World Health Organization
Regional Office for Europe
Copenhagen

EURO Reports and Studies 97

Management of waste from hospitals

and other health care establishments

Report on a WHO meeting

Bergen
28 June–1 July 1983

ISBN 92 890 1263 3

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PRINTED IN DENMARK

CONTENTS

	Page
Introduction	1
Conclusions and recommendations	3
Waste categories and their sources	4
Occupational hazards and health risks	6
Impact of health care waste on human health and the environment	11
Waste handling, storage and transport	12
Segregation and storage	12
Transport	13
Special requirements for chemical waste	14
Waste treatment and disposal methods	16
Treatment and disposal of chemical waste	17
Incinerators and associated equipment	21
Radioactive waste	22
Sources of radioactive waste	23
The form of radioactive waste	23
Disposal methods	25
Conclusion	26
Planning for health care waste management	26
Waste handling in new or renovated buildings	27
Regional or area planning	28

Training and supervision 29

Legislative, administrative and economic aspects 30

Annex 1. Bibliography 33

Annex 2. Types of health care establishment that generate waste 36

Annex 3. The amount of waste produced by health care establishments in various countries 38

Annex 4. Membership of subgroups 41

Annex 5. Participants 45

Summaries in French, German and Russian 49

INTRODUCTION

A Working Group on Hospital Waste Management was convened in Bergen from 28 June to 1 July 1983 by the WHO Regional Office for Europe in collaboration with the Norwegian Government. The meeting was attended by 34 participants, including medical specialists, hospital engineers and administrators from 19 countries. A list of those attending is given in Annex 5.

The meeting was opened by Dr P. Marten, Acting County Medical Officer, Ministry of Social Affairs, Norway, who welcomed the participants. Dr A. Rot was elected Chairman, Mr J. Clemons and Mr B.O. Fremming were elected Vice-Chairmen, and Mr P.K. Patrick was appointed Rapporteur. Dr M.J. Suess acted as Scientific Secretary.

The purpose of the meeting was to review recent developments in the handling, transport, treatment and disposal of waste from health care establishments and to prepare guidelines for a code of practice to be used by administrators, engineers and others in industrialized countries. The characteristic hazard of health care waste is its potential for transmitting infection; a small quantity of flammable and toxic chemicals and some low-level radioactive waste is also generated. Nevertheless, most of the waste, including that from food services, is no more hazardous than general municipal waste.

Although the original terms of reference of the Group referred to "hospital waste", it was considered that a more suitable and comprehensive term was "health care waste", as this embraces infectious and other hazardous or obnoxious waste arising in

various kinds of health care establishment other than hospitals. "Waste" should include any type of waste material generated in health care establishments, including aqueous and other liquid waste.

The Group's deliberations concentrated on three principal aspects of the subject:

- the health of personnel and patients in health care establishments;
- the risks to public health arising from the transport and disposal of infectious and hazardous waste;
- the environmental and economic implications of waste disposal methods.

While both the internal and external aspects of waste disposal were considered, the organizational and legal arrangements of municipal and other environmental authorities concerning waste disposal were not within the scope of the Group's terms of reference.

To examine various specific aspects of the subject, 15 subgroups were formed, each of which produced a report with conclusions and recommendations where appropriate, as a basis for discussion in plenary sessions. The subjects and composition of the subgroups are shown in Annex 4.

The Group visited Haukeland Hospital in Bergen, which serves as a teaching hospital for the Faculty of Medicine at the University of Bergen, to examine its general and hazardous waste management practices. Particular emphasis was placed on infection control methods. Apart from its medical treatment facilities, the hospital is well known for its internal automatic transport supply system, connected to various units of the hospital. Members of the Group inspected this system, which uses containers running on overhead monorails served by vertical elevators at terminals. Different containers, each with a capacity of about 700 litres, carry food, laundry, medicines and other supplies in addition to handling the hospital's solid waste. The waste containers are automatically lifted and emptied into an incinerator and on the return route go through an automatic washing machine. The whole system is controlled by computers that programme the containers to travel to the correct unit.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions and recommendations on specific aspects of health care waste management appear in the appropriate sections of this report. The main conclusions and recommendations are summarized here.

1. Health care waste management requires a systems approach, involving the handling, storage, transport, treatment and disposal of waste by methods that at all stages minimize the risk to health and the environment.

2. All personnel in health care establishments should be made aware of the potential risks of mishandling waste. Training for all personnel involved in waste management is an essential part of health care training programmes.

3. Emphasis should be placed on the need to segregate "risk" waste — pathological, infectious, hazardous chemical — from other waste and to use appropriate packaging and labels. Colour-coding of waste bags and containers should be adopted, with appropriate emblem-coded tags for high-risk waste. National standardization of colour- and emblem-coding would be advantageous.

4. The basic approach to waste management is to reduce the quantity of waste at source as far as practicable. In health care waste management, this is particularly significant for chemicals. Waste should be recycled whenever feasible, with due regard to environmental considerations, to reduce the quantity of material entering the waste stream.

5. Incineration is the preferred method of disposing of pathological and infectious waste. Incinerators must be specifically designed to deal with such waste and be able to meet local or national emission standards.

6. Radioactive waste produced in health care establishments is of very low-level radioactivity and has a short half-life. Residues are stored until their radioactivity has decayed to the point where they

are no longer considered to be radioactive. The waste should then be disposed of according to its other characteristics, e.g. chemical, infectious or general, and in conformity with applicable regulations.

7. All health care establishments should have comprehensive waste disposal plans. Policies for disposal will vary with local circumstances. It may be carried out on-site or at a centralized plant. In planning new hospitals or other health care establishments, or their renovation, full account must be taken of the need for waste disposal, including provision for future extensions.

8. Legislation on health care waste management should be restricted to basic principles, leaving individual health care establishments or units to adopt the systems that suit them best. The feasibility of local health care establishments cooperating with each other should be considered, with a view to minimizing waste disposal costs.

9. Information needs to be collected and exchanged on the performance and capabilities of various health care waste treatment and disposal techniques, especially incineration. Demonstration projects reflecting different national waste management strategies would be beneficial. To facilitate the transfer of resultant information, the cooperation of organizations such as the International Federation of Hospital Engineering should be sought. WHO should also continue to assist in the assessment, dissemination and use of this information.

WASTE CATEGORIES AND THEIR SOURCES

Health care waste can be classified into eight main categories: general waste, pathological waste, radioactive waste, chemical waste, infectious and potentially infectious waste, sharps, pharmaceutical waste and pressurized containers.

General waste includes domestic-type waste, packing materials, non-infectious animal bedding, wastewater from laundries and

other substances that do not pose a special handling problem or hazard to human health or the environment.

Pathological waste consists of tissues, organs, body parts, human fetuses and animal carcases; and most blood and body fluids.

