CHAPTER 10: SANITATION AND ENVIRONMENTAL SERVICES

List of contents

Need

The social disruption, overcrowding and lack of sanitation facilities that characterize refugee emergencies can quickly lead to conditions that are hazardous to health and offensive unless action is taken.

Aim

To prevent the spread of disease and promote a safe environment for the refugees.

Principles of response

- ☐ The co-operation of the refugees is essential for success, and programmes must be developed with and to the extent possible run by them. The measures taken must be culturally acceptable to the refugees.
- ☐ The advice of an experienced public health engineer with local knowledge is required.
- ☐ Swift provision of a basic system for human waste disposal is better than delayed provision of improved systems.
- ☐ The simplest technologies possible should be applied.
- ☐ Individual family allocation of appropriate latrines is the best guarantee of maintenance and use.
- ☐ Co-ordinate with other public health programmes.

Action

- ☐ Localize defaecation and prevent contamination of the water supply.
- ☐ Develop an appropriate excreta disposal system.
- ☐ Establish effective services for disposal of garbage and waste water, insect and rodent control, disposal of the dead, dust control where necessary, and fire prevention and control.
- ☐ Establish an inspection and reporting system for all sanitation and environmental services, linked to health surveillance.
- ☐ Provide education on sanitation and environmental services as a part of general public health education.

10.1 Introduction

1. Disruption and the crowding together of people who are accustomed to living in different and less crowded conditions makes adequate sanitation of critical importance. The facilities to which the refugees were accustomed are no longer available, basic services are often lacking and habits may have to be changed. In these conditions, indiscriminate disposal of human and other waste will pose serious threats to the health of individuals, family groups and finally the whole community.

2. Environmental sanitation is often considered to include: the provision of safe water; disposal of human excreta, waste water and garbage; insect and rodent control, safe food-handling practices; and site drainage. All these services, and the provision of health care, are very much interrelated and should be considered together. In particular, this chapter should be read in conjunction with chapter 9 on water.

3. The key to reducing health hazards is an acceptable and practical system for the disposal of human excreta. This must be developed in co-operation with the refugees and be culturally appropriate, even if circumstances necessitate a departure from traditional practices. Special public health education may be required; the system must be one which the refugees will use.

4. The refugees must also run the services to the extent possible. Control will be essential: the effectiveness of the services will depend to a significant degree on regular and thorough maintenance and inspection.

10.2 Organization

☐ Take full account of sanitation needs in site selection and particularly layout.

☐ Seek professional advice from those with local knowledge and above all consult and involve the refugees.

☐ Ensure maintenance and cleanliness of the system and the supervision of its operation.

☐ Educate the refugees as part of the public health education programme.

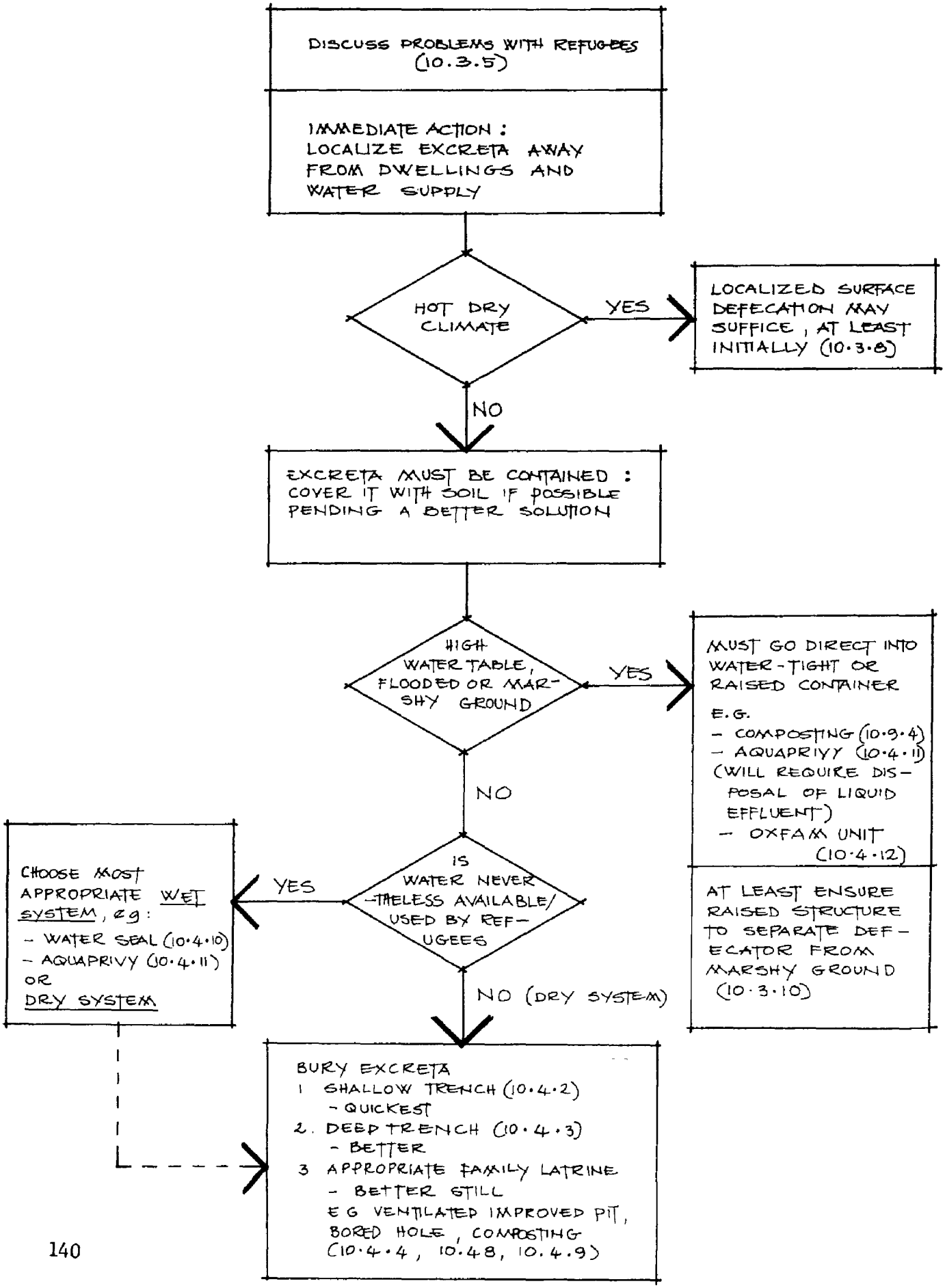
1. As has been stressed in chapter 6, environmental sanitation will be a very important consideration in site layout, and the organization and operation of the sanitation services must be integrated with other community services.

