

10

Collection and disposal of wastewater

10.1 Characteristics and hazards of wastewater from health-care establishments

Wastewater from health-care establishments is of a similar quality to urban wastewater, but may also contain various potentially hazardous components, discussed in the following paragraphs.

10.1.1 *Microbiological pathogens*

The principal area of concern is wastewater with a high content of enteric pathogens, including bacteria, viruses, and helminths, which are easily transmitted through water. Contaminated wastewater is produced by wards treating patients with enteric diseases and is a particular problem during outbreaks of diarrhoeal disease.

10.1.2 *Hazardous chemicals*

Small amounts of chemicals from cleaning and disinfection operations are regularly discharged into sewers. If the recommendations of section 9.4 are not followed, larger quantities of chemicals may be present in wastewater.

10.1.3 *Pharmaceuticals*

Small quantities of pharmaceuticals are usually discharged to the sewers from hospital pharmacies and from the various wards. If the recommendations of section 9.2 are not followed, more important quantities of pharmaceuticals—including antibiotics and genotoxic drugs—may also be discharged.

10.1.4 *Radioactive isotopes*

Small amounts of radioactive isotopes will be discharged into sewers by oncology departments but should not pose any risk to health if the recommendations of section 9.7 are followed.

10.1.5 *Related hazards*

In some developing and industrializing countries, outbreaks of cholera are periodically reported. Sewers of the health-care establishments where cholera patients are treated are not always connected to efficient sewage treatment plants, and sometimes municipal sewer networks may not even exist. Although links between the spread of cholera and unsafe wastewater disposal have not been sufficiently studied or documented, they have been strongly suspected, for instance during recent African outbreaks (Democratic Republic of the Congo, Rwanda), and during the 1991–92 cholera epidemic in southern America. Little information is

available on the transmission of other diseases through the sewage of health-care establishments.

In developed countries, water use is commonly high and the sewage therefore greatly diluted; effluents are treated in municipal treatment plants and no significant health risks should be expected, even without further specific treatment of these effluents. Only in the unlikely event of an outbreak of acute diarrhoeal diseases should excreta from patients be collected separately and disinfected. In developing countries, where there may be no connection to municipal sewage networks, discharge of untreated or inadequately treated sewage to the environment will inevitably pose major health risks.

The toxic effects of any chemical pollutants contained in wastewater on the active bacteria of the sewage purification process may give rise to additional hazards.

10.2 Wastewater management

The basic principle underlying effective wastewater management is a strict limit on the discharge of hazardous liquids to sewers, as recommended in Chapter 9.

10.2.1 *Connection to a municipal sewage treatment plant*

In countries that do not experience epidemics of enteric disease and that are not endemic for intestinal helminthiasis, it is acceptable to discharge the sewage of health-care establishments to municipal sewers without pretreatment, provided that the following requirements are met:

- the municipal sewers are connected to efficiently operated sewage treatment plants that ensure at least 95% removal of bacteria;
- the sludge resulting from sewage treatment is subjected to anaerobic digestion, leaving no more than one helminth egg per litre in the digested sludge;
- the waste management system of the health-care establishment maintains high standards, ensuring the absence of significant quantities of toxic chemicals, pharmaceuticals, radionuclides, cytotoxic drugs, and antibiotics in the discharged sewage;
- excreta from patients being treated with cytotoxic drugs may be collected separately and adequately treated (as for other cytotoxic waste).

If these requirements cannot be met, the wastewater should be managed and treated as recommended in section 10.2.2 below.

In normal circumstances, the usual secondary bacteriological treatment of sewage, properly applied, complemented by anaerobic digestion of sludge, can be considered as sufficient. During outbreaks of enteric disease, however, or during critical periods (usually in summertime because of warm weather, and in autumn because of reduced river water flow), effluent disinfection by chlorine dioxide (ClO₂) or by any other efficient process is recommended. If the final effluent is discharged into coastal waters close to shellfish habitats, disinfection of the effluent will be required throughout the year.

When the final effluents or the sludges from sewage treatment plants are reused for agricultural or aquacultural purposes, the safety recommendations of the relevant WHO guidelines should be respected (see section 10.2.2).

10.2.2 On-site treatment or pretreatment of wastewater

Many hospitals, in particular those that are not connected to any municipal treatment plant, have their own sewage treatment plants.

Wastewater treatment

Efficient on-site treatment of hospital sewage should include the following operations:

- *Primary treatment*
- *Secondary biological purification.* Most helminths will settle in the sludge resulting from secondary purification, together with 90–95% of bacteria and a significant percentage of viruses; the secondary effluent will thus be almost free of helminths, but will still include infective concentrations of bacteria and viruses.
- *Tertiary treatment.* The secondary effluent will probably contain at least 20 mg/litre suspended organic matter, which is too high for efficient chlorine disinfection. It should therefore be subjected to a tertiary treatment, such as lagooning; if no space is available for creating a lagoon, rapid sand filtration may be substituted to produce a tertiary effluent with a much reduced content of suspended organic matter (<10 mg/litre).
- *Chlorine disinfection.* To achieve pathogen concentrations comparable to those found in natural waters, the tertiary effluent will be subjected to chlorine disinfection to the breakpoint. This may be done with chlorine dioxide (which is the most efficient), sodium hypochlorite, or chlorine gas. Another option is ultraviolet light disinfection.