Radioactive waste includes solid, liquid and gaseous waste contaminated with radionuclides generated from *in vitro* analysis of body tissues and fluid, *in vivo* body organ imaging and tumour localization, and therapeutic procedures.

Chemical waste comprises discarded solid, liquid and gaseous chemicals, for example from diagnostic and experimental work, and cleaning, housekeeping and disinfecting procedures. Chemical waste may be hazardous or nonhazardous. For the purpose of choosing the most appropriate waste handling method, hazardous chemical waste is considered to be waste that is:

— toxic;

— corrosive (acids of pH <2.0 and bases of pH >12.0);

— flammable;

— reactive (explosive, water reactive, shock sensitive);

— genotoxic (carcinogenic, mutagenic, teratogenic or otherwise capable of altering genetic material); for example, cytotoxic drugs.

Nonhazardous chemical waste consists of chemicals other than those described above, such as sugars, amino acids, and certain organic and inorganic salts.

Infectious waste contains pathogens in sufficient concentration or quantity that exposure to it could result in disease. This category includes cultures and stocks of infectious agents from laboratory work, waste from surgery and autopsies on patients with infectious diseases, waste from infected patients in isolation wards, waste that

has been in contact with infected patients undergoing haemodialysis (e.g. dialysis equipment such as tubing and filters, disposable towels, gowns, aprons, gloves and laboratory coats) and waste that has been in contact with animals inoculated with an infectious agent or suffering from an infectious disease.

Sharps include needles, syringes, scalpels, saws, blades, broken glass, nails and any other items that could cause a cut or puncture.

Pharmaceutical waste includes pharmaceutical products, drugs and chemicals that have been returned from wards, have been spilled, are outdated or contaminated, or are to be discarded because they are no longer required.

Pressurized containers include those used for demonstration or instructional purposes, containing innocuous or inert gas, and aerosol cans that may explode if incinerated or accidentally punctured.

All these types of waste can arise at a wide range of health care establishments: hospitals, clinics, long-term health care premises, support services. A detailed list of potential sources is given in Annex 2. Categories of waste that may be produced by particular types of health care service are shown in Table 1.

OCCUPATIONAL HAZARDS AND HEALTH RISKS

One of the main tasks of the Group was to identify health and environmental hazards that could arise from the mismanagement of health care waste. At the same time, it was important, for both practical and economic reasons, not to cause public alarm by looking for problems that do not exist or by exaggerating risks that are minimal or are present also in other areas of everyday life.

Three main categories of people are liable to be exposed to health hazards associated with health care waste:

- patients and personnel in health care establishments;
- personnel in organizations providing support services on a contract basis, such as laundries, incinerators, waste disposal sites;
- patients and personnel involved in home care or primary care, such as home dialysis.

Patients at special risk from infections and other complications, resulting from exposure to microbial pathogens and sharps that may arise from breaks in the waste disposal system chain, are:

- immunosuppressed patients or those whose host defence mechanisms are otherwise altered (patients with AIDS belong to this category);
- patients with bleeding or clotting disorders;
- patients on dialysis;
- drug abusers or addicts (who should be kept away from waste that contains needles, syringes or discarded drugs).

In general there is insufficient awareness of the health hazards associated with contaminated or infectious waste. There are also sociological problems, such as foreign workers with language limitations or workers who may be illiterate or of low intelligence. The health of all personnel working in or associated with health care establishments can be at risk, and it is important that they be made aware of the risks and be trained in precautionary measures and disposal procedures. The risks for particular groups of personnel are as follows.

Personnel handling waste that contains blood-soaked objects from patients in dialysis units must be protected against the transmission of hepatitis B. Special arrangements are necessary for the isolation, separation, collection and disposal of this waste. In the case of patients whose diagnostic status is unclear, it would be appropriate to deal with waste in the same manner.

Custodial personnel, maintenance staff and porters could be at risk from sharps in waste that contains syringes and needles, if these have not been kept separate and safely packaged for disposal.

Table 1. Categories of waste produced by various types of health care service

Source	Waste category							
	General	Patho-logical	Radio-active	Chemical	Infectious	Sharps	Pharma-ceutical	Pressurized containers
Patient services								
medical	X	X[a]		X	X	X	X	X
surgical	X	X[a,b]		X	X	X	X	X
operating-theatre	X	X[a,b]		X	X	X	X	X
recovery and intensive care	X	X[a]		X	X	X	X	X
isolation ward	X	X[a]		X	X	X	X	X
dialysis unit	X	X[a]		X	X	X	X	
oncology unit	X	X[a]		X	X	X	X	
emergency	X	X[a,b]		X	X	X	X	
outpatient clinic	X	X[a]		X	X	X	X	X
autopsy room	X	X[a,b]		X	X	X	X	
radiology	X	X[a]		X	X	X		
Laboratories								
biochemistry	X	X[a]	X	X	X	X		
microbiology	X	X[a]	X	X	X	X		
haematology	X	X[a]	X	X	X	X		
research	X	X[a,b]	X	X	X	X		X
pathology	X	X[a,b]	X	X	X	X		
nuclear medicine	X	X[a]	X	X	X	X		

Table 1 (contd)

Support services								
blood bank	X	X[a]		X	X	X		
pharmacy	X			X			X	
central sterile supply	X			X				X
laundry	X			X		X		
kitchen	X							
engineering	X			X		X		X
administration	X							
public areas	X							
Long-term health care establishments	X			X	X	X	X	X

[a] Blood and body fluids.

[b] Tissue and bone.

Personnel involved in the final disposal or incineration of waste may be exposed to risk from pathological waste that has not been kept sufficiently cool, especially if the wrapping or storage sacks are punctured or torn.

Pharmacy personnel may be at risk from respiratory or dermal exposure to aerosols contaminated with pharmaceuticals or solvents.

Custodial personnel could be exposed to risk on any premises where leaks or obstructions in drains result in the escape of gases or hazardous solvents that may be inhaled. Exposure to H_2S escaping from blocked sewers is a well known hazard.

To minimize the occupational health risks associated with health care waste, occupational health programmes should:

— introduce safe or less hazardous substitutes for chemical agents with exposure hazards (substance distribution inventories would be helpful in finding out what agents are actually in use);

— require closed storage for volatile agents, traces of or brief exposure to which are a health hazard;

— require the use of proper venting and exhausting in accordance with the established principles of occupational hygiene (the special problems involved in the collection and trapping of mercury must be taken into account);

— provide appropriate protective clothing (including masks) with disinfection and disposal arrangements, for workers involved in various stages of waste disposal;

— require the use of colour- and emblem-coded tags and containers where the pre-sorting and segregation of waste is necessary (the colours and emblems should be consistent throughout the establishment using them);

— introduce monitoring measures to carry out spot surveys in problem areas or high-risk situations; search for occupational exposure where clinical or epidemiological information suggests a possible source of morbidity; and

— introduce epidemiological analysis to determine whether certain groups or subgroups of personnel may be at excessive risk of particular types of health problem.