2. Developing adequate sanitation in a refugee emergency is difficult and correcting mistakes is more difficult. Expert advice should be sought from a public health engineer who is familiar with the habits of the refugees and nationals of the country of asylum, and if possible has experience of refugee emergencies. Assistance should first be sought from local sources such as government departments, the UN system, NGOs, universities, consultants or contractors. If these cannot meet the need, Headquarters' assistance should be requested. There are, however, effective measures that can and should be taken at once. Figure 10-1 overleaf illustrates some of them in diagrammatic form.

3. Good sanitation depends to a great extent on the attitudes of the community and the people who run the system. The systems and services developed should be able to operate effectively with a minimum of outside involvement. Selected refugees must be trained to run the sanitation and environmental programmes.

4. The most common cause of complete failure of a sanitation system is selection of the wrong system as a result of inadequate discussion with the refugees and a

10 – 1 CONSIDERATIONS IN EXCRETA DISPOSAL



failure to take all relevant factors into consideration.

5. The most common cause of breakdown is inadequate maintenance, even for properly designed and installed systems. The best guarantee of proper maintenance is the individual family allocation of latrines. Breakdown of latrines will lead to contamination of the environment and a high risk of infection and disease. There must be regular inspection and maintenance.

6. Even when in working order, latrines will not be used unless they are clean. Individual families will be responsible for their own units, but where communal latrines are unavoidable, special arrangements to keep them clean will be essential. Particular attention must be given to the maintenance and cleanliness of the latrines serving community facilities such as health centres. Refugee workers and proper supervision will be required, and it may be necessary to pay or otherwise compensate those who are responsible for keeping communal latrines clean and operational. Latrines must be cleaned daily. It should be noted that disinfectants should not be poured into the pits or tanks of latrines which dispose of excreta by biological degradation. The regular addition of soil, ashes or oil, if available, to trench or pit latrines may help control insect breeding and reduce odour.

7. The public health education programme must place proper emphasis on the importance of sound environmental sanitation practices. The link between excreta contamination and disease must be clearly understood by all. Whatever the success of the sanitation system with adults, children will present a special challenge. Children are both the main sufferers from excreta-related diseases and also the main excreters of many of the pathogens that cause diarrhoea. Children are often frightened by unfamiliar latrines and particular care will be needed to ensure that the latrines are safe and physically suitable for children.

10.3 Disposal of excreta

- ☐ Take immediate action to localize excreta disposal and prevent contamination of the water supply.
- ☐ Carefully consider cultural and physical factors.
- ☐ Trench latrines may be needed initially, but in most circumstances individual family latrines are much better.
- ☐ Ensure that latrines can be used at night and that appropriate anal cleaning materials are available.

General

1. Safe disposal of excreta is necessary because the agents of most important infectious diseases are passed from the body in excreta and may reach other people. These are called the excreted infections and fall into four main groups: viruses, bacteria, protozoa, and worms (helminths). Furthermore, unless properly isolated, excreta can provide a breeding ground for insects, which then act as direct or indirect transmitters of disease.

2. The specific link between the incidence of diseases and the sanitation system may not always be obvious, as often the most important human link in transmission of an infection is a carrier who shows little or no sign of disease. Conversely, persons in an advanced state of disease may have little or no importance in transmission. The links between diseases, infections, the means of transmission, and the sanitation system must be kept under constant surveillance.

3. The safe disposal of human excreta is more important than disposal of animal waste, because more diseases affecting humans are transmitted by human waste than animal. Human faeces are much more dangerous than urine. For urine, it is probably sufficient in an emergency just to prevent contamination of the water, but in the areas of Africa and the Middle East where the Schistosoma haematobium species of bilharzia occurs, and in all areas where typhoid is common and endemic, disposal of urine also requires special attention.

4. Two main factors will affect the choice of an excreta disposal system: the traditional sanitation practices of the refugees and the physical characteristics of the area, including the geology, the availability of water, rainfall and drainage. Failure to take proper account of either of them can easily result in the system itself rapidly becoming a health hazard.

5. Consideration with the refugees of their traditional sanitation practices and how these can be modified or adjusted to reduce health hazards in the circumstances of a refugee emergency is the essential starting point. Over half the world's population does not use latrines. Of those who do, some cultures require privacy, some separate the sexes physically or by time, others do not. Such factors, and the method of anal cleaning, must be considered at the planning stage and will directly affect the type of system. Once they have been taken into account, the cleanliness of latrines and their ease of access will determine whether or not they are used. The following may help as a check list:

(1) Previous sanitation system and practices;

(2) Method of anal cleaning;

(3) Preferred position (sitting or squatting);

(4) Need for privacy;

(5) Segregation of sexes and other groups or individuals with whom it is culturally unacceptable to share a latrine;

(6) Cultural practices for children;

(7) Cultural taboos (for example, against contact with anything that may have touched excreta of others);

(8) Social factors, including likelihood of community action to ensure proper use of proposed system;

(9) Need for special orientation (direction) of latrine in some cultures;

(10) Systems used locally in neighbourhood of site.

6. Arrangements must be made to assure the availability of appropriate anal cleaning materials at or near all latrines. This is essential to the maintenance of hygiene.

7. The latrines must be safe for children, and must be able to be used at night. For individual units, families may be able to arrange their own lamps, but for communal units some form of lighting should be provided.

Immediate action

8. The refugees are likely to be defaecating indiscriminately, contaminating their environment and often the water supply. In consultation with the community leaders, the best first step is to try and localize excreta: controlled surface defaecation. If space allows, designate an area or areas away from the dwellings and down wind, but sufficiently close to be used. Fence the area(s) and provide privacy and a shallow trench and spades, if necessary and possible. Covering excreta lessens risks.

Site such areas where the surface run-off during rain will not cause contamination and protect the area with cut-off ditches.

9. A publicity campaign will be required to encourage refugees to use these areas and not defaecate indiscriminately near dwellings. At the same time measures must be taken to prevent defaecation or urination in or near the water supply. This immediate action can already significantly reduce public health hazards.

