated earth could be infected. Excreta could contaminate water sources, the water which is used in food preparation, cleansing of utensils or drunk directly. For most people, particularly young children who are the main victims of gastro-enteric infection in developing countries, this environment is the domestic setting.

A detailed review of the scientific data assessing the infection potential and the transmission of infection in the home has been prepared by the IFH (Beumer *et al.* 2001).

1.5. PRINCIPLES OF HYGIENE IN THE DOMESTIC SETTING

1. The implied purpose of applying a hygiene procedure in the home is to achieve a reduction in the number of viable organisms to a level where there is no longer a threat to health. This level is variable according to specific circumstances and will dictate what acceptable measures are required. Cross infection in the domestic environment does not always result in an infectious disease. The risk of infectious disease arising from transfer of infection in the domestic environment is highly variable and depends on a number of factors:

- The presence and pathogenicity of the organism
- The infective dose – there is a direct correlation between the size of the infecting dose and the risk of infection
- The length of time micro-organisms exist on surfaces in conditions favourable for growth to infective doses
- The susceptibility of the host. Neonates, geriatrics, pregnant mothers and other immunocompromised people are at increased risk of infection. Even for healthy adults, susceptibility to infection can be altered by various factors, e.g. stress, alcohol use, and even the use of medications, such as antacids which reduce the effectiveness of the acid barrier
- The route by which the organism enters the body, e.g. oral, topical, etc.
- The degree of occupancy of the home and climatic conditions

2. The main principles for achieving high standards of infection control in the domestic environment are concerned with:

- Preventing the outgrowth of micro-organisms and preventing the transfer of contamination from these sources
- The reduction or elimination, where feasible, of sources/reservoirs of infection, and the proper cooking of contaminated raw foods
- Education of the public in good hygiene practices

Since in many situations there is continual recontamination of surfaces or sites, the emphasis in these situations is on managing these risks through high standards of hygiene practices, which prevent infection transfer.

3. Over the last 30 years or so the concept of HACCP (Hazard Analysis Critical Control Point – the process of identifying critical sites and hazardous situations and focussing hygiene at these points) has been used successfully to control microbial risks in food and other manufacturing environments. It is suggested that a similar approach in the domestic environment, which has come to be referred to as “targeted hygiene”, is required to devise a hygiene policy that has real health benefits (Bloomfield and Scott, 1997; Jones, 1998; Griffiths *et al.* 1998, Scott 1999). By encouraging the concept of the home as a setting in which the whole range of human activities occur, and that home hygiene is a series of interrelated procedures based on the same underlying microbiological principles, this provides the opportunity for a rational approach based on risk assessment.

In devising a risk assessment, or targeted approach to home hygiene, the first step – hazard characterisation – involves identifying the sites and surface in the home where pathogens are most likely to be found. Consideration must also be given to whether these are likely to be present in numbers that represent an infectious dose. Risk assessment depends on considering this information together with an assessment of the probability of human exposure to the hazard.

4. A number of procedures can be applied in order to achieve hygienic decontamination of sites and surfaces. These include:

I. INTRODUCTION & BACKGROUND

CLEANING

In many situations, such as for cooking, eating utensils and handwashing, decontamination can be achieved by the use of a cleaning product and water. However, since decontamination in these situations is largely achieved by mechanical removal of the contaminating micro-organisms, this method is only effective in achieving a hygienically clean surface if applied in conjunction with mechanical action (i.e. wiping or scrubbing) and a rinsing process. This process is, therefore, not effective on fixed surfaces, such as some food preparation surfaces, which cannot be effectively rinsed.

HEAT

Although heat is an effective method for decontamination of small items such as clothes, cleaning utensils and linens, it is not the most convenient method for decontamination of areas and surfaces in the home and can be unreliable in unskilled hands. Heat is the method used to reduce microbial contamination of foods to a level that is safe for consumption.

HYGIENIC CLEANERS AND CHEMICAL DISINFECTANTS

Hygienic cleaners and chemical disinfectants are used for decontamination of sites and surfaces in situations where the former methods are either impractical or deemed to be inadequate for the particular situation. Information on the choice of a suitable disinfectant or hygienic cleaning product is given in a number of international guideline documents, such as the British Standard document BS 7152 *Guide to Choice of Chemical Disinfectants* (Anon 1991), or the *List of Disinfectants* published by the Disinfectant Commission of the German Society for Hygiene and Microbiology (Anon).

5. It must be borne in mind that the effectiveness of any hygiene procedure applied in the home depends not only on the effectiveness of the procedure (e.g. the hygienic cleaner or the disinfectant) but also on the way in which it is applied, i.e. in the right way and at the right time. Effective hygiene in the home requires good hygiene practices, which in turn are dependent on good hygiene education. It is important to raise and maintain the awareness of the need for consistent standards of hygiene. It is important that the home manager understands the fact that a lapse in hygiene practice which does not result in an infection outbreak does not imply that the procedure is not important.

2. GUIDELINES FOR GENERAL HOME HYGIENE

Procedures to prevent infection and the transmission of infection are used in a variety of domestic situations. These may be categorised into four main areas, namely general home hygiene, food hygiene, personal hygiene and home healthcare. In the following sections guidelines for infection control in each of these areas is described. It is important to restate, however, that general home maintenance hygiene, food hygiene, personal hygiene and home healthcare should not be regarded as separate issues, and the basic underlying principles are the same for all these hygiene areas.

2.1. GUIDELINES FOR GENERAL HOME HYGIENE

In order to formulate a policy for day-to-day general home hygiene which achieves maximum benefit it is necessary to identify those sites and surfaces which are most frequently contaminated with potentially infectious organisms and which are most likely to spread contamination, as compared with other

sites and surfaces where the hazards are less. It is important that these areas are given priority in the application of hygiene procedures. In some cases, cleaning is sufficient while in others (particularly those most likely to represent a cross contamination hazard), hygienic cleaning or the application of heat or a disinfectant is required to achieve a satisfactory level of decontamination.

A policy for general home hygiene, based on risk assessment, can best be identified if sites and surfaces are grouped under different headings: reservoirs; reservoir/disseminators; hand and food contact surfaces; other surfaces (Table 2). When the frequency of occurrence of significant contamination for each of these categories of sites/surfaces is combined with the risk of contamination transfer, it is possible to assess the relative need for decontamination and suggest a suitable approach to achieving this (Bloomfield and Scott 1997; Jones 1998).

A general approach to home hygiene based on risk assessment is summarised in Table 3.

TABLE 2. CATEGORISATION OF SITES AND SURFACES IN THE HOME BASED ON RISK ASSESSMENT

CATEGORY	TYPE OF SITE
RESERVOIRS	WET SITES: TOILET BOWLS, ALL SINK U-TUBES, PLASTIC WASHING BOWLS, DRAINING BOARDS, NAPPY BUCKETS
RESERVOIR/DISSEMINATORS	WET-CLEANING UTENSILS: DISHCLOTHS, DISH SPONGES, FLOOR CLOTHS, MOPS, WASHING-UP BRUSHES, SCOURING PADS. BATHROOM OBJECTS: FACE CLOTHS, BATH SPONGES AND CLOTHS, NAIL BRUSHES, TOOTH BRUSHES*. SHOWER HEADS, HUMIDIFIERS
CONTACT SURFACES	HAND CONTACT SURFACES: TOILET FLUSH HANDLES, TOILET SEATS, DOOR HANDLES, TAP HANDLES, BASIN AND BATH SURFACES. OTHER HOUSEHOLD OBJECTS WHICH ARE FREQUENTLY TOUCHED BY MORE THAN ONE PERSON SUCH AS TELEPHONES
	HAND AND FOOD CONTACT SURFACES: CHOPPING/CUTTING BOARDS, KITCHEN WORK SURFACES, FRIDGE AND FREEZER SURFACE, COOKING HOB, EATING AND COOKING UTENSILS, BABY FEEDING MATERIALS. OBJECTS HANDLED BY CHILDREN SUCH AS TOYS**
	DRINKING WATER CONTACT SURFACES ALL UNDERGROUND AND ROOF TOP RESERVOIRS WHICH RECEIVE THE MUNICIPAL SUPPLY OF DRINKING WATER, STORAGE VESSELS, CONTAINERS, ETC.
OTHER SURFACES	ALL FLOORS (CARPETED AND NON-CARPETED) WALLS, ETC., OTHER BEDROOM AND LIVING SURFACES, FURNITURE, ETC.

* Hygiene issues regarding personal cleaning materials are reviewed in Section 4.3.

** Hygiene issues concerning children are discussed in detail in Section 2.7.

2. GUIDELINES FOR GENERAL HOME HYGIENE

TABLE 3. THE INFECTION HAZARD ASSOCIATED WITH THE FOUR CATEGORIES OF ENVIRONMENTAL SITE

SITE	FREQUENCY OF SIGNIFICANT CONTAMINATION	RISK OF CONTAMINATION TRANSFER	ASSESSMENT OF NEED FOR DECONTAMINATION	DECONTAMINATION APPROACH
RESERVOIRS	HIGH	OCCASIONAL	RELATIVELY LITTLE (EXCEPT DURING OUTBREAKS)	SUSTAINED ACTION DISINFECTANTS
RESERVOIR/DISSEMINATOR	HIGH	CONSTANT	CONSTANT	HYGIENIC DECONTAMINATION AFTER CONTACT WITH CONTAMINATED MATERIAL*. HYGIENIC DECONTAMINATION IMMEDIATELY BEFORE RISK HANDLING PROCEDURES**
HAND/FOOD	MEDIUM			
HAND/FOOD CONTACT SURFACE	MEDIUM			
DRINKING WATER CONTACT SURFACES	HIGH	CONSTANT	PERIODIC	PERIODIC CLEANING AND DISINFECTION
OTHER SITES	LOW	OCCASIONAL	RELATIVELY LITTLE (EXCEPT KNOWN CONTAMINATION)	DISINFECT ONLY WHERE REQUIRED

* e.g. after contact with contaminated raw meat, after nappy changing, etc.

** e.g. before contact with cooked food, etc.

Adapted from Bloomfield SF, Scott E. *Journal of Applied Microbiology* 1997; 83: 1-9.

2.2. RESERVOIR SITES

Although the probability of contamination at these sites is high, indications are that, under normal conditions, the risk of transfer from reservoir sites, such as flush toilets, U-tubes and drains, etc. is relatively low. Transfer from reservoirs may occur through direct contact with contaminated reservoir site surfaces, e.g. by directly touching toilet bowl surfaces. Although there is some evidence of cross contamination from toilets and sink U-tubes by splashing or aerosol formation, the evidence for this is conflicting and further studies are required. For reservoir sites, therefore, the following procedures should be applied:

- Reservoir sites must be regularly cleaned and well maintained. The frequency of the cleaning and maintenance procedures depends on the usage of the site, such as the number of occupants in the home and on the ambient conditions.
- In developing countries where the incidence of chronic diarrhoeal infection is high, it is recommended that toilets should be disinfected as well as cleaned and descaled on a routine basis. This is particularly important where the toilets are frequently used or where toilets are shared by one or more families or in specific circumstances, e.g. in certain high-risk situations as outlined in Chapter 5 (Anon 1991).
- When used in situations where they are deemed necessary, chemical disinfectants are effective but it is important to be aware that contaminating organisms can grow quite rapidly in the aqueous environment and that in order to achieve maximum benefit, a continuous release or sustained action disinfectant product should ideally be used.
- Procedures for cleaning and/or disinfection of toilets and other reservoir sites, such as sink and bath U-tubes, overflows, drains are specified in Section 6.4 of the “*Recommendations for selection of suitable hygiene procedures for use in the domestic environment*”.