IMPACT OF HEALTH CARE WASTE ON HUMAN HEALTH AND THE ENVIRONMENT

In addition to health risks to patients and personnel, consideration must be given to the impact of health care waste on human health and the environment outside health care establishments. In particular, attention should be paid to possible effects on the public, including aesthetic factors, and to the risk of the pollution of air, water and soil. To minimize these external health and environmental risks, action should be taken to deal with pollutants at their source. To this end, waste should be segregated and concentrated within health care establishments to simplify its management and, wherever feasible, waste should be recycled so that it does not enter the waste stream requiring disposal.

To safeguard against water pollution, measures should be taken at source to reduce the quantity and strength of incompatible pollutants in the wastewater flow. If a health care establishment is not connected to a municipal wastewater treatment system, on-site treatment should be carried out where feasible. Sludge from an on-site plant should be managed with the same precautions as for municipal waste sludge, e.g. it should not be spread on food crops unless properly treated.

Chemicals used in health care establishments are a potential source of pollution, mainly to water via the sewer system. An on-site chemical waste survey is a prerequisite to the development of an effective waste management programme. Any hazardous chemical waste generated should be dealt with by a proper chemical waste management system; waste chemicals should be recycled whenever possible. There should be scope for substituting chemicals with less environmental impact than those at present in use.

The use of disinfectants should be minimized when there are alternatives. This would reduce the quantity of waste disinfectants produced. Where a large amount of dilution water is available, however, disinfectants may safely be disposed of in the sewer.

The grinding of solid waste for disposal in the sewer system is not recommended unless the sewer and sewage treatment systems are designed to cope with them. Excessive solids can cause problems at sewage treatment plants. Food waste from health care establishment

kitchens, however, is often disposed of through garbage grinders to the sewer system.

Faeces and urine from patients in isolation wards should be disinfected before disposal in the sewer. Provision should be made in case of an epidemic for the emergency disinfection of waste from a large number of infectious patients, before disposal in the sewer system.

General waste and properly treated infectious waste can safely be disposed of in a landfill, but special measures may be necessary for aesthetic reasons.

Incinerator emissions are a potential source of air pollution. Incinerators for health care waste should be designed specifically for the purpose and must comply with air pollution control standards. Fume hoods are another outlet for air pollutants. Protective measures may require that they are fitted with filters. The height of chimney stacks is also an important factor.

Climatic conditions are a detectable factor in the gap between normal infectious disease rates and epidemics. This gap is smaller in hot climates than in moderate ones. Health care establishments in hot climates may, therefore, need to be more alert to detecting changes in normal conditions. The difference between seasons may also call for attention.

WASTE HANDLING, STORAGE AND TRANSPORT

The management of health care waste is basically a systems problem, usually beginning in clinical departments and wards. It involves the removal and disposal of the waste as hygienically and economically as possible, by methods that at all stages minimize the risk to health and the environment. In this context, "handling" is defined as the link between packaging, storage and transport.

Segregation and storage

General waste needs no special measures and can safely be dealt with in the same way as general municipal waste. Recycling should

be practised where feasible. Paper, glass, metal and plastics may be saleable, depending on local conditions. Non-infected food could be used for animal feed. Kitchen waste should be stored in fly-proof containers and cooled if kept for a prolonged period. Large containers used to store general waste should be leak-proof and protected against scavengers, such as rodents, dogs and people.

Sharps should be packed in puncture-proof containers for disposal with general waste or for further packaging and handling with hazardous waste.

Pathological and infectious waste must be segregated. High-risk infectious waste may initially be autoclaved, preferably at source, to reduce the risk to staff and patients, before packaging for treatment and disposal (see p. 16). Blood from screened donors that has been determined to be non-infectious may be poured down the drain if flushed with copious amounts of water.

Pressurized containers such as aerosol cans must not be placed in waste disposal bags destined for incineration.

Waste to be segregated should be put into single-use, moisture-proof bags hung in special holders or used as liners for plastic or metal containers. The bags should be strong enough to resist internal or external mechanical damage and should be filled only to a level that allows the bag to be easily and tightly closed. Colour-coded bags or containers should be used to identify pathological and infectious waste and labelled with appropriate symbols. The containers must be sealed before transport and be compatible with the intended treatment or disposal method. If autoclave bags are used, they must allow steam to penetrate and accomplish sterilization. Radioactive waste should be properly labelled and can be stored to allow decay (see p. 22).

Transport

The movement and transport of waste internally and externally should be considered as part of a comprehensive waste management system in all health care establishments. Internally, waste is usually transported from its initial storage point to an assembly area or on-site incinerator by means of trolleys or handcarts. Such equipment should be cleaned regularly and used only for waste transport.

In some modern hospitals pneumatic pipeline transport systems are used for waste movement. While such systems reduce the need for manual handling of waste, they can give rise to hygienic and technical problems. Their introduction, therefore, needs very careful consideration (apart from the cost factor) and they are not considered suitable for use with pathological and infectious waste.

Waste being transported externally should present no public health risk provided it has been suitably treated, but its physical appearance or the identifiable colour-coded containers may give rise to objection on aesthetic grounds. When hazardous waste is transported, the contents of all containers and their potential hazard should be identified in documents carried in the vehicle (several countries have laws controlling the classification and labelling of hazardous material in transit). The transport vehicle should have an enclosed leak-proof body and be cleaned after each use and disinfected when necessary.

Special requirements for chemical waste

The handling, storage and transport of chemical waste require special measures, not only because of health risks within the generating establishments, but on account of the potential environmental hazards during external transport and disposal.

The problem should be minimized by:

- reducing, as far as practicable, the use of chemicals in health care establishments;
- keeping chemical inventories low;
- substituting nonhazardous chemicals for hazardous ones whenever possible.

The first step in the management of chemical waste should be to segregate nonhazardous waste chemicals from those that are hazardous. The waste should be put in leak-proof containers which should be labelled to identify their contents and stored according to their compatibility. Nonhazardous waste can then be disposed of along with general waste or be recycled. Chemical waste should be recycled whenever feasible.

Nonhazardous chemical waste

Examples of nonhazardous chemicals commonly found in health care establishments are listed below.[a]

— *Organic chemicals.* Acetates (Ca, Na, NH_4, K); amino acids and their salts; citric acid and salts of Na, K, Mg, Ca and NH_4; lactic acid and salts of Na, K, Mg, Ca and NH_4; sugars.

— *Inorganic chemicals.* Bicarbonates (Na, K); borates (Na, K, Mg, Ca); bromides (Na, K); carbonates (Na, K, Mg, Ca); chlorides (Na, K, Mg, Ca); fluorides (Ca); iodides (Na, K); oxides (B, Mg, Ca, Al, Si, Fe); phosphates (Na, K, Mg, Ca, NH_4); silicates (Na, K, Mg, Ca); sulfates (Na, K, Mg, Ca, NH_4).