10. If the ground is flooded or marshy or there is a high water table, arrangements must be made as soon as possible to try and physically contain the excreta: in such circumstances the risks to public health are greatest and location of the area away from the dwellings and water source is even more important. Pending a proper containment system, simple raised structures, for example a wooden stage some 50cm high, may be essential to avoid the refugees immediately being contaminated by their own excreta. Alternatively empty 200 litre (45 gallon) oil drums can be used. One end of the drum is cut out and the drum inserted that end down into the ground, after digging a hole as deep as the water allows. The last half metre of the drum is left out of the ground and a small hole cut into the end of the drum to transform it into a squatting plate.

11. Where the site is not yet occupied, immediate action will be determined by the type of system adopted (see below). The first refugees moved to the site should construct the system if this has not been done earlier.

Longer-term options

12. Expert advice will be required on the most appropriate system. The nature of the soil will be important; if it is highly impervious some systems will be precluded. The availability of water will be another factor, and the importance of cultural considerations has already been stressed. There are many simple options that, if properly constructed and maintained, will meet all public health requirements.

13. In hot, dry climates, where sufficient space is available, localized defaecation areas away from the dwellings may also be the best continuing arrangement, particularly for those whose normal practice it would be. In time, the heat and sunlight render the faeces harmless. Black rock is the best surface. If this solution is adopted keep the potential health hazards under review and watch out for increased numbers of rats in the area. In most emergencies, however, some sort of latrine will be required, even for refugees unaccustomed to them. The broad division is into dry latrines - trenches, pits or holes in the ground - and water-dependent latrines, which are flushed. In addition there are also systems based on composting or the cartage of excreta.

14. If the site is on the coast, local practice may be to defaecate in the sea. While this is less harmful for the refugees than indiscriminate defaecation on land, it should be discouraged unless there is no other option. The dangers increase greatly with numbers. Faeces will contaminate the high-water line, and the practice will increase the health hazards of washing in the sea. Where defaecation in the sea is unavoidable, it should be localized by fencing off an area. Structures should be built that permit defaecation away from the immediate shore line and both the location of these and organization of the system should make use of tides, currents and prevailing winds to avoid direct contamination of the foreshore. Pumping untreated excreta far enough out to sea so that it is carried away from the coastline is one possibility. Defaecation in bays, estuaries or lagoons where fish or shellfish

are caught should be discouraged since this may be a source of infection.

Selection of a system - basic considerations

15. The selection of an excreta disposal system suitable for a particular situation requires consideration of a number of factors. In an emergency, however, time is the critical factor. Pollution of the environment by excreta, with all its attendant risks, cannot be stopped without immediate sanitation measures. Thus the range of choice is always much more limited at the very outset of an emergency; weeks or months cannot be lost in waiting for expert advice, construction to be completed or material to arrive. Temporary systems to meet the most immediate needs will have to be improved or replaced by others as soon as possible, in order to maintain adequate sanitation standards. In emergency sanitation act first and improve later.

16. Emergency conditions may therefore dictate at least the initial use of trench latrines. These can be dug quickly and need less space than individual family units. While shallow trenches may be a quick-action solution for a very short initial period, deep trench latrines are incomparably more effective. Where space and soil conditions allow, the simplest and commonest individual family unit is the pit latrine. Details of various types of latrine are given in section 10.4. Once a system has been selected, a pilot project may yield valuable lessons.

Specific considerations

17. There are three basic options for the allocation of latrines: individual family units, centralized units with each latrine allocated to an individual family and communal systems. People will always make more effort to keep their own latrine clean and in good order than to do the same for a communal facility, and dirty and smelly latrines will not be used. Consequently, individual family units are, under normal conditions, the preferred solution.

18. Cost, installation and maintenance. The most appropriate system is likely to be the one that is cheap, simple to install and easy to maintain. Maintenance problems often prevent satisfactory operation of otherwise well designed and installed systems. Particularly important, the latrine must be easy to clean and the surfaces round the hole washable. Avoid uncovered wood if possible.

19. Number and siting of latrines. As a rule, at least one latrine should be provided for every 20 people. Latrines should be at least 6 metres from dwellings if possible, further away from feeding and health centres, say a minimum of 10 metres, and over 15 and preferably over 30 metres from wells or other drinking water sources though all these distances depend on latrine and soil type. Latrines should be located no more than 50 metres from user accommodation and be easy of access. Figure 6-1 on page 62 shows these considerations in the context of site planning. If people have to walk a considerable distance to a latrine they will defaecate in a more convenient location regardless of the health hazard.

20. Population density will affect the space available for the excreta disposal system and thus the type of system. One of the major health hazards as a result of overcrowding is that latrines are too close to dwellings and there may be insufficient space for individual units. This must be considered in site planning. The site layout should be determined, among other things, by the needs of the most suitable sanitation system, not vice versa. Space must be available for replacement latrines where necessary.

21. The nature of the soil may exclude certain options. For example, rocky soil may prevent the digging of pit-type systems; sandy soil will demand special measures for preventing side wall collapse of pits; impervious clay soils may exclude any system dependent upon seepage. Account should be taken of the difference between dry season and wet season soil conditions. If the ground freezes in winter this may limit the choice of systems. Soil conditions can vary over a short distance and a thorough survey is necessary. Where there is a high water-table, perhaps only seasonally, care must be taken to ensure it is not contaminated by seepage from the latrines. In flood or swampy conditions the excreta must be contained.

22. The amount of water available will determine whether disposal systems which require water are a possibility. These systems are generally more expensive than those which do not need water. Refugee situations are often characterized by a lack of reliable water sources, which usually means that the excreta disposal system should not be dependent on water availability. However, whatever the system, many communities require water for anal cleaning.

23. All sites have rain at some time and seasonal rains may be very heavy; it is necessary to anticipate where surface run-off will flow and it may need to be diverted by cut-off ditches. The possibility of flooding should be considered and drainage provided if necessary. If flood water enters the latrines large areas may be contaminated.

24. Construction material will be needed. The structure should be made of local materials and these should be used for reinforcing the pit where necessary. Refugees not used to latrines will generally prefer a large enclosure with no roof but there are often strong arguments for covering latrines in order to prevent rain water filling the latrine, causing contamination around it, or weakening the surrounds. Make sure proper drainage off the roof is provided, away from any soakaway. Special measures will be necessary for the manufacture of squatting or sitting slabs, and U-pipes and other material for wet systems, if these are not available locally. Where refugees or locals have an established method of covering latrines, for example with a wooden lattice, this is generally to be preferred, even if it is less easy to clean than a special plate. There are, however, a number of simple techniques which exist for making the latter on site, for example with reinforced cement or fibreglass from moulds. Guidance is given in the technical references. Seek advice on local methods.