2.3. RESERVOIRS / DISSEMINATORS

For items such as cleaning cloths and other cleaning utensils which act as reservoir/disseminators, a high risk of contamination is combined with a constant risk of transfer of contamination. In the home, reservoir/disseminators represent a situation which has the highest risk of transfer. If cleaning cloths or other cleaning utensils in the kitchen or bathroom are left in damp conditions they can support the growth of micro-organisms which can then be spread to other objects or surfaces. Where possible, the use of disposable cloths should be encouraged. For re-usable wet-cleaning items, such as dishcloths, floor cloths/mops, washing-up brushes and scouring pads, the following procedures should be rigorously applied:

- All items which can serve as reservoir/disseminators, such as wet-cleaning cloths, must be decontaminated each time after contact with any contaminated surface or material (e.g. after wiping raw food, after wiping up spills, cleaning nappy buckets). At a minimum, used wet-cleaning cloths should be decontaminated at least once a day even if they have not come into contact with a contaminating source.
- Ensure that all cloths are hygienically clean, not just visibly clean, before use in risk handling procedures (e.g. for cleaning surfaces used in the preparation of cooked food or food to be eaten raw – see Section 3.1).
- Cloths and other wet cleaning utensils can be decontaminated by hot machine washing (at least 60°C), by microwaving (1 min at full power), by boiling or by use of a chemical disinfectant as described in Section 6.3 of the *“Recommendations for selection of suitable hygiene procedures for use in the domestic environment”*. Soap and water washing is relatively ineffective for decontamination of cloths (Scott and Bloomfield 1990b).
- After decontamination, cloths must be dried as rapidly as possible. If cloths are left in a damp condition residual contamination not destroyed by the decontamination process will rapidly multiply at ambient temperatures.
- Mops used to clean up heavily contaminated areas, such as spills of faeces or vomit, should be cleaned, rinsed with a disinfecting solution, wrung as dry as possible and then dried as rapidly as possible, preferably at elevated temperatures.
- There is some evidence that aerosols generated from shower heads and humidifiers can cause infection, although this is only likely to occur with “at risk” groups. Showerheads should be designed and maintained so as to avoid the accumulation of stagnant water. Humidifiers should regularly be emptied, disinfected and refilled with fresh water.
- Procedures for cleaning and/or disinfection of other reservoir disseminators including humidifiers, showerheads, tap filters and nebulisers are specified in Section 6.4 of the *“Recommendations for selection of suitable hygiene procedures for use in the domestic environment”*.

2.4. HAND AND FOOD CONTACT SURFACES

Micro-organisms will not grow in the absence of water, but there is evidence to show that bacteria and viruses can survive on a dry surface for relatively long periods of time (2-4 hours and up to 24 hours or more for some species) in sufficient numbers to pose a cross infection hazard (Scott and Bloomfield 1990a, 1990b; Sattar *et al.* 1993; Hendley *et al.* 1973). Surfaces which represent the greatest hazard in the home are hand and food contact surfaces. For these surfaces there is a constant risk of infection transfer, indicating the need for regular and rigorous decontamination. The following procedures should be applied:

- Hand and food contact surfaces must be decontaminated after contact with contaminated material (e.g. after contact with raw meat or processing of nappies).
- Ensure that all hand and food contact surfaces are hygienically clean, not just physically clean, particularly before use in risk handling procedures (e.g. before using surfaces and utensils for preparation of cooked food or food to be eaten raw).
- Procedures recommended for cleaning and/or disinfection of hand and food contact surfaces in different situations (both general and risk situations) are specified in Section 6.2 of the *“Recommendations for selection of suitable hygiene procedures for use in the domestic environment”*.

In general:

- Hand and food contact surfaces (e.g. cutting boards or cooking and feeding utensils) can be decontaminated by washing with hot water and detergent provided this is followed by thorough rinsing. Where this is not feasible (e.g. for large surfaces where rinsing cannot be applied, or for hand contact surfaces, such as taps, toilet seats, toilet flush handles and door and fridge handles) the surface should be decontaminated using a hygienic cleaner or by wiping to remove soil followed by application of a chemical disinfectant. This is particularly important after touching contaminated surfaces (e.g. when washing hands after raw meat preparation, especially poultry, tap handles may become contaminated). Wiping with a cloth impregnated with only a cleaning product will not decontaminate surfaces.

- Where detergent-based cleaning without disinfection is applied, surfaces must be washed/cleaned/rinsed with safe and potable water. For effective cleaning and mechanical removal of dirt and germs, the quality and quantity of water is a critical factor, either or both of which could be a problem in the developing countries. Wherever there is doubt about the quality of water (e.g. the pond water in rural areas of many developing countries), initial washing may be done with the same, but final rinsing should be done with water of assured quality (tubewell in the rural areas). 50 ppm chlorine solution may be used for 1st phase washing, to be followed by rinsing with good quality water.

- Procedures for decontaminating surfaces of water reservoirs and containers are discussed in Chapter 6.

- Hands must be washed after contact with contaminated material and before risk handling procedures. Handwashing is reviewed in Chapter 4 (Personal Hygiene).
- After decontamination of surfaces, where possible they should be rapidly dried and maintained in a dry condition.
- Contact surfaces that apply particularly to children are reviewed in Section 2.7.

2.5. LAUNDRY HYGIENE

The laundering of clothing and other fabrics is strongly related to well-being and comfort, alongside its function of reducing microbial contamination, particularly where the ill, disabled or infants are concerned. Clothing, bed linens, towels and other items that are in constant or intermittent contact with the body may form an important route of transmission of infection for “at risk” groups (see Chapter 5). The following procedures should ensure effective laundry hygiene:

- During laundering, modern cleaning products effectively remove substrates from soiled fabrics which may support the growth of micro-organisms.
- Fabrics which may be contaminated with micro-organisms can be decontaminated using soap/detergent and hot water washing (60°C) or above, or at 40-60°C using an activated bleach-based powder. If lower temperature washes are used (<45°C), the addition of hypochlorite bleach will promote decontamination.
- Procedures recommended for cleaning and decontamination of laundry in different situations (both general and risk situations) are specified in Section 6.5 of the *“Recommendations for selection of suitable hygiene procedures for use in the domestic environment”*.
- Laundering of cloths, towels, etc. which are used in association with food preparation should be carried out separately from laundering of clothes and bed linens.
- Hands should be washed after contact with soiled laundry.
- In rural areas of countries with low income populations, such as India, washing of clothing in grossly polluted water (ponds/canals/rivers) is a major infection hazard, by way of bacterial and fungal infection. In areas where there is no piped water supply, people should be advised to stop this practice and to use tap water or tubewell/dugwell water as an alternative. In this situation the use of bleaching powder during laundering is advised. For the future, the development of low cost detergents with disinfectant action for use by the rural and urban poor may have significant health benefits.

2.6. OTHER SURFACES

These surfaces generally combine a low risk of contamination with low risk of transfer.

- All other surfaces should be regularly cleaned, kept dry to prevent the growth of micro-organisms, and well maintained.
- Disinfection or hygienic cleaning is only necessary where there is a known high risk (e.g. MRSA contamination) or where there is known contamination such as vomit or faecal material.
- Hygienic cleaning may, however, be beneficial for floors in hotter, more humid climates where the possible rates of growth of micro-organisms (and potential transfer by, for example, insects) are considerably greater.
- Procedures recommended for cleaning and decontamination of floors walls and furnishings are specified in Section 6.6 of the *“Recommendations for selection of suitable hygiene procedures for use in the domestic environment”*.

2.7. HYGIENE ISSUES FOR HOMES WITH YOUNG CHILDREN

When there are young children in a home, such as crawling toddlers, a number of surfaces with which they come into close contact may become contaminated. These may include toys that children put in their mouths, cot/crib rails, food preparation surfaces, nappy changing areas, nappy changing mats, toilet training equipment, floor surfaces and carpets. Nappy hygiene is as important for young children as for neonates.

- Parents must be made aware that toys which children put in their mouths can sometimes act as a means of transfer of infection, particularly where they are shared between different children. Preferably, toys should be washed and disinfected between use by different children (Hale and Polder 1996).
- Spills of body fluids from children, such as faeces, nasal and eye discharges, saliva, urine and vomit should be cleaned immediately and any contaminated surfaces cleaned and disinfected.
- Nappy hygiene is described in Section 4.1.1
- Children's faeces in the domestic and peri-domestic environment is a serious health hazard in many Asian and African communities. Children's faeces must not be allowed to remain in the home or peri-domestic environment. It must not be thrown into the courtyard or outside. Immediate and safe disposal should be assured. Procedures for safe disposal of excreta are specified in Chapter 7, and Tables 4 and 5 of this document.

2.8. HYGIENE ISSUES FOR HOMES WITH PETS

Owners of pets need to be made aware of the potential infection hazards associated with their pets (Wall *et al.* 1996b). These may include cats, dogs, especially when young, reptiles and birds. There is evidence to show that the presence of pets in the home is associated with increased levels of contamination in the kitchen and bathroom (Scott 1981). Domestic cats, dogs and other types of pets, although apparently healthy, can act as carriers of enteric pathogens, such as *Salmonella* and *Campylobacter*. Pets such as cats and dogs may also bring pathogens into the home on their paws and contaminate kitchen food surfaces as well as floor surfaces. In these situations, additional hygiene measures need to be considered:

- Pets such as dogs or cats should be appropriately immunised from disease.
- Pets are best housed and fed elsewhere than in the kitchen.
- Pet living quarters and items, such as cat litter boxes, should be cleaned on a daily basis. Faecal material should be removed from the surface of the litter tray using gloved hands and paper towels and flushed down the toilet.
- Avoid cleaning pet cages and tanks in the kitchen sink.
- Floor surfaces used by pets and pet feeding areas should be regularly decontaminated using a hygienic cleaner, or by cleaning followed by disinfection.
- Pets should not be allowed to come into contact with food preparation surfaces. Any of these surfaces which may have been in contact with a pet should be decontaminated before food preparation (see Section 2.4).
- Pet feeding utensils should be decontaminated using a hygienic cleaner or by application of a disinfectant.
- Hands should be washed after handling pets, pet cages, pet feeding utensils or other pet objects. Children particularly should be taught to wash their hands after handling their pets.
- Spills from pets, such as faeces, urine and vomit, should be cleaned immediately and any contaminated surfaces cleaned and disinfected.
- If a pet appears unwell, it should be taken to a veterinarian. Veterinarians should also advise parents about pets that are suitable for children.
- Pets in the home may be a particular risk in those groups of people whose immune defence systems are weaker than those of a normal healthy adult. This is reviewed in Chapter 5.