Non-recyclable, nonhazardous waste chemicals should be collected in disposable containers or plastic bags clearly labelled as nonhazardous waste.

Hazardous chemical waste

Hazardous chemical waste that cannot be recycled should be further segregated according to the type of hazard and the appropriate treatment and disposal method. Adequate storage areas must be provided for the accumulation of waste chemicals. Separate and secure areas should be maintained for reactive and explosive waste. Because it often has toxic or flammable properties, hazardous chemical waste should not be disposed of in the sewer system. Any waste that cannot be incinerated on-site must be handled and disposed of by an authorized waste management organization. Where local quantities are small, development of an area or regional cooperative collection and disposal system is advisable and may provide an economic disposal system.

[a] *Hazardous chemical waste management: a guidebook for lab personnel,* 2nd ed. Minneapolis, University of Minnesota, 1982.

It is advisable for all health care establishments using hazardous chemicals to know where to seek expert opinion in hazardous waste management, if required or in an emergency such as the risk of explosion.

WASTE TREATMENT AND DISPOSAL METHODS

In considering the most suitable treatment and disposal methods for health care waste, account should be taken of all the existing local options. Plans should also provide for emergencies. Suitable methods are discussed below for the waste categories set out in Table 1.

General waste. No special treatment is necessary for this waste which can be disposed of with municipal waste. With regard to waste food, a good principle is for all food leaving the kitchen to be treated as waste if not consumed. Food waste from tuberculosis or similar category treatment areas should be autoclaved before disposal.

Pathological waste. Treatment and disposal can be by sterilization, incineration or burial. Incineration is the preferred method, provided that an incinerator specially designed to deal with pathological waste is used. If disposal is by incineration the packaging container must also be burned.

Radioactive waste. Methods are discussed on pp. 25–26.

Infectious waste. Incineration is the preferred method for this class of waste. Reclassification after disinfection or sterilization should be considered. The Group discussed the need or advisability of autoclaving infectious waste before incineration, but provided that the waste is properly packaged and handled, autoclaving as a form of pre-treatment was not considered to be essential.

Sharps. Incineration is the preferred method for disposable syringes, needles and knives, which should be delivered to the incinerator in protective (combustible) packaging.

Pharmaceutical waste. All unwanted pharmaceuticals should be returned to the pharmacy, which will determine the most suitable method of disposal (e.g. incineration or return to supplier).

Pressurized containers. These may be disposed of in landfills or by recycling.

Aqueous and other liquid waste. Wastewater and other liquid waste should be sampled for contaminants, including heavy metals, organic solvents, chlorinated solvents and pH, which may affect treatment plants. Appropriate treatment capabilities should be provided at the point of discharge.

Treatment and disposal of chemical waste

Nonhazardous chemical waste may be disposed of along with general waste, but special measures are necessary for chemical waste of a hazardous character. Hazardous chemical waste should, whenever feasible and economic, be recycled. Examples of appropriate reclamation and recycling methods are given below.

Reclamation and recycling of hazardous chemical waste

Unused hazardous chemicals. Unopened hazardous chemical reagents that are unwanted may be given or sold to other health care establishments. In some countries, the question of the liability of the health care establishments participating in this practice has been raised. Therefore, although the practice is quite acceptable technically, the question of liability should be carefully considered, taking into account national or local precedent.

Solvent redistillation. Used solvents, such as toluene, xylene, acetone and some alcohols, can be redistilled for reuse. Such solvents

should be collected separately and labelled by chemical name. A suitable collection vessel is a safety container of protected glass, metal or polyethylene designed for flammable solvents.

Reuse of hazardous flammable organic solvents as fuel. Some flammable organic solvents can be used as fuel when mixed with other fuel, unless they are highly toxic or give off toxic products of combustion (this may not be legally permissible in certain countries). Great care must be taken in selecting organic solvents for this purpose, as many used in health care establishments are highly volatile. It is advisable to let them be handled by an authorized hazardous waste management organization.

Recycling of chromic acid. Chromic acid is often used to clean glassware in laboratories. Waste chromic acid may be recycled for recovery of the chromium.

Recovery of metallic mercury. Waste metallic mercury from thermometers, manometers and other equipment should be collected in a safe manner and sold to a commercial recycler. Metallic mercury should never be incinerated, as this generates toxic gas emissions.

Recovery of silver from photographic developing solutions. Developing solutions from radiology departments contain appreciable amounts of silver, which can be reclaimed by electrolytic devices. This can be done in-house or by a commercial firm.

Discarded batteries. Used batteries of various types, such as mercury, cadmium, nickel and lead–acid, may be sold for the recovery of reusable materials.

Perchlorethylene from dry-cleaning operations. Perchlorethylene from in-house dry-cleaning operations can be cleaned and reused.

Waste oil. Waste lubricating oil may be sold for recovery or used as a supplementary fuel.

Other disposal options for hazardous chemical waste

Where recycling is impracticable for technical or economic reasons, alternative disposal methods must be adopted. Various methods are discussed below.

Incineration. Combustible chemical waste may be incinerated in suitable on-site or regional waste incinerators. The residue — fly ash, bottom ash and residue from gas-cleaning equipment — may contain heavy metal contaminants. If heavily contaminated, the residues should be taken off-site by an authorized hazardous waste management organization for disposal in accordance with national regulations or codes of practice. Otherwise, the incinerator residue may be disposed of in landfills.

Reactive waste. Compounds that are unstable because of inherent instability, water reactivity or air reactivity require special handling and collection and protected storage. Reactive waste includes the following compounds.[a]

- *Shock sensitive*: diazo compounds, metal azides, nitrocellulose, perchloric acid, perchlorate salts, peroxidizable chemicals, picric acid and picrate salts, polynitroaromatics.
- *Water reactive*: alkali and alkaline earth metals, alkyl lithium reagents, boron trifluoride solutions, Grignard reagents, hydrides of Al, B, Ca, K, Li and Na, metal halides (anhydrous) of Al, As, Fe, P, S, Sb, Si, Sn and Ti, phosphorus oxychloride, phosphorus pentoxide, sulfuryl chloride, thionyl chloride.
- *Other reactive materials*: nitric acid above 71% (fuming nitric acid), phosphorus (red and white).

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[a] *Hazardous chemical waste management: a guidebook for lab personnel*, 2nd ed. Minneapolis, University of Minnesota, 1982.

All peroxidizable chemicals, such as those listed below, must be dated on receipt. Storage and use must be limited in time according to the following schedule.[a]

— Three months after opening: diethyl ether, isopropyl ether, dioxane, tetrahydrofuran, sodium amide, cyclohexane.

— Twelve months after receipt: acrylonitrile, butadiene, vinylidene chloride, chlorotrifluoroethylene, vinyl chloride, vinyl ethers.