25. Biogas can be produced from excreta, with fertilizer as a by-product. While rarely likely to be a priority in an emergency, this possibility should be considered where fuel is short and effective local biogas systems already exist. The applications are generally in communal services: there is a minimum effective plant size and conversion of a family's excreta to biogas only yields up to a quarter of their needs in cooking fuel.

10.4 Types of latrine

There are many potentially satisfactory types of latrine: low cost, simplicity of construction and ease of maintenance are the priorities once cultural and physical factors have been considered. The basic division is into wet and dry systems.

Dry systems

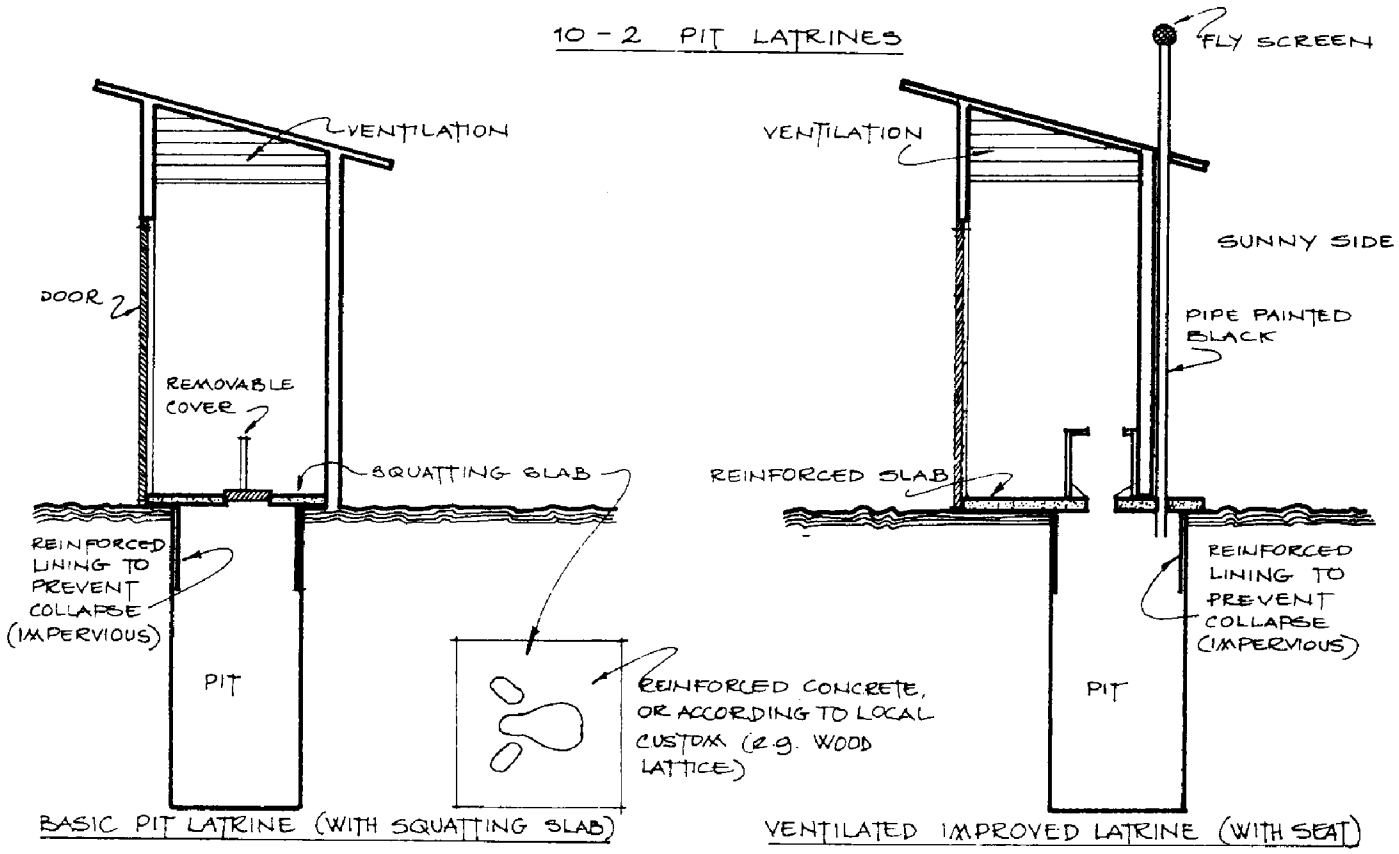
1. In dry systems, keep the squatting hole as small as possible and ensure a close fitting cover is provided and used, except with VIP latrines (see 10.4.4).

2. Shallow trench latrines (very cheap). Shallow trenches can be dug with picks and shovels and last for only a few days. The shallow trench is usually 30 cm wide and 90-150 cm deep. For every 100 people 3.5 metres of length is recommended. After every use the excreta should be covered with soil from the digging of the trench, which is left on one side. When the trench is filled to within 30cm of the top, it must be covered with soil and compacted. Simple platforms which can be cleaned without much difficulty and moved on may be placed over the trenches.

3. Deep trench latrines (cheap). Deep trenches can be used for a few months. If necessary, and where space is available, this solution can continue for longer periods, with new trenches being dug as old ones fill up. They should be dug 1.8 to 2.5m deep and 75-90cm wide. Recommended length per 100 persons is again 3.5 metres. A platform and structure will be needed, providing a seat or squatting hole, as appropriate, with lid, and the trench should be fly-proofed to the extent possible. Adding earth, ashes or oil will reduce flies. Trench sides must be shored up if there is a danger of collapse.

4. Pit latrines (cheap). The most common excreta disposal system around the world is the individual family pit latrine (figure 10-2), which has major advantages over a trench latrine. It consists of a superstructure for privacy, and a squatting place (or seat) above a hole in the ground. Individual families can dig the pit and build the superstructure and if used by only one family these latrines are usually well maintained. Pit latrines can also be used in clusters as communal facilities. While the basic variety has both odour and insect problems, the simple improvements shown in the diagram can reduce these considerably, as will the addition of oil and use of lids. Where pit latrines are used, the ventilated improved version (VIP) should be built whenever possible.