In many parts of the Indian subcontinent as well as in Asia/Africa, people share the peri-domestic environment with animals, such as cows, pigs or chickens. Cowsheds and piggeries are common features in most rural homes in India and the hygiene of these is an important issue. There should be adequate arrangement for disposal of waste (faeces and urine), and as far as possible cow-sheds should be separate and detached from the home. Introduction of bio-gas stoves in rural homes could solve the problem of animal waste/human waste disposal, as well as improve the air quality in kitchens. It is important to ensure that pet animals are regularly washed, and if possible immunised. It is also important to ensure that pet animals are not allowed to eat food from the same dish as the family members, as may sometimes be the practice.

2.9. HOME HYGIENE TO REDUCE THE RISK OF INFECTION FROM AIR-BORNE DISEASE

Houses of the socio-economically weaker section in countries like India are often conspicuous by their unhealthy and unhygienic living conditions – damp floors, overcrowding and lack of adequate ventilation. Women in particular, who spend the most time in the home, are exposed to serious smoke hazards due to lack of proper extractors in the kitchen. Lack of ventilation in bathrooms and toilets make them vehicles for transmission of air-borne contamination. While poor standards of housing, exacerbated by economic factors, is the major cause of poor air quality in homes, at the root of the problem is the fact that even among the middle income group, ventilation of kitchen and bathrooms is often neglected at the time of house planning and construction. The Environmental Hygiene Committee of the Indian government recommended (as far back as the early 1950s) that windows in kitchens should span at least 20% of the floor area while windows in living rooms should span 10% of the floor area. These recommendations are valid even today for non-air conditioned middle-income and low-income group houses. It is unfortunate that even government-sponsored housing projects do not always adhere to these recommendations. Use of poor quality coal in cooking ovens may create a serious SO₂ hazard in the kitchens, in the absence of proper exhaust arrangement. Again, introduction of bio-gas ovens (with human/animal excreta) could improve this situation. Overcrowding in low quality houses among the poor has facilitated the spread of tuberculosis infection in the domestic environment in India. There are 17 million cases of tuberculosis annually in India, with 0.5 million deaths.

Indoor bioaerosols generated in the home may include bacteria (including actinomycetes), yeasts, moulds and fungi. Although mould spores can occur in isolation, bacteria and viruses in the air are usually associated with skin scales or mucous droplets generated by sneezing. These airborne micro-organisms do not generally represent an infection hazard to the normal healthy individual, but the following advice should be given:

- Airborne contamination from bacteria, viruses, moulds and fungi can best be avoided by good ventilation and by the use of cleaning procedures that involve vacuum extraction.
- Excessive mould in the home should be avoided.
- Regular cleaning of surfaces where mould is likely to grow is important to prevent accumulation to levels that may become hazardous.

Allergic reactions from airborne contamination

The relationship between damp housing, mould growth and symptomatic health state has been well established (Strachan and Elton 1986; Martin *et al.* 1987; Platt *et al.* 1989; Strachen *et al.* 1990). It has also been concluded that damp and mouldy living conditions have an adverse effect on health, especially among children. Moulds can exacerbate asthma and other respiratory diseases, and allergens from house dust mite faeces are also implicated in respiratory diseases, such as asthma. Although these are allergic reactions and are outside the scope of this document, the following advice, in addition to published advice for asthmatics, should be considered:

- As a temporary measure, moulds should be wiped away with a diluted solution of bleach and areas of mould growth treated with approved products. More severe problems of damp housing and mould growth suggest poor ventilation and may need to be referred to relevant environmental housing departments.
- Regularly remove dust from sites where dust mites and dust mite faeces may accumulate to reduce their occurrence.

2.10. HOME HYGIENE IN EMERGENCY SITUATIONS

Following emergency situations and natural disasters, such as flooding, the home may become dangerously contaminated and the risk of infection increased. In these situations local authorities will usually provide advice and support for affected homes and make provision in case of loss of power and running water.

3. GUIDELINES FOR FOOD HYGIENE

The evidence suggests that within Europe and the USA the greater proportion of reported food poisoning outbreaks arise in the domestic environment. The majority of these outbreaks result from inadequate temperature control (either inadequate cooking, or storage of food under unsuitable conditions) (Roberts 1990). In a significant proportion of incidents cross contamination via surfaces (either food preparation surfaces or the hands) is a contributory, or even the causative, factor (Roberts 1986, 1990).

The most recent UK surveillance data (Day 2001) suggest that the most common cause of food-borne outbreaks in the home (up to 50%) is inappropriate storage, while inadequate heating accounts for 11% of outbreaks. Poor hygiene involving hands and other surfaces is cited as a contributory factor, in up to 39% of domestic food poisoning outbreaks (Griffith and Redmond, 2001). Although consumption of contaminated foods is a primary cause of IID, it is increasingly acknowledged that spread of IID in the community is by no means all food-borne, and that secondary spread within families, particularly of viral infections, is often the cause. Person-to-person spread via hands or surfaces, via food prepared in the home by an infected person, or by airborne spread can all occur particularly during the vomiting or diarrhoeal phase of gastrointestinal infections. An estimate from the UK Food Standards Agency (FSA) states that the proportion of total IID cases that are food borne is between 17 and 50%, which means that between 50 and 80% are not food borne (FSA 2000). In addition, data from the UK Communicable Disease Surveillance Centre (CDSC) indicate that maybe 19% of *Salmonella* outbreaks are transmitted not by food but by other means (Le Baigue *et al.* 2000). The data also suggest that fewer than half of *E. coli* 0157 outbreaks are food borne and less than 3% of the very large numbers of cases of IID are due to Norwalk-like viruses. A study of *E. coli* 0157:H7 infections from hamburgers prepared at home, implicated poor hand and surface hygiene as the cause (Scott 2001).

In homes where there was an infant infected with *Salmonella*, environmental sources, infected family members and pets, were found to be more significant risk factors than contaminated foods (Anon 2001b).

3.1. FOOD PREPARATION

- Certain raw foods or ingredients have a high risk of contamination such as meats, fish, poultry and eggs. When brought into the home these can act as vehicles for spreading contamination throughout kitchen surfaces. Other foods may have a medium risk of contamination, such as certain vegetables, which may have been contaminated during production, or which are soiled.
- A chopping board should be used for preparation of high-risk raw foods likely to be contaminated. After preparation of high-risk raw foods all surfaces which have come into contact with the food should be immediately decontaminated either with a detergent wash and rinse, or using a hygienic cleaner, or by wiping to remove soil followed by application of a chemical disinfectant*. It is recommended that separate chopping boards should be used for raw meat and fish, for fresh fruit and vegetables and for other items.
- Hands must be washed immediately after handling raw food (see Section 4.1). It is important to be aware that, during and after handling high-risk raw food, *any* surface subsequently touched with the hands (even tap handles, refrigerator doors and cooker control knobs) will be contaminated with micro-organisms from the food.
- Dishcloths and hand cloths used during the preparation of raw food *must* be decontaminated and dried. Cloths can be decontaminated by hot machine washing, boiling or by use of a chemical disinfectant*. Soap and water washing is relatively ineffective for decontamination of cloths. The use of disposable cloths/paper towels is recommended.
- After decontamination, cloths should be dried as rapidly as possible. If cloths are left in a damp condition residual contamination not destroyed by the decontamination process can rapidly multiply at ambient temperatures.

3.2. COOKING

- To cook meat safely so that commonly implicated foodborne pathogens such as *E. coli* 0157, Salmonella, *Campylobacter* and *Listeria* are killed, the centre of the meat must reach and maintain a temperature of 70°C for a minimum of 2 minutes or an equivalent core cooking temperature and time, or until the juices run clear. Note: cooking will not kill ALL of the bacteria present in food, but must be sufficient to reduce the numbers to a “safe” level.
- Food cooked from frozen, or re-heated chilled food must also be cooked for a sufficient period of time such that ALL of the food maintains a satisfactory temperature for a sufficient period of time as described above for raw food.
- Cooking equipment should be properly maintained to achieve consistently the required cooking temperatures and times.
- It is advisable that the cooking process should be routinely monitored (e.g. by using a meat thermometer).
- Users of microwave ovens should refer to the manufacturer’s instructions on the appropriate times and power settings for cooking or defrosting food. As with conventional ovens, microwaves have hot and cold spots so foods must be turned or stirred to prevent uneven heating.
- The internal surfaces of microwaves should be regularly cleaned and decontaminated.

EQUIVALENT COOKING CORE TEMPERATURES AND TIMES:

TEMPERATURE	TIME
60°C	45 mins
65°C	10 mins
70°C	2 mins

3.3. MEAL PREPARATION OF COOKED FOOD OR FOOD TO BE EATEN RAW

- Hands must always be washed before handling cooked foods (see Section 4.1).
- Ensure that all meal preparation/serving surfaces are hygienically clean, not just visibly clean, before use in the preparation of cooked food or food to be eaten raw*.
- Ensure that all cloths are hygienically clean, not just visibly clean, before use*.
- Cooked foods must never be allowed to come into contact with raw food, or with utensils, cloths or other surfaces contaminated by contact with raw food.

3.4. STORAGE OF FOOD

- Cooked food should be cooled as quickly as possible in order to prevent the growth of pathogenic micro-organisms, and then stored in a refrigerator or freezer.
- Refrigerators and freezers should be checked regularly to ensure that they maintain the required temperature. The temperature of a domestic refrigerator should be between 7°C and 4°C and that of a freezer -18°C (Eley 1996).
- Refrigeration only reduces the rate of growth of micro-organisms. It does not prevent it. Food should only be stored in the refrigerator for a limited period and sell-by dates on product packaging strictly adhered to.
- Raw food must always be stored separately from cooked food in the refrigerator. It is important to ensure that the juices from raw, potentially contaminated foods, such as raw meat, do not drip onto foods stored below which will not be cooked.
- Cooked foods or raw foods that are not cooked or heated before eating should be covered when stored in the refrigerator.
- Avoid mould growth on food residues and food storage areas.
- Refrigerator surfaces should be regularly decontaminated by cleaning and chemical disinfection*.
- Freezing of foods prevents bacterial growth for an indefinite period. Food, which is safe for consumption, can be maintained in that state by rapid freezing.

*Procedures recommended for cleaning and decontamination of kitchen cloths, hand and food contact surfaces, and hands are given in Sections 2.3, 2.4 and 4.1, respectively, of this document and in Sections 6.1, 6.2 and 6.3 of the “*Recommendations for selection of suitable hygiene procedures for use in the domestic environment*”.

More detailed information on food hygiene in the home is given by Scott and Sockett (1998) and Farber and Todd (1998).