The following materials may be susceptible to peroxidation, must be dated on receipt and should not be kept longer than 24 months.[a]

— *Peroxide hazard on concentration*: acetal, ethylene glycol dimethyl ether (Glyme), dicyclopentadiene, tetrahydronaphthalene, diethylene glycol dimethyl ether (Diglyme), decahydronaphthalene, methyl acetylene, diacetylene.

— *Hazardous due to peroxide initiation of polymerization*: methyl methacrylate, styrene, acrylic acid, vinyl acetate, vinyl pyridine, chloroprene, diacetylene, methyl acetylene.

Other toxic and flammable waste. Chemicals previously identified as suitable for reuse as fuel can alternatively be incinerated. Solvents not intended for redistillation should be segregated and labelled as either halogenated or nonhalogenated. Halogenated solvents should be disposed of by a professional hazardous waste treatment organization. Nonhalogenated solvents may be incinerated.

Waste scintillation media. Scintillation media, typically toluene-based, have low-level radioactive properties as well as toxic and flammable properties. When the media have been stored until they

[a] *Hazardous chemical waste management: a guidebook for lab personnel*, 2nd ed. Minneapolis, University of Minnesota, 1982.

are no longer a radioactive hazard (see p. 25), they can be handled and disposed of with other toxic and chemical waste. Incineration is a suitable method.

Cytotoxic and genotoxic drugs and waste contaminated by these drugs. This waste should be segregated, packaged, labelled and disposed of by incineration. It should not be autoclaved, because this may expose the autoclave operator to toxic substances and, moreover, does not reduce the hazard of the waste. (See also *Pharmaceutical waste*, p. 17.)

Waste containing asbestos. Precautions for handling, disposal or reuse should be consistent with the hazard of asbestos dust at trace contaminant levels. Enclosure of such waste into a "fixed" substance should be done under conditions that prevent the release of asbestos fibres to the air. Waste containing asbestos may be disposed of under controlled conditions at landfill sites authorized to receive such waste.

Chemicals from engineering and housekeeping services. A number of chemical wastes, hazardous because of their toxicity or flammability, are generated by health care engineering and housekeeping activities and should be handled and disposed of according to their characteristics. Such wastes include disinfectants and detergents, lubricating oil, machinery cleaning solutions, contaminated charcoal filters, contaminated particulate filters, water treatment compounds, paint, paint solvents, brush-cleaning compounds, oil from transformers and capacitors containing polychlorinated biphenyls (PCBs), immersion oil from microscopes containing PCBs, and insecticides (such as boric acid).

Incinerators and associated equipment

It was not the Group's function to propose or define criteria for the design or performance of special incinerators for health care waste, but discussion took place on the practical and environmental

aspects of their use. Reference was made to a recent draft British standard for hospital incinerators.[a]

An incinerator should be capable of burning health care waste under controlled combustion conditions and producing a sterile residue. For this purpose, the combination of burning temperature and retention time must ensure efficient combustion of all the waste. All emissions and residues should be pathogen-free. The incinerator must be safe to operate, e.g. the surface temperature of all external parts must be effectively guarded so as not to cause injury to personnel who may inadvertently touch them. Safety control, fail-safe devices and control instrumentation should be fitted.

Chimneys and flues must be designed and constructed to remove combustion gases effectively and comply with local regulations. Emissions must not exceed locally permitted levels.

Incinerator capacity and feed rate should be adequate, when operated in accordance with recommendations, to dispose of all the waste required by established local policies.

The economics of heat recovery should be carefully considered, particularly for all new installations.

Regular scheduled maintenance is essential to obtain efficient operation. Operators and maintenance staff should be instructed on the use and maintenance of the equipment and provided with operating manuals.

RADIOACTIVE WASTE

Radioactive waste is classified according to its type and its radioactivity. High-level radioactive waste is in the gigabecquerel (GBq) activity range and above. Low-level radioactive waste is under 1 MBq. The type, form and level of radioactive material used in health care establishments results in low-level radioactive waste. Most of this waste is generated during body organ imaging and tumour localization, with a radioisotope for each procedure in the

[a] *Incinerators* (Parts 1–4). London, British Standards Institution, 1983 (draft revision of document BS 3316).

MBq activity range. Radioactive waste of lesser activity is produced during *in vitro* diagnostic studies. The therapeutic application of radioiodine is infrequent, but the activity range used is large, nearly 1 GBq. The waste may therefore also be of higher radioactivity. The only high-level radioactive materials used for health care are sealed sources used in brachytherapy, but these sources do not routinely generate radioactive waste.

Sources of radioactive waste

There are three sources of radioactive waste: research activities which commonly use significant quantities of ^{14}C and ^{3}H and generate large volumes of waste with low radioactivity; clinical laboratories, which are involved in radioimmunoassay procedures that likewise generate relatively large volumes of waste with low radioactivity; and nuclear medicine laboratories, which will normally generate relatively small amounts of waste but with higher radioactivity than the previous two sources. Table 2 summarizes the principal radionuclides used in health care establishments along with their application and characteristics.

The nuclear medicine laboratory generates two types of waste: that resulting from the diagnostic application of radioactive material and that following radiotherapy. The radionuclides used in radiotherapy are essentially limited to ^{131}I and ^{123}I. These radionuclides are used in the activity range of up to 1 GBq to treat hyperthyroidism, and 10 GBq to treat thyroid carcinoma. The radioactive waste generated can be of a relatively high level, but these applications are infrequent. Over 90% of diagnostic nuclear medicine applications use ^{99m}Tc. This is fortunate because ^{99m}Tc has a short half-life (six hours) which renders it relatively easy to handle and dispose of. Most other diagnostic radionuclides are also short-lived.

The form of radioactive waste

Solid waste. All these applications of radioactive material generate some solid radioactive waste. The vials, syringes and contamination control materials, such as absorbent paper and protective clothing, constitute the solid waste generated in the nuclear medicine imaging laboratory. Research activities can generate the largest volume, especially when experimental animal cadavers are involved.

Table 2. Principal radionuclides used in health care establishments

Radionuclide	Principal emission	Half-life	Application
^{3}H	Beta particle	12.3 y	Research
^{14}C	Beta particle	5730 y	Research
^{32}P	Beta particle	14.3 d	Therapy
^{51}Cr	Gamma ray	27.8 d	*In vitro* diagnosis
^{57}Co	Beta particle	270 d	*In vitro* diagnosis
^{59}Fe	Beta particle	45.6 d	*In vitro* diagnosis
^{67}Ga	Gamma ray	72 h	Diagnostic imaging
^{75}Se	Gamma ray	120 d	Diagnostic imaging
^{99m}Tc	Gamma ray	6 h	Diagnostic imaging
^{123}I	Gamma ray	13 h	Diagnostic uptake
^{125}I	Gamma ray	60 d	Diagnostic uptake
^{131}I	Beta particle	8 d	Therapy
^{133}Xe	Beta particle	5.3 d	Diagnostic imaging

The clinical laboratory uses a large number of vials that may have to be handled as radioactive waste, if they are not washed and disposed of with the ordinary waste.