10 - 2 PIT LATRINES



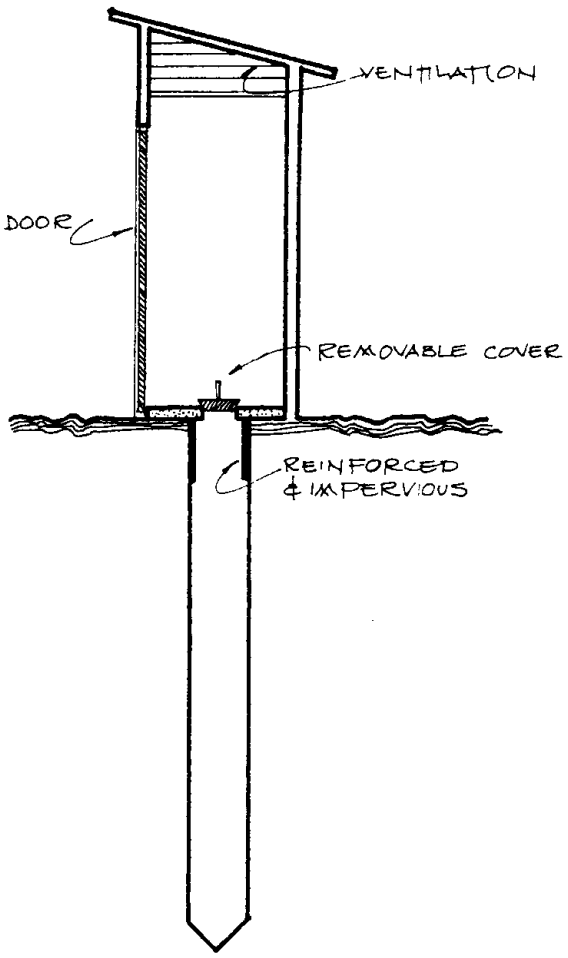
5. Pit latrines are most suitable in conditions of low to medium population density - up to about 300 persons/hectare - but have been used satisfactorily in areas with twice this density. Space should be available not only for the construction of one pit latrine per family, but also for the digging of new pits when the old ones are full. This is an important consideration when pit latrines are used as communal facilities. When the pits are three-quarters full, they must be filled with soil and the superstructure and squatting plate moved to a new pit. If layers of ashes are applied as the pit fills the excreta will decompose and in time the site can be used again.

6. The pit should be about one metre across and over two metres deep. The rim of the pit should be raised about 15cm and cut-off ditches dug to divert surface run off. The pit should always be reinforced and the sides may need to be reinforced for one metre below ground level to prevent collapse. A light wooden squatting plate or wooden lattice, although harder to clean, may be more practical than a heavy concrete one. The danger of collapse may be further reduced by digging the pit as a trench only 50-60cm wide or by having a circular pit, when the use of oil drums as described in 10.3.10 could be considered.

7. The vent pipe in a VIP latrine should be at least 15cm in diameter, about 2 metres high, painted black and placed on the sunny side of the latrine for maximum odour and insect control. It must be fitted with an insect-proof gauze screen, when it will work as an excellent fly trap. The hole should not be covered by a lid as this impedes the air flow.

8. Bored-hole latrines (cheap)

Bored-hole latrines (figure 10-3) are dug with a hand auger or mechanical drill and require a smaller slab than a pit. The bore-hole is 35-45cm in diameter and any depth up to 7 metres. The advantage of the bored-hole latrine is that it can quickly be constructed as a family unit if augers are available. The disadvantages are that the side walls are liable to fouling and fly breeding, they are smellier than vented systems and the risk of ground water contamination is greater because of the depth.



10-3 BORED HOLE LATRINE

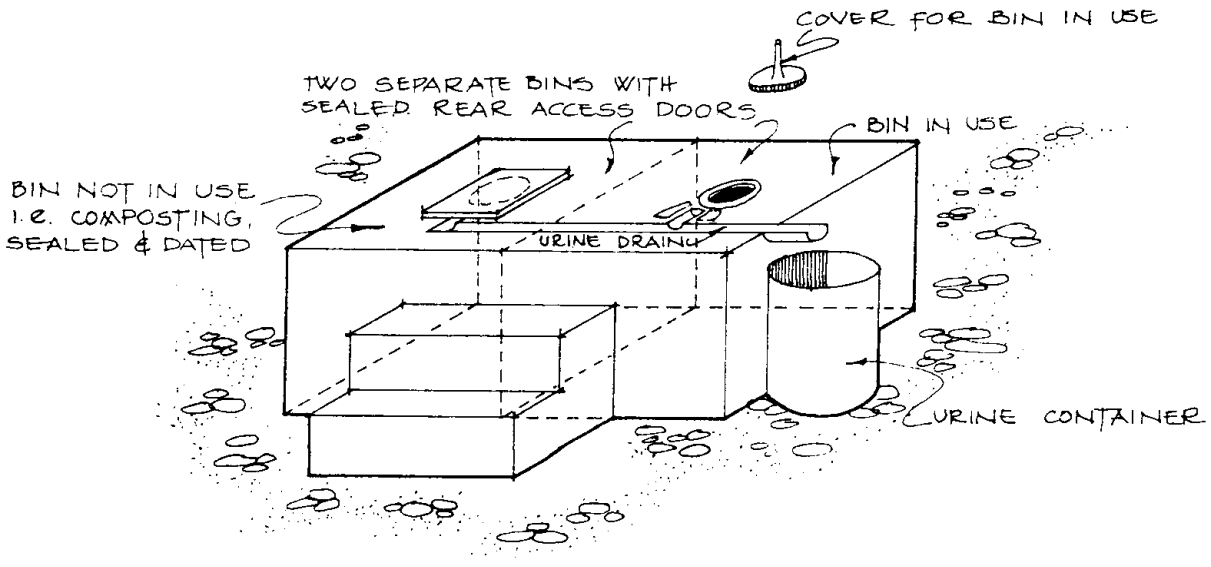
9. Composting latrines (cheap). Such latrines render excreta harmless with time and produce fertilizer. Figure 10-4 shows one of proven effectiveness, the Vietnamese double septic bin, suitable for a family of 5-10. Urine does not enter the bin, being diverted into a container. After each defeacation ashes are sprinkled over the faeces. Once filled, the bin is sealed (e.g. with lime cement or clay) and the adjoining bin used. A full bin is left to compost for at least two months and the contents then removed through the rear access door, which has also been hermetically sealed during composting.