4. GUIDELINES FOR PERSONAL HYGIENE

4.1. HAND HYGIENE

One of the most important routes for transmission of infection is via the hands. It is vital to raise and maintain awareness of the fact that ANY item, surface or object (including human skin) touched by the hands after contact with a contaminated source will be contaminated with micro-organisms from that source. The major contamination sources may include raw food, pets, soiled nappies, contaminated surfaces and reservoir sites such as toilets, sneezing, coughing and transfer of nasal secretions to the hands. Transient microbial contamination picked up onto the hands by contact with a contaminated source can be effectively removed by thorough handwashing with soap and running water.

Hands should be washed:

- Before handling food.
- Before eating.
- After using the toilet.
- After handling pets, pet cages, pet feeding utensils or other pet objects.
- After coming into contact with body fluids, such as nasal secretions, saliva, vomit etc., or after changing nappies.
- After hands have come into contact with a potentially contaminated reservoir site (e.g. a drain) or reservoir/disseminator (e.g. a wet-cleaning cloth).
- Whenever hands are visibly dirty.
- Before giving or applying medication to another person.
- Before applying contact lenses.

Procedures recommended for cleaning and/or disinfection of hands in different situations (both general and risk situations) are specified in Section 6.1 of the *“Recommendations for selection of suitable hygiene procedures for use in the domestic environment”*. Guidelines on an effective handwashing procedure are given in Appendix II.

4.2. GENERAL PERSONAL HYGIENE

All areas of the skin and mucous membranes, such as the mouth and nose, are colonised with micro-organisms. Although not harmful under “normal” conditions to the carrier, these can produce infection if transferred to other areas of the body (e.g. the urinary tract), or if transferred to another person who is susceptible to infection (see Section 5.1). It is impossible and undesirable to eradicate the normal resident microbial flora from the body. Regular bathing/showering and good general personal hygiene can reduce the risks of self as well as cross infection.

4.3. PERSONAL HYGIENE MATERIALS

Materials, such as bath sponges, nail brushes, tooth brushes and towels which are used for personal hygiene can become contaminated and can act as reservoir/disseminators if not correctly maintained (see Section 2.3). Therefore, the following procedures are advised:

- Face cloths, bath sponges, nail brushes and toothbrushes should be thoroughly rinsed under running water after use and then dried as rapidly as possible. If face cloths or other items are left in a damp condition residual contamination will rapidly multiply at ambient temperatures.
- Face cloths and sponges should be regularly laundered (see Section 2.5).

4. GUIDELINES FOR PERSONAL HOME HYGIENE

4.4. NEED FOR CHANGE IN PERCEPTIONS AND PRACTICES OF PERSONAL HYGIENE IN INDIA AND OTHER DEVELOPING COUNTRIES

Religious beliefs and cultural ethos, coupled with years of tolerance of unhygienic surroundings, have resulted in unscientific perceptions of hygiene and unhygienic practices among the people living in rural and urban under-served areas (particularly low income groups).

People commonly bathe in highly contaminated water, such as ponds/rivers, not always because of economic constraints or water scarcity, but often because of religious/cultural beliefs. They may even drink such contaminated water on religious grounds. People use cow-dung for plastering floors of kitchens and homes in the rural areas. Many of them use mud/ash for washing teeth and cleaning hands after defecation and wash cooking utensils in highly contaminated ponds. In today's economic conditions, most rural populations can afford to use low-cost soaps/detergents.

Availability of water is one of the key factors for improving personal hygiene (Curtis 1998); unless people have access to an adequate quantity of clean water, changing and improving personal hygiene behaviour may prove to be elusive.

There is an urgent need to promote a more scientific-based attitude to personal and domestic hygiene in schools and colleges if unhygienic practices are to be abolished. However, promoting hygiene behaviour in the community is a challenge that needs to be approached with multiple tools and methods. This aspect is discussed in more detail in Chapter 8.

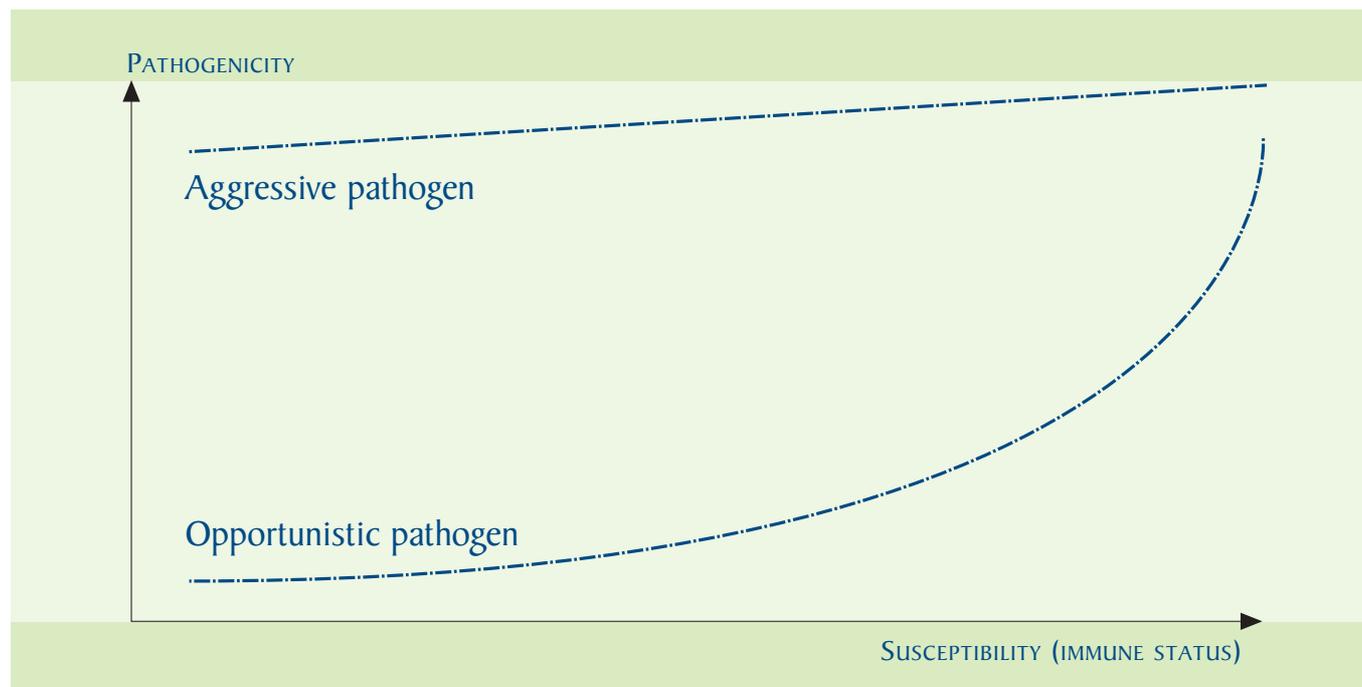
5. GUIDELINES FOR HOME HEALTHCARE

5.1. GROUPS WITH REDUCED RESISTANCE TO INFECTION

As stated previously, it must be borne in mind that cross infection in the domestic environment does not always result in an infectious disease. The risk of infectious disease arising from transfer of micro-organisms in the domestic environment depends on a number of factors including the type of organism and its pathogenicity, the infective dose, the susceptibility of the host (neonates, geriatrics, pregnant women and other immunocompromised people are at increased risk of infection) and the route by which the organism enters the body.

It is not possible to quantify the risks of infection for a particular organism in relation to a particular host. Figure 1 gives an illustration of the way in which the infection risk increases according to the nature of the infecting micro-organisms and the susceptibility of the host. From this, certain high-risk situations and groups can be identified where the application of additional and/or more rigorous hygiene measures over and above those which are routinely employed is recommended. Such measures are also required in situations where infected family members represent a source of infection to others.

FIGURE 1. A SIMPLIFIED ILLUSTRATION SHOWING THE INCREASING RISK OF INFECTION ACCORDING TO THE PATHOGENICITY OF THE INFECTING MICROORGANISM AND THE IMMUNE STATUS OF AN INDIVIDUAL



5.1.1. NEONATES

Neonates and young babies (0-1 years old) are at increased risk of infection. In addition, procedures, such as nappy changing, carry an increased risk of transmission of gastrointestinal infection through faecal contamination of hands and hand contact surfaces, and most particularly of face cloths and sponges where organisms can grow at ambient temperatures to establish permanent reservoirs of contamination. Disposal of nappies also poses an increased risk of faecal contamination of reservoir sites, such as the toilet water, toilet bowl and toilet seat.

In addition to normal hygiene routines the following situations therefore require rigorous hygiene procedures: hygiene of infant feeding utensils, personal hygiene to prevent infection and self infection (particularly eye infection), nappy hygiene and the hygiene of toilet training equipment (potties).

Hygiene of feeding utensils:

- Feeding utensils should be decontaminated by boiling or by use of a suitable disinfectant product. Note: these products are often referred to commercially as “sterilising products” whereas in practice they achieve disinfection.

Nappy changing:

- Used disposable nappies should be sealed in a plastic receptacle and placed in the waste.
- Reusable nappies should be placed in a nappy bucket and disinfected using a disinfectant product. After disinfection the contents of the nappy bucket should be flushed down the toilet – NOT poured down the kitchen sink.
- Vessels used for washing and cleaning nappies may also become heavily contaminated. In these situations, additional measures need to be considered.
- After disinfection soiled reusable nappies together with any other soiled clothing should be laundered (see Section 2.5).
- All objects and surfaces which were touched and may have become contaminated with faecal material during and after nappy changing should be cleaned and disinfected.

5.1.2. GERIATRICS

There are increasing numbers of elderly people who will be living at home, either alone or as part of a family group, who may be at increased risk of infection, including foodborne infection, due to the effects of ageing on their immune system. A proportion of elderly people may also be bedridden or incontinent, requiring particular attention towards laundry hygiene.

5.1.3. PREGNANT WOMEN

Pregnant women in the home are at increased risk from infections, such as *Listeria*, rubella, varicella, and should be given appropriate advice on the prevention of acquiring these infections in the home environment.

Although primarily recognised as a foodborne pathogen, *Listeria* species are common in the domestic setting and may be found outside the kitchen, particularly in wet areas. Advice on the prevention of *Listeria*-associated foodborne illness is provided by the Centers for Disease Control in the United States (Anon 1992b).

Toxoplasmosis represents a significant problem in pregnant women, who should take precautions to avoid contact with or cross-infection from cats that sometimes harbour this pathogen.

5.1.4. IMMUNOCOMPROMISED PEOPLE/PATIENTS DISCHARGED FROM HOSPITAL

Immunocompromised patients discharged from hospital into the home are at increased risk from all types of infection and should be given appropriate advice on the prevention of acquiring these infections in the home environment.