Disinfection of the effluents is particularly important if they are discharged into coastal waters close to shellfish habitats, especially if local people are in the habit of eating raw shellfish.

Sludge treatment

The sludge from the sewage treatment plant requires anaerobic digestion to ensure thermal elimination of most pathogens. Alternatively, it may be dried in natural drying beds and then incinerated together with solid infectious health-care waste. On-site treatment of hospital sewage will produce a sludge that contains high concentrations of helminths and other pathogens.

Reuse of wastewater and sludges in agriculture and aquaculture

According to the relevant WHO guidelines (Mara & Cairncross, 1989), the treated wastewater should contain no more than one helminth egg per litre and no more than 1000 faecal coliforms per 100 ml if it is to be used for unrestricted irrigation. It is essential that the treated sludge contains no more than one helminth egg per kilogram and no more than 1000 faecal coliforms per 100 g. The sludge should be applied to fields in trenches and then covered with soil.

10.3 Options for establishments that apply minimal waste management programmes

10.3.1 Lagooning

In a region or an individual health-care establishment that cannot afford sewage treatment plants, a lagooning system is the minimal requirement for treatment of wastewater. The system should comprise two successive lagoons to achieve an acceptable level of purification of hospital sewage. Lagooning may be followed by infiltration of the effluent into the land, benefiting from the filtering capacity of the soil. There is no safe solution for the disposal of sewage from a hospital that cannot afford a compact sewage treatment plant and that has no space available to build a lagooning system.

10.3.2 Minimal safety requirements

For health-care establishments that apply minimal programmes and are unable to afford any sewage treatment, the following measures should be implemented to minimize health risks:

- Patients with enteric diseases should be isolated in wards where their excreta can be collected in buckets for chemical disinfection; this is of utmost importance in case of cholera outbreaks, for example, and strong disinfectants will be needed (see section 16.4.3).
- No chemicals or pharmaceuticals should be discharged into the sewer.
- Sludges from hospital cesspools should be dehydrated on natural drying beds and disinfected chemically (e.g. with sodium hypochlorite, chlorine gas, or preferably chlorine dioxide).
- Sewage from health-care establishments should never be used for agricultural or aquacultural purposes.
- Hospital sewage should not be discharged into natural water bodies that are used to irrigate fruit or vegetable crops, to produce drinking-water, or for recreational purposes.

Small-scale rural health-care establishments that apply minimal waste management programmes may discharge their wastewater to the environment. An acceptable solution would be natural filtration of the sewage through porous soils, but this must take place outside the catchment area of aquifers used to produce drinking-water or to supply water to the health-care establishment.

10.3.3 Sanitation

In many health-care establishments in developing countries, patients have no access to sanitation facilities. Excreta are usually disposed of in the environment, creating a high direct or indirect risk of infection to other people. Human excreta are the principal vehicle for the transmission and spread of a wide range of communicable diseases, and excreta from hospital patients may be expected to contain far higher concentrations of pathogens, and therefore to be far more infectious, than excreta from households. This underlines the prime importance of providing access to adequate sanitation in every health-care establishment, and of handling this issue with special care. The faecal–oral transmission route—and other routes such as penetration of the skin—must be interrupted to prevent continuous infection and reinfection of the population.

The health-care establishment should ideally be connected to a sewerage system. Where there are no sewerage systems, technically sound on-site sanitation should be provided. Guidance on this is available in a number of publications (Franceys, Pickford & Reed, 1992; WHO, 1996; Mara, 1996) which cover both simple techniques, such as the simple pit latrine, ventilated pit latrine, and pour-flush latrine, and the more advanced septic tank with soakaway or the aqua-privy. In temporary field hospitals during outbreaks of communicable diseases, other options such as chemical toilets may also be considered (Dunsmore, 1986). In addition, convenient washing facilities (with warm water and soap available) should be available for patients, personnel, and visitors in order to limit the spread of infectious diseases within the health-care establishment.

References and suggested further reading

- Dunsmore DJ (1986). *Safety measures for use in outbreaks of communicable diseases*. Geneva, World Health Organization.
- Franceys R, Pickford J, Reed R (1992). *A guide to the development of on-site sanitation*. Geneva, World Health Organization.
- Mara D (1996). *Low-cost urban sanitation*. Chichester, England, Wiley.
- Mara D, Cairncross S (1989). *Guidelines for the safe use of wastewater and excreta in agriculture and aquaculture*. Geneva, World Health Organization.
- WHO (1989). *Health guidelines for the use of wastewater in agriculture and aquaculture*. Report of a WHO Scientific Group. Geneva, World Health Organization (WHO Technical Report Series, No. 778).
- WHO (1996). *Fact sheets on environmental sanitation. Epidemic diarrhoeal diseases control*. Geneva, World Health Organization (unpublished document WHO/EOS/96.4, available on request from Division of Operation Support in Environmental Health, World Health Organization, 1211 Geneva 27, Switzerland).