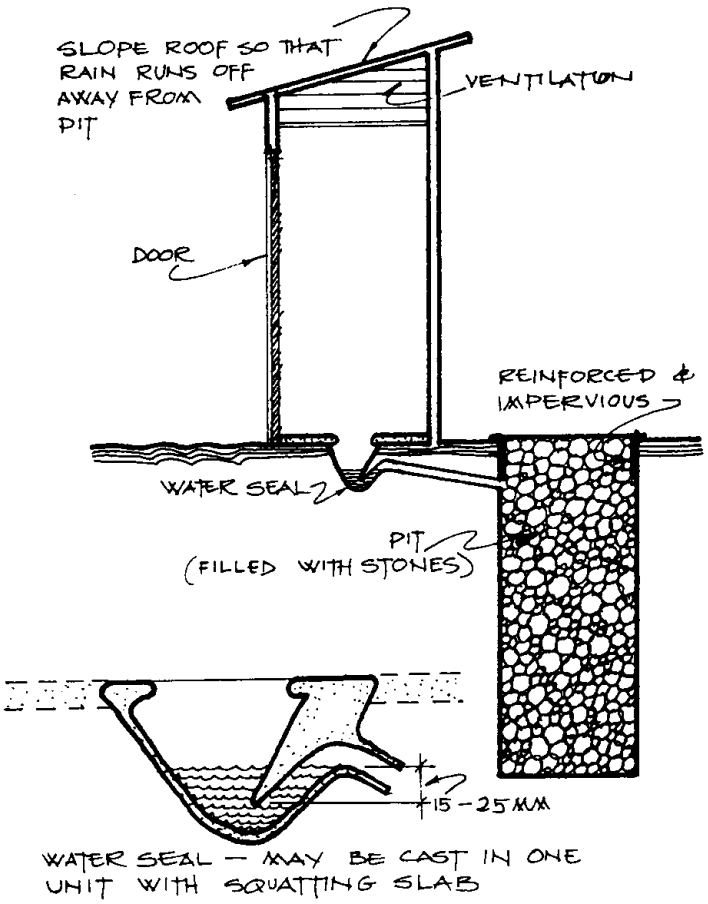
Wet systems

10. Water seal (pour-flush) latrines (cheap). Water seal latrines (figure 10-5) are simple in technical design but require a permeable soil for their soakaway. A water seal is made by a U-pipe filled with water below the squatting pan or seat. It is flushed by hand with some 1-3 litres of water into a pit or soakaway. This system is suitable where water is used for anal cleaning and where refugees are used to flushing. It is not suitable where paper, stones, corncobs or other solid materials are used for anal cleaning. Water seal latrines will be used properly only if water is readily available. A large container with a 3 litre dipper should be close by the latrine. Pit latrines can be modified to become water seal latrines where soil conditions allow.

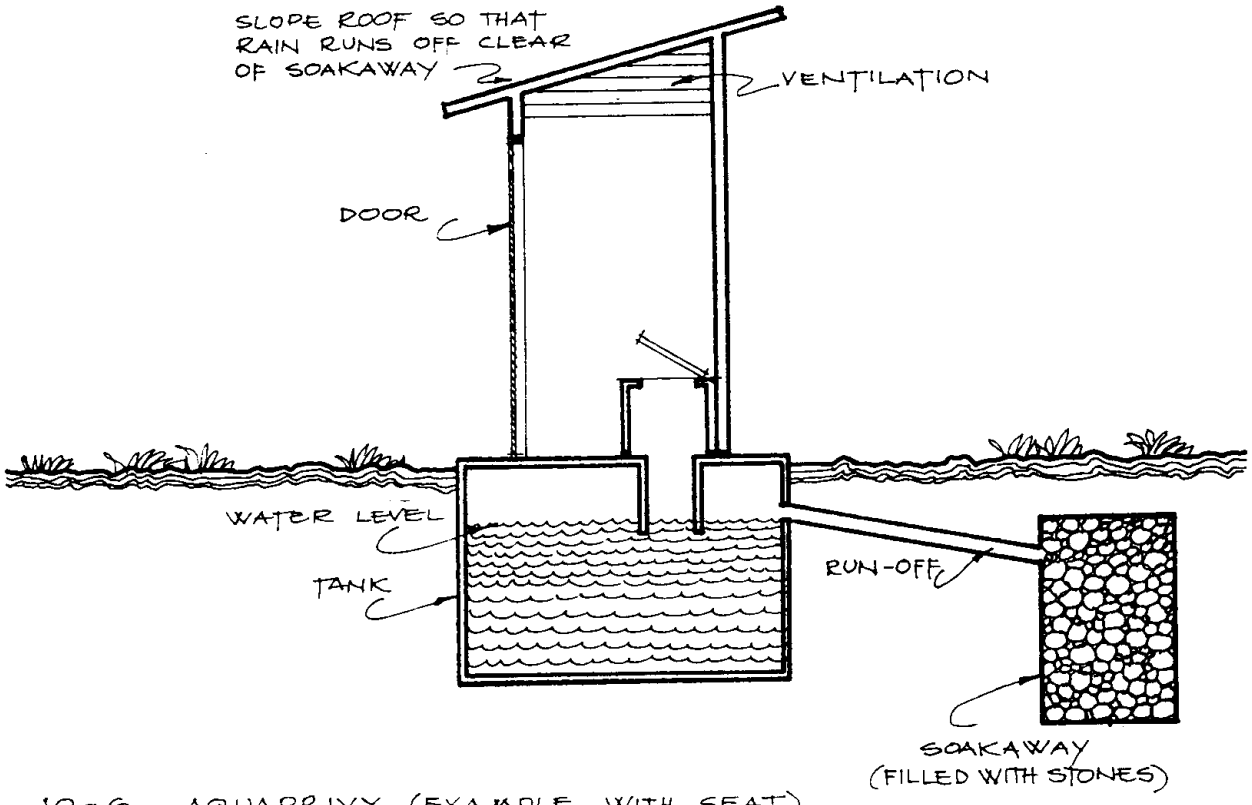
11. Aquaprivies (more expensive). Aquaprivies (figure 10-6) consist of a squatting plate or seat above a small septic tank from which effluent drains to an adjacent soakaway. The aquaprivy requires a minimum water tank volume of one cubic metre (1,000 litres), to which some five litres per user must be added daily. In areas with impermeable soil such as clay it is not possible to use a soakaway. The liquid run off can be carried in pipes and passed to an area suitable for disposal. The most common difficulty with aquaprivies is failure to maintain the water seal, causing serious odour and insect problems. Experience has shown they do not work satisfactorily where water has to be carried to the latrine, but as long as the aquaprivy is kept topped up with water there are few things that can go wrong. Aquaprivies are not recommended where solid materials are used for anal cleaning. Seek

10-4 DOUBLE BIN COMPOSTING LATRINE
(ENCLOSURE NOT SHOWN)





10 - 5 POUR-FLUSH (PF) LATRINE



10 - 6 AQUAPRIVY (EXAMPLE WITH SEAT)

local advice before deciding between aquaprivies and water seal latrines. The former are less easily blocked but have no other major advantage over the latter, which are cheaper.