- Persons infected with HIV living at home should receive advice on the prevention of opportunistic infections. Advice to HIV patients about the avoidance of exposure to opportunistic pathogens has been published (Anon 1995a).
- Patients and caregivers need to take special precautions regarding the monitoring, insertion, use and maintenance of intravenous catheters in the home healthcare setting. Guidelines for i.v. care have been published and patients or caregivers can be taught to maintain the i.v. system according to these guidelines (Simmons *et al.* 1982; Simmons *et al.* 1990).

5.1.5. CONTACT LENS WEARERS

The eye is at great risk from contamination by contact lenses and these should be disinfected using a recognised preparation. The method for employing these preparations should be carried out rigorously according to the manufacturer's instructions.

5.2. THE INFECTED FAMILY MEMBER AS A SOURCE OF INFECTION

5.2.1. SYMPTOMLESS CARRIERS OF INFECTIOUS DISEASE

There are a number of categories of people who may be present in the home and who represent a source of serious, and in some cases life-threatening, infection in the home. These include, for example, symptomless carriers of primary pathogens, such as *Salmonella*, carriers of MRSA, carriers of HIV and hepatitis.

In many cases it is not possible to identify these people as carriers, but where they are identified rigorous hygiene precautions as outlined in these guidelines should be implemented. It is important that the families of infected people are educated about how the diseases are transmitted so that appropriate precautions are taken but also to promote ordinary family interactions by alleviating concerns about transmission.

For carriers of bloodborne diseases, such as HIV and hepatitis B and C, universal blood and body fluid precautions should be implemented in the home healthcare environment (Anon 1987; Anon 1988).

Generally, the following procedures are recommended:

- Whenever contact with blood or body fluids is anticipated, safe practices and appropriate barrier precautions should be used to prevent percutaneous, mucous membrane and skin exposures to bloodborne pathogens.
- Gloves should be used for touching blood, body fluids, mucous membranes or areas of broken skin and for handling items soiled with blood or body fluids.
- Hands should be washed after removing gloves which have come into contact with these sources.
- Blood and blood-containing fluids spilled on surfaces should be promptly removed and the contaminated surfaces cleaned with a disinfectant product (Simmonds and Chanock 1993).
- Gloves should be used during cleaning and decontaminating procedures.
- Carriers of bloodborne infections should not share razors, toothbrushes or any other object which may become contaminated with blood.

For carriers of MRSA, guidelines on its control have been published and include the following recommended procedures (Anon 1995b):

- Handwashing is one of the most important practices in preventing the spread of MRSA and MRSA carriers should be encouraged to practice good hygiene.
- The carrier as well as other family members should adhere to good infection control procedures.

For carriers of pathogens which are primarily transmitted through the faecal-oral route, such as hepatitis A or enteric pathogens including *Salmonella*, *Shigella*, *Campylobacter* and rotavirus, particular attention to personal hygiene and handwashing will minimise the risk of transmission.

5.2.2. FAMILY MEMBERS SUFFERING INFECTIOUS OUTBREAKS

In addition to symptomless carriers of infectious diseases, family members suffering infectious outbreaks, such as diarrhoea, acute hepatitis A, skin or eye infections, must follow more rigorous personal hygiene procedures to minimise the risk of transmission.

5.3. TREATMENT OF MINOR INJURIES

Animal bites, insect bites and stings, abrasions, cuts, burns and scalds may be responsible for a range of injuries in the home which may become susceptible to infection or a source of cross-infection to others.

- A first aid kit should be kept fully stocked in all homes for the treatment of minor injuries. This must be kept out of the reach of any children.
- The application of antiseptics may, in the case of a dirty wound, contribute to prevention of infection. There is however a body of opinion which suggests that the use of antiseptics can delay healing of healthy tissues, and this practice is therefore no longer encouraged for minor “clean” injuries.

First aid measures for a range of conditions or injuries are listed in a handbook for child care providers published by the Centers for Disease Control and may be equally applied for injuries occurring in the home (Hale and Polder 1996).

5.4. DISPOSAL OF EXCRETA AND WASTE OF INFECTED PEOPLE

Infectious waste including blood stained bandages, gauze, sputum, discarded syringes and other bio-medical infectious waste matters which are related to the care of sick persons in the home should be collected, stored separately and disposed of via municipal services designated for bio-medical waste collection. In rural areas, where there may not be any system of municipal collection, such infectious waste should be buried and covered with soil. Surfaces and clothes which come into contact with the sputum, faeces or vomit of sick persons must be adequately disinfected and washed.

6. DRINKING WATER HYGIENE

(STORAGE, HANDLING AND DISINFECTION OF DRINKING WATER IN THE DOMESTIC SETTING)

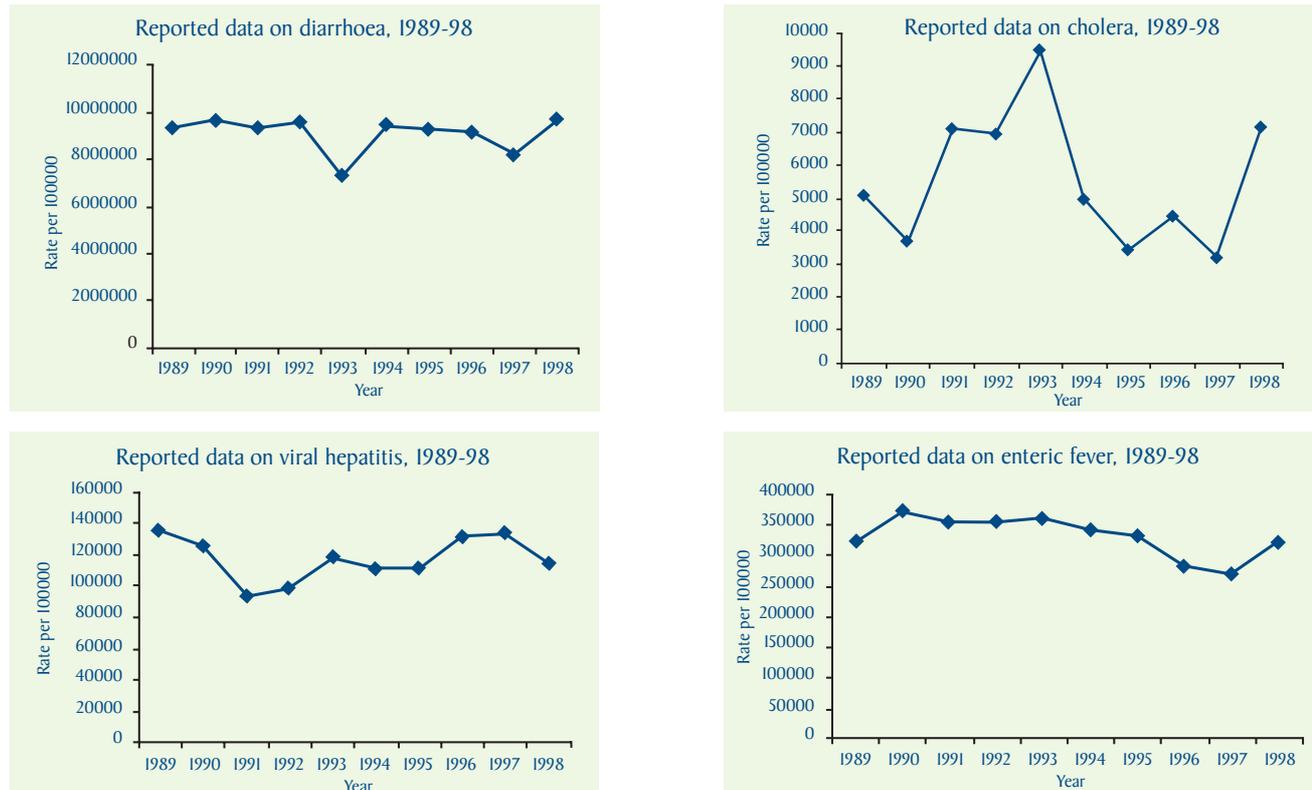
6.1. UNSAFE WATER AND COMMUNICABLE DISEASES: IMPORTANCE OF HOME HYGIENE

Water-borne diseases are of immense public health importance in developing countries like India. Contaminated water is one of the most significant factors which contributes to the high morbidity and mortality from infectious diseases in these areas. Contaminated water supplies have the potential to cause large, rapidly spread epidemics (e.g., cholera) which can create panic in the community. The lack of specific treatments against viral diseases such as viral hepatitis E, and the increasing problem of antibiotic resistance which makes bacterial diseases including

typhoid fever and bacillary dysentery more difficult to treat, underlines the importance of prevention through effective hygiene.

In India, massive programmes aimed at supplying potable water to urban as well as rural areas have been implemented by government in recent years, resulting in coverage of about 90% of the population in urban areas and about 86% of the population in rural areas. Sanitary coverage is not so high – about 49% in urban areas and about 14% in rural areas. Despite this, however, morbidity and mortality due to water-borne diseases have not declined to an extent commensurate with the increase in availability of potable water supply (Figure 2).

FIGURE 2. BURDEN OF WATER AND SANITATION-RELATED DISEASES IN INDIA (SOURCE: NATIONAL INSTITUTE OF COMMUNICABLE DISEASES, 2001; UNPUBLISHED)



N.B. These data grossly underestimate the true burden of water-borne diseases. For example, based on the reported data the incidence of viral hepatitis is around 12 per 100,000 population. In contrast, community studies from two urban communities have revealed that the incidence may be around 100 per 100,000 population. Similarly less than 10 million cases of diarrhoeal diseases are reported every year through routine surveillance system. On the other hand, community studies indicate that every child below 5 years of age has 2-3 episodes of diarrhoea every year. It means many hundred millions cases of diarrhoea every year.

6. DRINKING WATER HYGIENE

It is now known that water supply departments usually introduce safe water into the supply system, but often the quality is not maintained at the point of use or collection by the consumer due to deficiencies in the distribution system. In addition, safe water can become contaminated during storage due to poor handling practices at home and poor personal hygiene. From this it is concluded that increased availability of potable water will only produce a significant decline in water-borne diseases if the quality of the water is also ensured at home. To achieve this there is an urgent need to educate people about hygienic practices for handling and storage of water at home and for cleaning and disinfection of reservoirs and surfaces in contact with drinking water.

It is important that people are informed about the source and the quality of the water source that they are using in the home since this may vary considerably from one local community to another. Table 4 and Figure 3 show the various sources of water for domestic use in typical communities of India and Africa (Nath 2000; Curtis 1998).