Liquid waste. Many shipments of radioactive material are in liquid form. The residues of these shipments constitute the principal liquid radioactive waste requiring handling and disposal. Radioactive waste in liquid form can come from chemical or biological research, from body organ imaging, from decontamination of radioactive spills, from patients' urine and from scintillation liquids used in radioimmunoassay. Undoubtedly, this last source of liquid waste produces the largest volume of liquid radioactive waste.

Gaseous waste. Research and radioimmunoassay activities may generate small quantities of radioactive gas. The clinical

application of ^{85}Kr and ^{133}Xe is the principal source of gaseous radioactive waste material requiring disposal.

Disposal methods

Although many health care establishments still use commercial or government radioactive waste disposal services, this is rarely necessary. With proper handling, all the generated radioactive waste can be disposed of through the normal waste channels.

There are two main approaches to radioactive waste disposal: concentration and storage, or dilution and dispersal.

Concentration and storage is used principally for solid waste. The waste is compacted and retained at a permanent storage or burial site. This method of disposal is unnecessary for most health care establishments.

Dilution and dispersal is usually applied to liquid and gaseous waste. The waste can be diluted through dispersal in the sewer system. Gaseous waste can likewise be diluted through dispersal in the atmosphere in a normally uninhabited area.

Incineration is a special application of both of these general methods. The ashes represent the concentration and the air effluent the dispersal.

By far the most widely used method for solid waste disposal is storage pending decay, followed by disposal in the ordinary waste system. Most solid radioactive waste, particularly that generated by the nuclear medicine imaging laboratory, can be stored in an appropriate container and under secure conditions pending decay. A plastic bag in a large can or drum is an appropriate container. Since the half-life of nearly all nuclear medicine imaging materials is in the range of hours or days, storage for a period of one or two months can be followed by disposal in the ordinary waste system with appropriate monitoring. When this method is used, all radioactive labels or warning signs must be removed or obliterated.

Very low-level liquid radioactive waste is usually handled by direct dispersal in the sewer system. Higher-level radioactive waste, such as that generated in radioiodine therapy, can be stored pending decay, followed by appropriate radiation monitoring and subsequent dispersal in the sewer system. It is not usually necessary to collect and confine patient waste. Under normal circumstances, urine and faeces can be handled as nonradioactive waste so long as the patient's room is routinely monitored for radioactive contamination.

In the case of contaminated liquid scintillation phosphorus, the toxicity of the chemical matrix is probably more hazardous than its radioactivity. Indeed, the chemical toxicity of this material may preclude its direct disposal in the sewer system. From a practical standpoint, it is acceptable to identify a sink in the laboratory as a waste receptacle if the daily disposal is restricted to 100 kBq.

Gaseous radioactive material should be evacuated directly to the outside. Under no circumstances should such gaseous radioactive waste be mixed with the indoor air. If a special exhaust system is not available, an activated carbon trapping device may be used. The use of such a device requires maintenance of the trap and monitoring of the off-gas.

Conclusion

If properly handled, radioactive waste from health care establishments does not constitute a significant hazard. In general, the generated radioactive waste can be disposed of without resorting to installations outside the health care complex. Most can be stored pending decay and then disposed of as normal nonradioactive waste. With proper monitoring and appropriate treatment, liquid and gaseous waste can generally be dispersed directly in the environment.

PLANNING FOR HEALTH CARE WASTE MANAGEMENT

A waste survey is essential for the planning of an effective waste management programme for any existing or contemplated health

care establishment, to determine the types and quantitites of waste arising or likely to arise.

Waste handling in new or renovated buildings

The arrangements for handling health care waste in new or renovated buildings require careful and detailed attention at the planning stage, as alterations later could be impracticable or prohibitively expensive. The types and quantities of waste produced in various classes of health care establishment vary considerably, depending on the medical treatment facilities, the number of beds, the number of outpatients, laboratories, etc. Data on waste output have been published in various countries, but these are not produced in any standard form or units. Data available to the Group from various countries are shown in Annex 3.

Waste storage methods and the requisite facilities have to be chosen, e.g. the extent of waste segregation, initial storage (in bags, bins, etc.). Initial storage will be required close to the sources of waste, and utility rooms for this purpose will be required in clinical departments, such as wards, operating-theatres, special units (renal dialysis, nuclear medicine, etc.). Storage areas will also be required in the vicinity of other departments, such as laboratories, laundries, pharmacies, kitchens, and residential and maintenance areas. Secondary storage or assembly areas will also be required, their location and size depending on whether disposal is to be carried out on-site or off-site. In the latter case provision must be made for access and manoeuvring space for collection vehicles. Movement or transport routes from the site of initial storage to secondary storage areas should be kept as short as possible. At secondary storage areas facilities for washing down and disinfection should be provided.

Policies for waste treatment and disposal will have to be decided early in the planning stage. Options to be considered include:

- — on-site incineration or transport to a central or regional incinerator;
- — incineration of all waste or only selected waste (pathological, infectious, etc.);
- — if on-site incineration is chosen, the feasibility and economics of heat recovery;

— the provision of spare incinerator capacity, on-site or off-site;

— the feasibility and desirability of automation in internal waste handling methods;

— the use of a macerator for specific waste (need for discussion with local sewerage authority);

— the use of compactors at the secondary storage area for general waste (coordination with local waste collection authority).

In planning buildings and services, matters to be considered include:

— the use of the "clean" and "dirty" corridor principle;

— fire-resistant construction of waste-storage areas;

— adequate access for vehicles to service areas;

— ventilation and cooling requirements;

— washing and changing facilities for staff;

— a minimum of 48 hours' storage capacity for waste awaiting removal from the premises;

— a separate storage area for recyclable materials;

— the need for power supply, fuel storage, water supply and drainage for waste disposal functions.

Regional or area planning

While self-contained on-site waste disposal methods for certain categories of waste may be desirable for large health care establishments, they may not be practicable or economic for smaller institutions. In such cases, area or regional disposal may be required. Such systems are in use in several countries and can operate in different ways. For example, a group of hospitals may set up a waste disposal facility (generally an incinerator) at one hospital which receives waste from others within the group. In other cases, the local authority may provide a centralized plant to receive waste from health care establishments within its area.

Each system has advantages and disadvantages. On-site disposal minimizes the external health or environmental risks, as pathological or infectious waste does not have to be transported outside the premises. On the other hand, the provision of spare incinerator capacity is expensive and, if not provided, disposal facilities must be available elsewhere for when the plant is shut down for maintenance and repair or involuntarily. With a centralized plant, the provision of spare capacity is more economic, and an important factor is that it is generally easier to ensure efficient operation than is the case with an on-site plant, where skilled operators may not be readily available. From an environmental point of view, a centralized plant may be preferable, as a large number of small incinerators present a potentially greater risk of air pollution than a well managed centralized plant.