12. Oxfam Sanitation Unit (more expensive still). The unit is a pre-packaged, communal treatment system in which 20 squatting plates, two flexible tanks made of nylon-reinforced butyl rubber for sewage treatment, and all necessary pipes and fittings are provided. As a unit designed specifically for emergencies, it has the advantage of being a proven system which can be assembled quickly and is not affected by soil conditions. One unit can serve up to 1,000 persons per day. Apart from cost and problems of unfamiliarity, the main disadvantage is that it requires about 3,000 litres of water a day at full design capacity. The unit is not suitable for communities using solids (stones, corn-cobs etc.) for anal cleaning. The water must not be saline. The unit requires a good soakaway or alternate effluent disposal. It also requires a reliable operator. Before deciding on this system, the advice of someone familiar with it should be taken.

Waste stabilization (oxidization) ponds

13. Where a liquid effluent has to be disposed of, for example from a 'wet' system in impermeable soil, waste ponds can provide a simple and cheap solution. Treatment is by natural biological and physical processes. As the rate of treatment increases with temperature, ponds are particularly effective in hot climates. Various systems are described in the technical references. If ponds are used they must be securely fenced off.

10.5 Waste water, garbage and dust

- ☐ Sources of waste water must be localized as much as possible and drainage provided.
- ☐ Improper garbage disposal increases the risk of insect and rodent-borne diseases, and an effective system must be established for the storage, collection and disposal of garbage.
- ☐ Garbage disposal areas must be designated and access to them restricted.
- ☐ Large amounts of dust can damage health. Preventing destruction of vegetation is the best preventive measure against dust; spraying of roads and traffic control are additional measures.

1. Waste water is created by washing, bathing and food preparation. The problem of waste water should be dealt with by localizing sources of waste water as far as possible, and by providing local drainage. If this water is not drained away, it will stand in malodorous, stagnant pools providing breeding places for insects, especially mosquitoes, and becomes an additional source of contamination of the environment. Washing, for example, is often done near water sources, causing many problems. In other circumstances, refugees may wish to use the latrine, with its privacy, impervious floor and drainage, for washing. To avoid these problems, special separate washing areas with duckboards or stones and proper drainage should be constructed.

2. All communities generate garbage, and the uncontrolled accumulation of garbage is both unpleasant and unhealthy. Rodent and insect-borne diseases increase with improper garbage disposal. An effective disposal of garbage must therefore be provided and the needs reflected in the initial site planning. Free range chickens, goats and pigs, when available, will help control garbage; dogs will spread it. The suggestions that follow particularly concern high-density sites, where the problem and dangers will be

greatest. Established routines for the storage, collection and disposal of garbage and control measures will be required. Disposal should be accomplished by burying at designated locations on the site, or removal off the site. The open burning of garbage on site should be avoided, and incinerators used if garbage is to be burnt.

3. For solids storage, garbage containers made of metal or plastic and with a minimum capacity of 50 litres should be provided. A 200 litre oil drum cut in half is often used. They should have lids if possible and drainage holes in the bottom. A ratio of one container per 10 families has proved to be effective. The containers should be placed throughout the site in such a manner that no dwelling is more than about 15 metres away from one.

4. The collection of garbage from the containers should take place regularly, daily if possible. Daily collection arrangements will also need to be made for the waste from feeding centres. The safe disposal of all medical waste requires particular attention.

5. Needles and scalpels are especially dangerous. Medical waste should be treated separately, burning as much of it as possible without delay. The designated areas where garbage is to be buried should be well away from dwellings, and be fenced to restrict access. If garbage has to be burnt, after each burning it should be covered with a layer of soil.

6. Large amounts of dust carried in the air can be harmful to human health by irritating eyes, respiratory system and skin, and by contaminating food. Dust can also harm some types of equipment which may be needed on refugee sites. The best preventive measure is action to stop the destruction of vegetation round the site. Dust control can be achieved by spraying roads with water or oil, especially around health facilities and feeding centres, limiting traffic and banning it from certain areas if necessary.

10.6 Insect and rodent control

- Insects and rodents carry and spread diseases and can spoil food supplies.
- Physical screens are the best immediate measures.
- Preventive action to eliminate or limit breeding areas and conditions favourable to the vectors is the best long-term solution.
- Specialist supervision of all chemical measures and local knowledge of resistances is necessary.

1. The environment in a refugee emergency is typically favourable to the proliferation of disease-carrying insects and rodents (vectors), which can also destroy or spoil large quantities of food. Flies tend to breed in areas where food or human excreta are present, mosquitoes where there is stagnant water, and rats where there is food, garbage and cover. For both flies and mosquitoes, the life-cycle from egg to adult can take less than two weeks. As a result of overcrowding and inadequate personal hygiene, lice, fleas, mites, ticks and other arthropods may also cause health problems. Table 10-7 overleaf gives an indication of common vectors and related diseases.

2. Reducing the numbers of flies, mosquitoes and rodents quickly in an emergency is difficult and physical screens may be the best immediate measure. The most effective method of controlling insects and rodents over the longer term is preventive: to improve personal hygiene, sanitation, drainage, garbage disposal and food storage and handling practices and thus make the envi-

ronment less favourable for the vectors. Examples of practical measures are the removal of stagnant waste water, regular garbage collection, use of oil in latrines and provision of soap and sufficient water for washing. The programme should provide for regular inspection and be integrated with other public health measures.

3. The problems should be discussed with the refugees and education given on the significance of vector control. Where solutions unfamiliar to the refugees are employed these must be carefully explained.