TABLE 4. WATER USAGE (% OF FAMILIES)

PURPOSE AND SOURCES	HIGHER INCOME GROUPS	MIDDLE INCOME GROUPS	SLUM	RURAL
DRINKING				
PIPED WATER	63	17	23	5
HAND PUMP	37	83	77	83
OPEN WELL	0	0	0	12
POND	0	0	0	0
OTHERS	0	0	0	0
COOKING				
PIPED WATER	76	87	23	5
HAND PUMP	24	13	77	80
OPEN WELL	0	0	0	12
POND	0	0	0	3
OTHERS	0	0	0	0
WASHING UTENSILS				
PIPED WATER	100	91	23	1
HAND PUMP	0	7	46	22
OPEN WELL	0	2	0	12
POND	0	0	21	62
OTHERS	0	0	0	3
WASHING CLOTHES				
PIPED WATER	100	91	11	0
HAND PUMP	0	7	27	7
OPEN WELL	0	2	0	10
POND	100*	100*	100*	80
OTHERS	0	0	11 (CANAL)	3
BATHING				
PIPED WATER	100	91	14	1
HAND PUMP	0	7	77	22
OPEN WELL	0	2	0	12
POND	0	0	9	62
OTHERS	0	0	0	3
OTHERS				
PIPED WATER	100	91	14	1
HAND PUMP	0	7	66	42
OPEN WELL	0	2	0	12
POND	0	0	9	42
OTHERS	0	0	11	3

* 100% of families washed some clothes by dhobi IFH case study in India (Nath, 2000)

6. DRINKING WATER HYGIENE

FIGURE 3. SOURCES OF DOMESTIC WATER

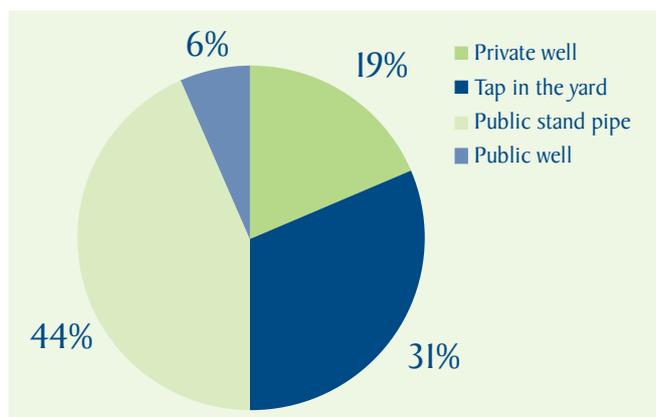


Table 5 shows the variable microbial quality of typical samples of the water from these various sources. As mentioned earlier, bacteriological quality of water from sources like village ponds, shallow bore-wells, etc. are highly questionable and must be boiled or disinfected in the home before use as drinking water or for food preparation.

TABLE 5. WATER QUALITY

TYPE	TOTAL AND FAECAL COLIFORM MPN /100 ML					
	0	1 – 10	11 – 90	91 – 180	181 – 360	360 +
1. MUNICIPAL / COMMUNITY PIPED SUPPLY (72 SAMPLES)						
TOTAL COLIFORM	55 (76.4)	11 (15.3)	4 (5.5)	2 (2.8)	0	0
FAECAL COLIFORM	58 (80.6)	8 (11.1)	6 (8.3)	0	0	0
2. HAND PUMP (81 SAMPLES)						
TOTAL COLIFORM	37 (45.7)	35 (43.2)	6 (7.4)	3 (3.7)	0	0
FAECAL COLIFORM	63 (77.8)	9 (11.1)	7 (8.6)	2 (2.5)	0	0
3. OPEN WELL (12 SAMPLES)						
TOTAL COLIFORM	0	0	2 (16.7)	7 (58.3)	2 (16.7)	1 (8.3)
FAECAL COLIFORM	0	2 (16.7)	5 (41.6)	2 (16.7)	2 (16.7)	1 (8.3)
4. POND (10 SAMPLES)						
TOTAL COLIFORM	0	0	0	3 (30)	4 (40)	3 (30)
FAECAL COLIFORM	0	0	0	3 (30)	4 (40)	3 (30)
5. CANAL (5 SAMPLES)						
TOTAL COLIFORM	0	0	0	0	0	5 (100)
FAECAL COLIFORM	0	0	0	0	0	5 (100)
6. WATER FROM UNDER GROUND RESERVOIR (12 SAMPLES)						
TOTAL COLIFORM	2 (16.7)	4 (33.3)	5 (41.7)	1 (8.3)	0	0
FAECAL COLIFORM	3 (25)	3 (25)	5 (41.7)	1 (8.3)	0	0
7. WATER FROM OVER HEAD RESERVOIR (16 SAMPLES)						
TOTAL COLIFORM	3 (18.7)	2 (12.5)	4 (25)	4 (25)	1 (6.3)	2 (12.5)
FAECAL COLIFORM	5 (31.2)	4 (25)	1 (6.3)	3 (18.7)	2 (12.5)	1 (6.3)
8. WATER FROM IN-HOUSE TAPS (24 SAMPLES)						
TOTAL COLIFORM	2 (8.3)	14 (58.3)	4 (16.7)	1 (4.2)	1 (4.2)	2 (8.3)
FAECAL COLIFORM	8 (33.3)	10 (41.7)	2 (8.3)	2 (8.3)	1 (4.2)	1 (4.2)
9. WATER IN STORAGE CONTAINER (30 SAMPLES)						
TOTAL COLIFORM	8 (26.7)	8 (26.7)	7 (23.4)	2 (6.7)	3 (10)	2 (6.7)
FAECAL COLIFORM	10 (33.3)	11 (36.7)	2 (6.7)	2 (6.7)	4 (13.3)	1 (3.3)

(Nath, 2000)

6.2. COLLECTION, STORAGE AND HANDLING OF DRINKING WATER IN THE HOME

Collection, storage and handling of drinking water in the home is one of the major risk areas in respect of domestic hygiene in most developing countries like India. This is important even in areas where the water is known to be of good quality at the point of collection. There are a number of specific risk areas and aspects that need special consideration.

6.2.1. CLEANING AND DISINFECTION OF DRINKING WATER RESERVOIRS IN THE HOME

Since water is often received into the home from municipal supply systems that are intermittent, one of the major risk factors in urban homes in India and other developing countries in Asia and Africa is the sanitation of the tanks or reservoirs which are used in the home to store water. In addition, the municipal water distribution system often becomes faecally contaminated during non-supply hours, due to leaky pipelines and sewerage systems. This has often contributed to the growth of micro-organisms in the domestic reservoirs and spread of infections like viral hepatitis, bacteria and viral diarrhoea, typhoid and enteric fever, etc. For hygiene of drinking water reservoirs in the home the following procedures should be applied:

- It is important to ensure that the communal reservoir or tank is cleaned and rinsed each time before being refilled using good quality potable water or treated water.
- The water contact surfaces of the reservoir should be regularly cleaned (at least once a month) and de-scaled to remove biological growth which may harbour pathogens, followed by disinfection (super-chlorination with a chlorine dose of 25-50 mg/l and contact period of 10-24 hrs).
- This water should be flushed out after disinfection.
- This process of periodic disinfection of water storage vessels is obligatory and cannot be compromised under any circumstances.

6.2.2. COLLECTION, STORAGE AND HANDLING IN THE HOME

Repeated hand contact with drinking water, during its collection, storage and serving among all groups of people in countries like India is a major health concern. Low-income groups in rural and peri-urban areas, who do not have piped water in the home, collect water in open jars/buckets or other vessels and store them in the home, often without proper covers. Water is taken from these containers by dipping hands and fingers into the water. Earthen vessels, used for storing water in rural homes, even in economically well-off families, are not cleaned and disinfected adequately. The following procedures should be applied:

- Hand contact with water during collection etc. can recontaminate the water and must be avoided.
- If possible all domestic containers for storing drinking water made of stainless steel/porcelain/glass/burnt clay should be covered and provided with a tap at the bottom so that hand contact is not required.
- Storage vessels should be kept covered.
- Hygiene of collection and storage vessels for domestic use is a key issue. Families must be made aware of the dangers of continually "topping up" water in storage vessels. In this situation residual contaminated water in the vessel can initiate the formation of a permanent reservoir of water-borne pathogens in subsequent batches of water. After each use collection and storage vessels should be thoroughly rinsed using good quality potable water or water which has been treated by one of the methods described above.
- Water should be stored in the home for the shortest possible time.

6. DRINKING WATER HYGIENE

6.2.3. DISINFECTION OF DRINKING WATER AND WATER FOR DOMESTIC USE

It is strongly recommended that water collected from sources of doubtful quality (e.g. ponds/rivers/dug-wells, etc.) in rural areas and even from the municipal water supply systems in the urban areas, should be disinfected in the home by boiling, filtration or by adding bleaching powder or chlorine tablets in appropriate doses (0.5 to 1 mg of chlorine per litre of water). In the rural areas, pond or river water is often used for various domestic purposes, including cleaning of utensils, cooking and washing of clothes. The water, apart from bacteriological contamination, may have some turbidity problem as well. In such a situation it is advised that the water should be treated with alum and bleaching powder, stored for at least 2 hours and then decanted or filtered through a clean cloth. This will improve the water quality to a great extent.

Where the quality of the water is not considered adequate for drinking or for hygiene purposes, procedures for decontamination of water given in Section 6.7 of the *“Recommendations for selection of suitable hygiene procedures for use in the domestic environment”* should be applied.

In China, the universal system of drinking boiled water in homes, hotels and restaurants, has helped reduce water-borne diseases and child mortality significantly.

6.3. OUTBREAK SITUATIONS

- Where a water-borne outbreak is suspected, guidelines by the WHO or UNICEF should be consulted (Anon 1994).
- For disinfecting surfaces of water reservoirs/containers/tube-wells/bore-wells which might have been seriously contaminated by faecal matter and where biofilms or scale may have been formed, thorough scrubbing and effective cleaning should be followed by super-chlorination (25-50 mg/l of chlorine) for a contact period of 24 hours. This water should be flushed out after disinfection.

7. PERI-DOMESTIC SANITATION: HUMAN EXCRETA AND WASTE DISPOSAL

7.1. PERI-DOMESTIC SANITATION: HUMAN EXCRETA AND WASTE DISPOSAL

In the rural and peri-urban areas of the developing countries in Asia and Africa, the home extends beyond the four walls of the living area. Figure 4 shows a village house complex in a typical Indian village and Figure 5 shows a typical compound plan of a polygamous African family. Peri-domestic hygiene is the interface between home hygiene and environmental hygiene, between community and public services. The important point to note here is that home hygiene procedures and norms of cleanliness must include the courtyard and the immediate surroundings of the house as well, if transmission of diarrhoeal and other faecal-oral diseases is to be prevented. Improvement of peri-domestic hygiene is a shared responsibility between the community and public.