Planning policy will depend on local circumstances: administrative control, the number, size and type of health care establishments, financial and technical resources, and the options available.

TRAINING AND SUPERVISION

It was considered desirable that all health care establishments should have written policies on waste handling procedures. The people responsible for implementing these policies should be clearly identified, and the waste handling procedures should be made known and readily available to all personnel concerned, not only those at the senior level.

Basic training in waste handling procedures should be given to all new personnel. Inservice training for all personnel should form part of the training programme. It is important that the training programme and methods be framed or adapted to suit personnel who may not be fluent in the language of the country or who may be only semi-literate. The basic content of training programmes should include information on:

- the hazards of health care waste;
- the methods of preventing the transmission of nosocomial infections related to waste handling methods;

— the safety procedures for dealing with chemical, pharmaceutical and radioactive waste and sharps;
— proper waste segregation, handling, packaging, transport and disposal;
— action and notification to supervisors in case of accident.

The content of these programmes should be periodically reviewed and updated as necessary.

Allied to training, good supervision is essential for the maintenance of efficient and safe waste-handling operations. The selection and training of supervisory personnel therefore plays an important part in in-house waste management. Information on health care waste management policy and methods should also be given to support staff, maintenance personnel and personnel from external organizations, such as transport firms, who may be involved in handling the waste.

LEGISLATIVE, ADMINISTRATIVE AND ECONOMIC ASPECTS

The Group discussed at some length various legislative, administrative and economic aspects of health care waste management. While the relevant legislation will vary from country to country, or within regions of particular countries, it was felt that some basic guidelines should be set out. There was agreement that health care establishments should be held legally accountable for their waste management practices and the following principal requirements were identified:

— a staff member should be designated as the waste management officer;
— all waste categories should be properly identified;
— waste should be properly segregated and disposed of safely and hygienically;
— health care establishments or their controlling organization should bear all the necessary costs associated with waste management programmes.

Legislation on health care waste management should be restricted to basic principles, leaving individual health care establishments or units to adopt systems appropriate to their specific requirements. Legislative and administrative guidelines would be appropriate on the following matters:

— the aim of regulations on health care waste management should be to prevent occupational, public health and environmental hazards and should also take account of aesthetic aspects;

— the recovery and recycling of materials should be encouraged provided that safety, health and environmental risks can safely be controlled;

— existing external waste disposal systems should be used whenever they are acceptable with regard to health and environmental considerations;

— hazardous health care waste should be dealt with as part of an overall hazardous waste management system, with appropriate control procedures;

— waste contaminated with pathogens of diseases notifiable under epidemic control regulations (or which can be assumed to be of that type) should not leave the premises unsterilized.

It was considered that on-site waste disposal plants, such as incinerators, should be subject to the same authorizing procedures as the other waste disposal facilities in the area. The incineration of pathological, infectious or hazardous chemical waste should be permitted only in plants designed for the purpose. Where special facilities are not available for the treatment of pathological waste, this should be disposed of at a crematorium or by burial.

If waste is assigned to an outside party for disposal, the waste producer should ensure that the firm or organization handling the waste is authorized for the purpose. Contractual relationships should exist between the waste producer, transporter, disposer and any other party involved in the management of the waste. There must be no break in the renewal of contracts or between the expiry of one contract and its replacement by another.

Cost-effectiveness is an essential factor in any health care waste management plan or programme. It should be judged on the most economic combination of:

— initial capital investment;
— amortization over the effective life of the plant and equipment;
— operating labour and materials costs;
— maintenance and repair costs;
— energy requirements;
— contractual costs; and
— overhead costs.

To minimize costs, the feasibility of cooperation between local health care establishments should be considered.

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Annex 2

TYPES OF HEALTH CARE ESTABLISHMENT THAT GENERATE WASTE[a]

Hospitals and their departments

- general hospital
- specialized hospital
- sanatorium (TB)
- departments
  - paediatric
  - oncology
  - rehabilitation
  - eye and ear
  - psychiatric
  - burns and trauma
  - orthopaedic
  - respiratory diseases
  - haemophilia

Clinics

- physician
- dentist
- dialysis centre
- alcohol treatment centre
- drug treatment centre
- abortion clinic
- maternity clinic
- thrombosis clinic

[a] This list is representative rather than all-inclusive.

Long-term health care establishments

- nursing home
- old people's home
- home for the physically and mentally handicapped
- home care (such as home dialysis)
- hospice

Support services

- blood bank
- pharmacy
- medical/teaching centres
- mortuary
- central sterile supply
- laundry
- technical services
- laboratories
  - clinical
  - pathology
  - haematology
  - chemistry
  - research, including veterinary and genetic

THE AMOUNT OF WASTE PRODUCED BY HEALTH CARE ESTABLISHMENTS IN VARIOUS COUNTRIES

The data are indicative only. There are important variations from one institution to another. Waste output refers to all waste, including general waste.

Table 1. Norway, Spain and United Kingdom

Type of hospital	Quantity of waste (kg/bed/day)		
	Norway[a]	Spain[b]	United Kingdom[c]
Geriatric	—	1.2	0.25
Mental	—	1.6	0.5
General	—	2.8	2.5
Maternity	—	3.4	3.0
Teaching	3.9 (55.5 litres)	4.4	3.3

[a] Trondheim Regional Hospital.

[b] Gutierrez, A., 1980 *Todo Hospital*. March/April 1983.

[c] *Incinerators* (Parts 1–4). London, British Standards Institution, 1983 (BS 3316)

Table 2. Netherlands

Type of health care establishment	No of beds	Quantity of waste (kg/bed/day)
University hospitals with medical research facilities	900-1000	4.2[a]
	800- 900	6.5[a]
General hospitals	600- 700	2.7
	300- 400	2.3
Specialized medical centres	< 100	5.0
	100- 200	6.0
Mental institutions	800- 900	1.3
	400- 500	1.2
Institutions for the mentally deficient	400- 500	1 8
	700- 800	1.4
Nursing homes	100- 200	1 7

[a] The difference between the two given figures is explained by the importance of the available research facilities in the two hospitals considered

Source: **van de Velde, J.M.A.** Aspects of the disposal of hospital waste in the Netherlands. *In: Proceedings of the International Congress of Hospital Engineering, Amsterdam, 9-14 May, 1982.* Schalkaar, Nederlandse Vereniging van Ziokenhuis Technici, 1982.

Table 3. France

Type of hospital	No. of beds	Quantity of waste (litres/bed/day)		
		Mean	Maximum	Minimum
Teaching		16.5	22.3	12.4
Central	>1000	14.8	16.4	11.9
	<1000	10.7	13.2	8.3
	> 500	8.1	9.7	5.4
	< 500	5.2	7.3	2.7
Local		2.8	3.5	2.1
Private	> 500	14.4	17.1	8.7
	< 500	11.6	13.2	7.6
	> 100	12.8	18.3	8.5
	< 100	10.0	14.5	6.3

Source: *Guide technique pour la gestion et l'élimination des déchets hospitaliers.* Paris, Centre national de l'équipement hospitalier, 1982.