4. Detailed descriptions of vector control methods using insecticides and poisons are given in the technical references. Specialist advice and supervision of all chemical measures is essential. These must be closely co-ordinated with national programmes and practices, especially with the national malaria control programme. Whole areas or specific insect breeding grounds, and perhaps the refugees' dwellings, can be sprayed. Insects may already have and can quickly develop a resistance to chemicals; a rotation system, using different sprays, may be necessary. Local knowledge of existing resistances is required. Poison and traps may be used against rats in food storage and handling areas but particular care must be taken in disposing of dead rats, which may carry plague-bearing fleas. Chemical spraying and rodent poisons can be dangerous to humans.

5. The body louse is the only proven vector of louse-borne (epidemic) typhus and epidemic relapsing fever. The lice are found on inner clothing, particularly at the seams. If there is a serious increase in body louse infestation quick action is required by properly trained personnel. This generally takes the form of dusting individuals' inner clothing and bedding with an insecticide or the use of clothing fumigants. There is widespread resistance of lice to some insecticides, especially DDT, and expert local advice must be sought. Mass washing of clothing is unlikely to be a solution as a water temperature of at least 52°C must be maintained to kill the lice.

10-7 Vectors which may pose significant health risks

Vector	Risks
Flies	Eye infections (particularly among infants and children); diarrhoeal diseases
Mosquitoes	Malaria, filariasis, dengue, yellow fever, encephalitis
Mites	Scabies, scrub typhus
Lice	Epidemic typhus, relapsing fever
Fleas	Plague (from infected rats), endemic typhus
Ticks	Relapsing fever, spotted fever
Rats	Rat bite fever, leptospirosis, salmonellosis

10.7 Fires

- Refugee sites are often very vulnerable to fires. An alarm system is essential at high-risk sites.

- The most effective preventive measure is the proper spacing and arrangement of all buildings. Other measures include controlling the use of fire, protecting cooking areas and safe storage of fuel.

- Water is unlikely to be available for major fire control on refugee sites. Forcible creation of additional firebreaks, manually or by bulldozer, may be a better control measure.

1. Refugee sites are often overcrowded, use light and highly combustible shelter materials, and have many individual cooking fires. Thus they are very vulnerable to major fires. Measures to prevent and control fires must be considered from the start of emergency assistance at refugee sites.

2. The most basic and effective preventive measure is the proper spacing and arrangement of all buildings to provide fire breaks (see ch.6.5.4). Other measures include allowing individual fires for cooking only, outdoors if possible. Where cooking takes place indoors, and especially in wooden or wattle-and-daub buildings, the cooking area should be protected with asbestos sheeting if possible. Where large scale cooking is taking place indoors, for instance in a supplementary feeding centre, an asbestos ceiling and walls or their equivalent, should be mandatory. Fire retardants can be applied to thatch roofing in dwellings. Proper precautions must be taken with regard to the storage and uses of fuels, and highly inflammable synthetic materials avoided.

3. All fires can be controlled in the first few minutes with modest resources providing quick action is taken. Therefore an alarm system, fire fighting teams and beaters must be organized in advance and plans prepared. Sand buckets are effective if sand is available. Water will generally not be available in sufficient quantity and at adequate pressure for the control of major fires. The creation of a new firebreak by taking down one or more rows of dwellings may be necessary. This can be done manually or with a bulldozer if available. Take great care to ensure that dwellings are empty: children may be left at home by parents fighting the fire. When fighting a large fire with scarce resources, the first priority is to contain it, rather than put it out.

10.8 Disposal of the dead

- Suitable arrangements for disposal of the dead are required from the start of an emergency, although dead bodies are generally not a health risk.

- Action should be co-ordinated with the national authorities.

- Burial is the simplest and best method where acceptable and physically possible. Arrangements should be made to allow traditional rituals.

- Before burial or cremation, bodies must be identified and the identifications recorded.

1. Suitable arrangements for the disposal of the dead are required from the start of a refugee emergency. The mortality rate after a new refugee influx may well be higher than under "normal" conditions. The authorities should be contacted from the outset to ensure compliance with national procedures, and for assistance as necessary.

2. Dead bodies present a negligible health risk unless the cause of death was typhus or plague,

when they may be infested with infected lice or fleas. Bodies must be protected from rodents, animals and birds. Burial is the simplest and best method of disposal if it is acceptable to the community and physically possible. Health considerations provide no justification for cremation, for which sufficient fuel may often not be available. Whenever possible, the customary method of disposal should be used, and the traditional practices and ritual should be allowed. Material needs, for example for shrouds, should be met. The necessary space for burial will need to be taken into account at the site planning stage, particularly in crowded conditions.

3. Before burial or cremation, bodies must be identified and the identification and, if possible, cause of death recorded. This is of particular importance to disease control, registration and tracing. If the whereabouts of relatives are known, the most immediate relation should be notified; steps must be taken to assure the care of minors who, as the result of a death, are left without an adult to look after them. (See ch.11.5)

Further References (1)

Feacham R. Cairncross S. (1978)	Small Excreta Disposal Systems A clear presentation with simple diagrams and practical advice.	Ross Bulletin No.8
Rajagopalan S. Shiffman M. (1974)	Guide to Simple Sanitary Measures for the Control of Enteric Diseases Covers water supply and all aspects of sanitation including food sanitation. (Also in Arabic, French and Spanish)	WHO
PAHO (WHO)	Emergency Vector Control after Natural Disaster (1982) General principles also relevant to refugee emergencies. (Also in Spanish).	PAHO Scientific Publication No.419
Oxfam	The Oxfam Sanitation Unit A guide to the unit. (A July 1975 Oxfam Technical Paper describes the design and testing of the unit.)	Oxfam
UNDRO (1982)	Disaster Prevention and Mitigation: Sanitation aspects Covers natural disasters but parts also relevant to refugee emergencies. (Also in French and Spanish)	Volume 8 in Compendium of Current Knowledge series
World Bank	Appropriate Technology for Water Supply Sanitation A 12 volume series. Volume 11: A Sanitation Field Manual (1980) is particularly relevant.	World Bank
WHO (1982)	Manual on Environmental Management for Mosquito Control (with special Emphasis on Malaria Vectors). (Also in French)	WHO offset publication No.66

(1) See also the further references at the end of chapters 7 and 9, only some of which are repeated here.