FIGURE 4. A TYPICAL RURAL HOME AND PERI-DOMESTIC ENVIRONMENT IN INDIA

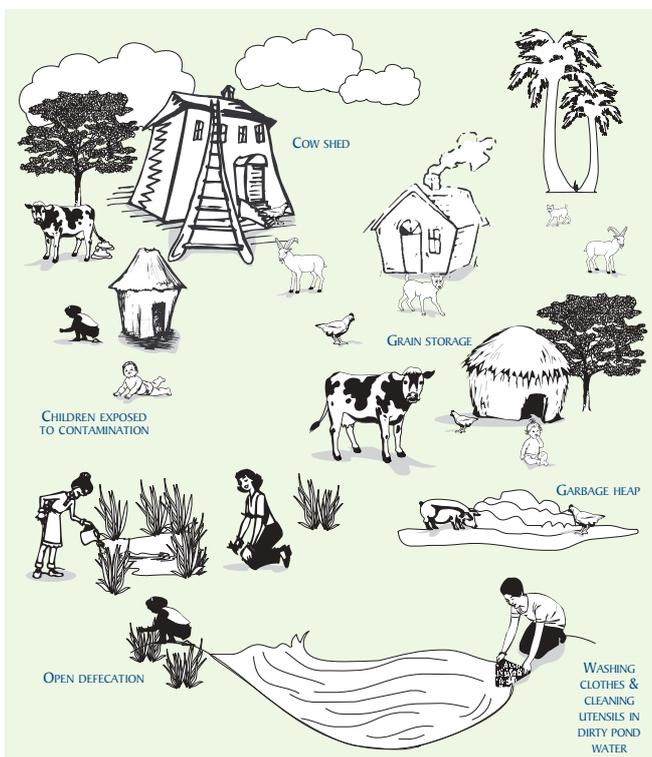
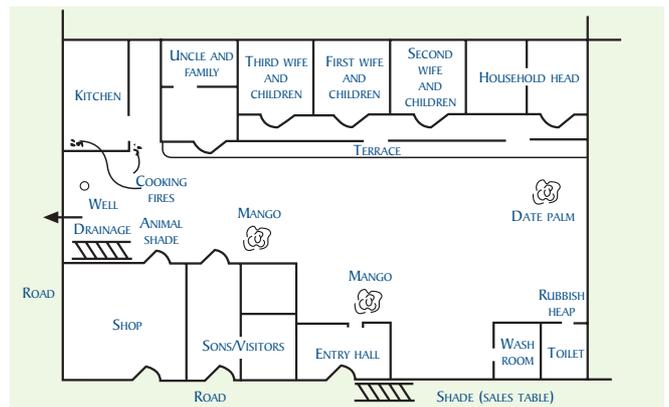


FIGURE 5. PLAN OF A TYPICAL COMPOUND OF A POLYGAMOUS FAMILY IN BOBO, AFRICA (SOURCE: CURTIS 1998)



7.1.1. DISPOSAL OF HUMAN EXCRETA

As reported from many studies in Asia and Africa, people's perceptions about the health risk associated with exposure to human faeces is very weak. As a result, it is common practice in African and Asian countries in rural and peri-urban areas to deposit the faeces of children and also that of the sick in the courtyard or in close proximity to the household compound (Tables 6 and 7). Children's faeces are often not disposed of straight away and kept for a time within the home. This may not only contaminate the floor of living rooms or the domestic environment, but also contributes to transfer of potential pathogens via insects from the stool to food, stored water or onto other objects which may then be ingested by a susceptible host.

7. PERI-DOMESTIC
SANITATION:
HUMAN
EXCRETA AND
WASTE
DISPOSAL

TABLE 6. DISPOSAL OF CHILD'S STOOL BY MOTHER

IN THE LATRINE	56
BURIED IN THE YARD	1
THROWN AWAY IN THE YARD	9
THROWN OUTSIDE THE YARD	16
OTHER	2
NOT DISPOSED OF	16

CASE STUDY IN BOBO-DIOULASSO, AFRICA

(Curtis 1998)

TABLE 7. DISPOSAL OF CHILD'S STOOL (% OF FAMILIES)

	HIGHER INCOME GROUPS	MIDDLE INCOME GROUPS	SLUM	RURAL
IN THE YARD	-	-	-	20
OUTSIDE YARD/ ON THE ROAD	15	4	30	7
IN DRAIN/ GARBAGE DUMPS	-	6	70	8
IN LATRINE	85	90	-	-
BURIED	NIL	NIL	NIL	2

IFH CASE STUDY IN INDIA

(Nath 2000)

The most important "Primary Barrier" to transmission of faecal pathogens in the domestic and peri-domestic environment is the safe and sanitary disposal of human stools in such a way that they are isolated from all future human contact (by the use of latrines, burying, etc.). There are many studies in the developing countries to indicate that indiscriminate defecation near the home or children defecating in the living areas are associated with an increased incidence of diarrhoea. Baltazar and Solon (1989) found a 64% increase in pathogen-positive diarrhoea in families where children's stools are inadequately disposed of. Mertens *et al.* (1992) found that safe stool disposal was associated with a 35% lower diarrhoea risk in Sri Lanka.

In the context of the above, guidelines for home hygiene should highlight the following:

- Do not defecate or urinate in the courtyard or in the vicinity of the house. Use latrines where available.
- Dispose of children's stools in the toilet pan or bury it and cover it with soil.
- Flies or other insects should have no access to faeces and food material.
- Wash hands with soap and water after defecation and after handling the stools of children and the sick.
- After removing stool from the floor or any other surface, wash the surface clean and disinfect.
- Bed pans and potties used to carry stool must be adequately cleaned and disinfected and dried.

7.1.2. DRAINAGE OF WASTE WATER/RAIN WATER: CONTROL OF VECTOR BREEDING

Inadequate drainage and consequent accumulation of water in the vicinity of the home has been the root cause of vector breeding (mosquito) and transmission of vector-borne diseases. While accumulation of dirty water in the sewage and sullage drains is responsible for diseases like filaria, dengue, etc., accumulation of clean water in unused containers left in the courtyards or around the bore-well/tap-stand, which are used for drinking water, help vector breeding and the spread of malaria. Today malaria is a major public health problem in the urban areas of India.

Use of insecticides during the 1950s in India controlled the transmission of malaria to a great extent, but with increased vector resistance to insecticides the disease has reappeared in the areas, primarily due to proliferation of breeding sites in the vicinity of the home.

7. PERI-DOMESTIC SANITATION: HUMAN EXCRETA AND WASTE DISPOSAL

The principal control measure should be not to allow accumulation of sullage, waste water or clean water in the peri-domestic environment by adhering to the following guidelines:

- Proper apron and drainage arrangements around tap-stand/bore-wells to flush away waste water to the municipal drain.
- Adequate drainage of rain water and waste water from the home to the municipal drain/sewerage.
- Periodic cleaning and de-sludging of drains.
- In the absence of any proper drainage system in the rural areas, soakage pits should be provided for individual homes or it may be shared by a number of homes.
- In higher income houses, accumulation of water in air conditioners and access of mosquitoes to household drinking water tanks should be prevented.

7.1.3. DISPOSAL OF HOUSEHOLD SOLID WASTE INCLUDING INFECTIOUS WASTES

Indiscriminate disposal of household solid waste in the vicinity of the home, apart from fouling the general environment, also adds to fly breeding and rat/insect harbouring. The accumulation of solid waste also blocks the drains and creates water logging in the peri-domestic environment.

Many municipal authorities in the developing countries fail to provide satisfactory services for sanitary and safe collection, storage and disposal of domestic solid waste. The piling of putrefying garbage by the roadside and the uncovered, uncontrolled disposal of waste (along with faecal matter) at municipal disposal grounds are common sights. There is hardly any system of house to house collection and segregation of bio-medical/infectious waste from that of general garbage, except in a few metropolitan cities. The individual citizen may contribute to the problem by disposing of garbage, including kitchen waste or the infectious waste of sick persons, indiscriminately on roads at any time of the day.

There is a tendency to shift the burden of hygiene from the private home to public environment; in most cases there is no co-ordination between private and public responsibilities. Together the present system of solid waste disposal in the urban areas, particularly in the small- and medium-sized towns and peri-urban areas, has become a significant vehicle for transmission of diarrhoeal and other faecal-oral communicable diseases. The following actions are recommended for prevention of infections and cross-infections at home and in the peri-domestic environment:

- Domestic waste should be segregated between putrefying, non-putrefying and infectious (bio-medical) wastes, stored in separate containers in the home and removed regularly.
- Domestic waste should never be discarded directly on the ground, but always put into containers and handed over to municipal collectors or placed directly in the municipal bins regularly, preferably to coincide with predetermined collection times.
- The municipal authorities must make proper arrangements for regular and individual house to house collections of infectious and non-infectious wastes, and for their safe and sanitary transportation and disposal. Wherever house to house collection is not possible, community bins (one bin for 10-20 houses) should be provided. The bins should be designed so that rats, rodents, flies and other insects do not have access to the waste.
- In absence of any municipal collection and disposal system in the rural areas, individual homes or a group of homes should have on-site treatment of domestic waste, including human excreta and animal waste. This could be accomplished through the use of vermi-composting, garbage pits or bio-gas generation.

8. IMPROVING HOME HYGIENE IN THE DEVELOPING COUNTRIES: A STRATEGY FOR ACTION

In order to formulate an effective action plan for improving home hygiene it is essential that we have a better understanding and adequate knowledge of the following:

- Existing hygiene practices in the home and peri-domestic environment and their linkages with socio-cultural factors and religious ethos of the country.
- The community's perception of existing hygiene practices and the risk of disease transmission. This may be best achieved using socio-behavioural assessment. We must also be aware of the potential risk of disease that may result from existing hygiene practices through appropriate epidemiological assessment.
- The most appropriate and cost-effective tools for changing hygiene behaviour.

The government and municipal authorities in the developing countries, as well as medical and environmental health professionals, must realise that infection prevention in the domestic, peri-domestic and public settings is not only a priority, but is a responsibility which has to be shared by the public and the community. Obviously, effective sharing of this responsibility demands that people must be properly and responsibly informed about the role that they need to play in infectious disease prevention programmes. In a developing country, motivating relatively simple and rational behavioural changes in the home could be the most cost-effective means of disease prevention. The data in Table I (Chapter I) on importance of alternative control measures for infectious diseases in the developing countries clearly demonstrates that of the six parameters which are key to infectious disease prevention, five, i.e. water quality, excreta disposal, personal and domestic cleanliness, drainage and sullage disposal, and food hygiene could be substantially improved by changing hygiene behaviour.

However, one should not lose sight of the fundamental issues involved in changing hygiene behaviour in a society. It would be too simplistic to assume that informing people about the health risks associated with existing hygiene practices and educating them about the preventive measures could, by itself, bring about the desired changes. In order to bring about fundamental changes in the hygiene behaviour of the community in a developing country, changes in the physical and social environment are a basic prerequisite. One of the main causes of poor domestic and personal hygiene of people in third world countries is the lack of safe water in adequate quantities in their homes. Accessibility and adequacy of water supply have been found to be a major determinant of hygiene behaviour of the community, particularly that of women (Cairncross, 1990). The other key determining factor in developing countries for improving hygiene behaviour is the empowerment of women. Empowered and more enlightened women are likely to be more receptive to the hygiene education messages.

8. IMPROVING HOME HYGIENE IN THE DEVELOPING COUNTRIES: A STRATEGY FOR ACTION

It is strongly recommended that governments and municipal governments in the developing countries, while launching any project for the improvement of community water supply and environmental sanitation, should make hygiene education and a hygiene awareness campaign an integral component. As such it is strongly recommended that hygiene education and hygiene awareness campaigns should be an integral component of all socio-economic and environmental health promotion programmes, including community water supply and sanitation undertaken by governments/municipal governments in the developing countries.

The corporate commercial sectors in the developing countries should also be encouraged to design their consumer public relations programmes to communicate pro-actively rational and consistent messages about hygiene based on scientific evidence. The debate in some of the European countries that too much hygiene, i.e. lack of exposure to microbes is weakening our immune system, is not very relevant to the prevailing realities in the developing country homes. In countries like India, lack of hygiene at home and the resultant transmission of communicable diseases is a far greater cause for concern than the possible hazards of too much hygiene and allergic conditions.

The effectiveness of soap and water as a hygiene measure is critically dependent on the quantity and quality of available water – either or both of which could be a significant problem in the developing countries. For situations where effective washing is not feasible, a disinfection process involving either heat or a chemical disinfectant is required. While inappropriate promotion of disinfectant must not be allowed to promote a false sense of security, in many situations (particularly in developing countries) if properly used they give a valuable margin of safety.

In devising and communicating hygiene strategies, there is a need to ensure that proper risk benefit assessments are taken into account. Failure to take a balanced approach was cited as a cause of the 1991 cholera outbreak in South America involving 350,000 cases, where chlorinating of water supplies was reduced because of unquantified risks of carcinogenicity from chlorinated hydrocarbons. Given the risk potential of infection and cross-infection in the home environment in the developing countries, the scope of use of chemical disinfectants for drinking water as well as contaminated sites, surfaces and reservoirs cannot be minimised. As such it is recommended that both public and private sector should undertake R&D studies to develop low cost detergents which maximise removal of contaminated soil during cleaning and disinfectants which kills the residual germs.

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APPENDIX I: DEFINITIONS

For the purpose of this document the following definitions apply. Some of the definitions are taken from agreed national and European standards e.g. British Standards (BS). For some hygiene processes referred to in this document there is no agreed definition or the definitions are currently under discussion within ISO (International Standards Organisation) or CEN (Comitè European de Normalisation) bodies:

BACTERICIDE (BS 5283): A chemical agent that under defined conditions is capable of killing bacteria, but not necessarily bacterial spores.

CLEANING/CLEANER: A physical process or product that removes soil or organic material from an object or surface, but does not have bactericidal, sporicidal, virucidal, fungicidal activity and does not necessarily reduce the level of microbial contamination.

CLEAN SURFACE:

Visibly clean surface – A surface (hands or other surface) which shows no evidence of visible dirt.

Hygienically clean surface – A surface which does not constitute a threat to health as a result of the presence of micro-organisms.

CONTAMINATION: The presence of an infectious agent on a body surface, clothes, bedding, toys, instruments, dressings, other inanimate articles or substances, or present in food or water.

DECONTAMINATION: The destruction (by physical or chemical agents) or removal of micro-organisms, but not usually bacterial spores: it does not necessarily kill all micro-organisms, but reduces them to a level acceptable for a defined purpose, for example a level which is harmful neither to health nor to the quality of perishable goods.

DISINFECTANT (BS 5283): A chemical agent that under defined conditions is capable of the destruction of micro-organisms, but not usually bacterial spores: it does not necessarily kill all micro-organisms, but reduces them to a level acceptable for a defined purpose, for example a level which is harmful neither to health nor to the quality of perishable goods.

FUNGICIDE (BS 5283): A chemical agent that under defined conditions is capable of killing fungi.

HYGIENIC CLEANING/HYGIENIC CLEANER: A practice or product that removes soil or organic material from an object or surface and also causes destruction of micro-organisms through an inherent bactericidal, virucidal or fungicidal activity: the combination of soil removal and destruction reduces contamination to a level where there is no longer a threat to health by transmission of the micro-organisms.

INFECTION: Colonisation of the body of humans or animals by an infectious agent that may manifest in disease or remain inapparent.

INFECTIOUS DISEASE: A clinically manifest disease of humans or animals resulting from an infection.

SPORICIDE (BS 5283): A chemical agent that under defined conditions is capable of killing bacterial spores.

VIRUCIDE (BS 5283): A chemical agent that under defined conditions is capable of killing or inactivating viruses.

OTHER COMMONLY USED DEFINITIONS

ANTIBACTERIAL: A product or process which kills bacteria or inhibits their growth.

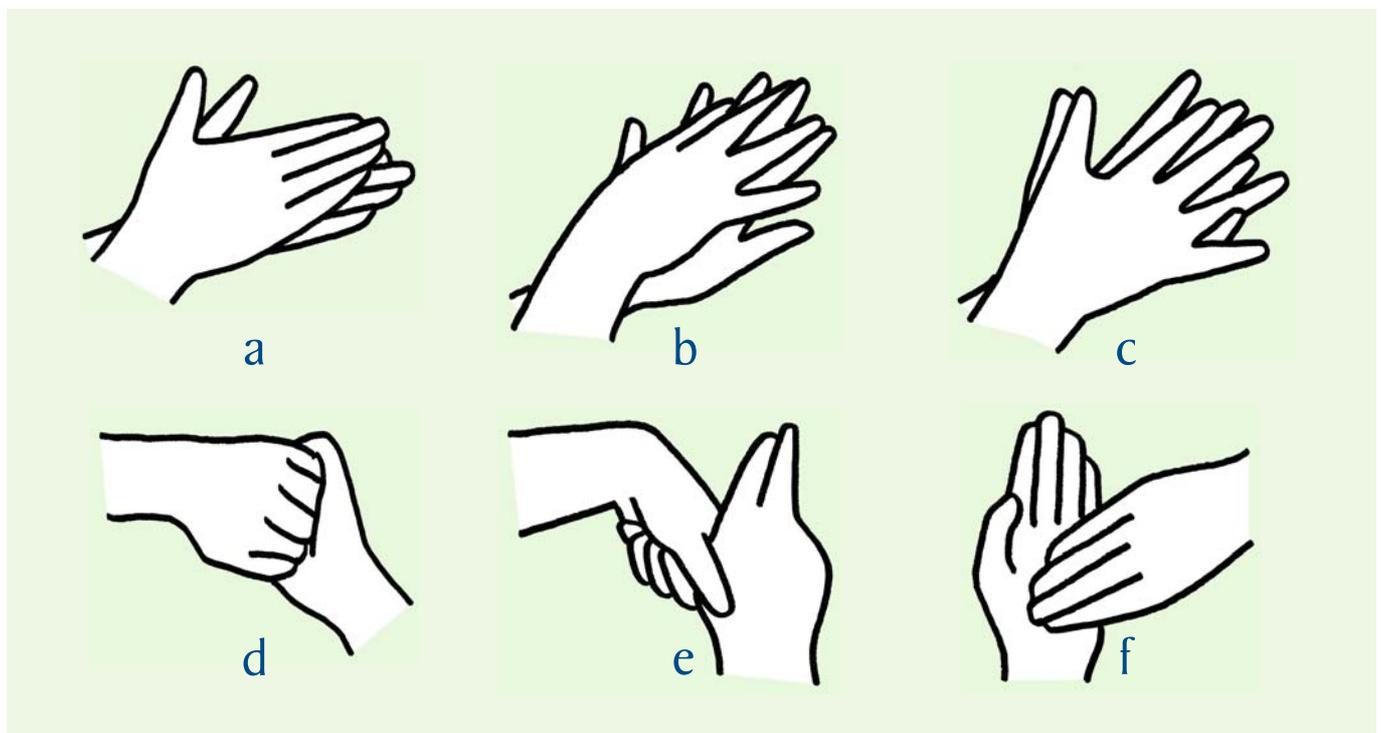
GERM: A micro-organism capable of causing an infectious disease.

STERILE (EN 556): The state of being free from viable organisms. Note: the theoretical probability of there being a viable organism present should be less than or equal to 1×10^6 .

APPENDIX II: INSTRUCTIONS FOR EFFECTIVE HANDS WASHING

These instructions may be helpful in distributing to parents in order to provide them with a method for effective handwashing.

1. Use warm running water and preferably a liquid soap.
2. Apply a small quantity of soap to the hands.
3. Rub hands together vigorously and ensure soap and water is applied to all surfaces of the hands. Be sure to scrub between fingers, under fingernails and around the tops and palms.
4. Rinse hands under running water. Leave the water running while drying hands.
5. Dry hands with a clean towel.
6. Turn the tap off. Wherever possible try to avoid touching the tap directly with washed hands since there is the possibility of recontamination (for rigorous hygiene, the tap should be turned off using a disposable paper towel).



SUGGESTED SEQUENCE FOR HANDS WASHING:

- | | |
|--|---|
| a: palm to palm | d: the back of the fingers with the opposing palm |
| b: with the palm over the back of the hand | e: rotational rubbing of the thumbs in the palm of the hand |
| c: palm to palm with fingers interlaced | f: rotational rubbing of fingers in the palm |

APPENDIX III: SELECTED GUIDELINES

CHILDREN

Hale, C.M. and Polder, J.A. (1996). *The ABCs of Safe and Healthy Child Care. A handbook for child care providers.* Department of Health and Human Services, US Public Health Service, Centers for Disease Control and Prevention.

DISINFECTANT GUIDELINES

Anon (1991). British Standard document BS 7152. *Guide to Choice of Chemical Disinfectants.* London: BSI Standards. List of Disinfectants published by the Disinfectant Commission of the German Society for Hygiene and Microbiology. Wiesbaden: mph-Verlag GmbH.

E. COLI O157:H7

Anon (1992c). Preventing foodborne illness: *Escherichia coli* O157:H7. US Department of Health and Human Services, Centers for Disease Control, Division of Bacterial and Mycotic Diseases. CDC.

HIV

Anon (1995a). USPHS/IDSA guidelines for the prevention of opportunistic infections in persons infected with HIV. *Morbidity and Mortality Weekly Report* **44**, 1-34.

I.V. CARE

Simmons, B.P., Hanton, T.M., Wang, E.S. and Allen, J.R. (1982). Guidelines for prevention of intravascular infections. *Infection Control* **3**, 61-72.

LISTERIOSIS

Anon (1992b). Preventing foodborne illness: Listeriosis. US Department of Health and Human Services, Centers for Disease Control, Division of Bacterial and Mycotic Diseases. CDC.

MRSA

Anon (1995b). Guidelines on the control of methicillin-resistant *Staphylococcus aureus* in the community. *Journal of Hospital Infections* **31**, 1-12.

UNIVERSAL BLOOD AND BODY FLUID PRECAUTIONS

Anon (1987). Centers for Disease Control. Recommendations for precautions of HIV transmission in health care settings. *Morbidity and Mortality Weekly Report* **36** Suppl 2S, 1-18S.

Anon (1988). Centers for Disease Control. Universal precautions for prevention of transmission of human immunodeficiency virus, hepatitis B virus and other bloodborne pathogens in health-care settings. *Morbidity and Mortality Weekly Report* **37**, 377-382/387-388.



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