Table 4. United States

No. of beds	Quantity of waste	
	(kg/bed/day (± SE))	(kg/patient/day)[a]
<100	4.10 (0.53)	5.38
100–299	4.42 (0.44)	5.80
300–499	4.88 (1.03)	6.40
>500	5.24 (0.79)	6.87
Mean	4.51 (0.31)	5.92

[a] The kg/patient/day is derived from kg/bed/day by the formula: kg/patient/day = 100% occupancy (North Carolina hospital occupancy rate in 1980 was 76.2%) × kg/bed/day.

Source: **Rutala, et al.** Management of infectious waste from hospitals. *Infection control,* **4**(4): 198–204 (1983).

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RESUME

Introduction

A la réunion ont participé trente-quatre médecins, scientifiques, ingénieurs et administrateurs originaires de dix-neuf pays.

Le groupe de travail avait pour mandat l'examen de l'évolution récente en matière de manutention, de transport, de traitement et d'élimination des déchets des hôpitaux et d'autres établissements de soins de santé ainsi que l'élaboration de directives à l'intention des administrateurs, des ingénieurs et de tous les services intéressés dans les pays industrialisés. Le risque exceptionnel qui s'attache aux déchets engendrés par les soins de santé est inhérent à son potentiel de transmission des infections. Une petite quantité de substances chimiques toxiques et inflammables et des déchets faiblement radioactifs sont également produits. Néanmoins, plus de la moitié des déchets, y compris ceux des services d'alimentation, n'est pas plus dangereuse que les rebuts ordinaires des municipalités.

Discussion

Le groupe a décidé d'étudier trois aspects essentiels de la question, à savoir :

- la santé du personnel et des patients des établissements de soins de santé;
- les risques pour la santé publique liés au transport et à l'élimination des déchets infectieux et dangereux;
- les effets écologiques et économiques des différentes méthodes d'élimination.

Il faudrait inclure sous le vocable «déchet» tout type de rebut produit dans les établissements de soins de santé, y compris sous forme aqueuse et liquide. Les aspects intérieurs et extérieurs de l'élimination des déchets devraient être étudiés; cependant, les arrangements structurels et législatifs des autorités municipales et écologiques autres régissant l'élimination des déchets n'étaient pas de la compétence du groupe.

A l'origine, son mandat portait sur les «déchets hospitaliers»; il est cependant apparu que l'expression «déchets des établissements de soins de santé» conviendrait mieux, dans la mesure où des déchets infectieux, dangereux ou désagréables sont produits dans différents types d'établissements de soins de santé.

Le groupe de travail a examiné divers aspects des questions qui lui étaient soumises, à savoir :

- catégories de déchets;
- établissements produisant des déchets;
- déchets radioactifs;
- aspects législatifs, administratifs et économiques;
- déchets des établissements de soins de santé classés selon leurs sources;
- risques professionnels et risques pour la santé;
- manutention, entreposage et transport;
- traitement et élimination;
- planification régionale, et planification de la manipulation des déchets dans des locaux nouveaux ou rénovés;
- incinération et équipement connexe;
- formation et supervision;
- impact des déchets des établissements de soins de santé sur la santé humaine et l'environnement;
- grandes lignes d'un code de bonnes pratiques proposé;
- manutention, conditionnement et entreposage des déchets chimiques.

Conclusions et recommandations

1. Les déchets produits par les installations de soins de santé devraient être classés en huit catégories principales :

- déchets ordinaires;
- déchets pathologiques;

- déchets radioactifs;
- déchets chimiques;
- déchets infectieux et potentiellement infectieux;
- déchets coupants (seringues ou verres brisés, etc., susceptibles de provoquer une coupure ou une piqûre);
- produits pharmaceutiques;
- récipients pressurisés.

2. Il faudrait que les déchets faiblement radioactifs puissent se désagréger jusqu'à ce qu'ils cessent d'être dangereux. Leur élimination serait ensuite assurée par des méthodes appropriées à la catégorie dans laquelle ils entreront alors (déchets chimiques, infectieux ou ordinaires).

3. Les hôpitaux et autres établissements de soins de santé devraient être légalement responsables de leurs pratiques en matière de gestion des déchets.

4. Les individus courant un risque du fait des déchets infectieux et dangereux peuvent être classés dans les catégories ci-après :

- personnel et patients des établissements de soins de santé;
- personnel employé par les sous-traitants chargés du transport et de l'élimination des déchets;
- le grand public.

5. Il conviendrait d'entreprendre des recherches sur les méthodes d'automation et de mise à l'écart, en vue de la protection de ces groupes qui devraient en outre recevoir les informations et la formation appropriées.

6. Les déchets devraient être regroupés selon les méthodes de manutention requises et leurs caractéristiques de dangerosité et être identifiés par des emballages répondant à un code chromatique et à des symboles en vigueur dans le pays. Il conviendrait de chercher à mettre au point des normes internationales pour ces couleurs et symboles.

7. Les politiques et méthodes d'élimination des déchets devraient viser à réduire la pollution de l'air, de l'eau et du sol.

8. Les politiques d'implantation des sites de traitement et d'élimination des déchets varient en fonction des situations locales. Le traitement et l'élimination peuvent être effectués sur un site hospitalier pour un hôpital unique, ou en un lieu central pour un groupe d'établissements de soins de santé. On peut aussi, le cas échéant, avoir recours à des établissements extérieurs de traitement et d'élimination.

9. L'incinération constitue la façon la plus efficace d'éliminer la plupart des déchets non recyclables.

10. Tous les établissements de soins de santé devraient coucher par écrit leur politique de manipulation des déchets. Le personnel intéressé devrait recevoir une formation sur la base de ces politiques.

11. Les déchets de substances chimiques devraient être réduits au minimum. A cette fin, on évitera, dans toute la mesure possible, d'utiliser des substances chimiques dans les établissements de soins de santé et l'on s'efforcera de remplacer les substances chimiques dangereuses par d'autres qui ne le sont pas. Les déchets chimiques devraient être recyclés autant que faire se peut. Il conviendrait de les éliminer par incinération. Les déchets peuvent aussi être manipulés et éliminés par une organisation professionnelle agréée de gestion des déchets.

12. Il serait utile d'élaborer un code de bonnes pratiques pour la gestion des déchets des établissements de soins de santé. Les grandes lignes d'un tel code ont été brossées à cet effet par le groupe.

13. La réunion du groupe devrait donner lieu à une activité portant spécifiquement sur l'utilisation des incinérateurs sur une base régionale, locale ou collective.

ZUSAMMENFASSUNG

Einleitung

Zu den 34 Teilnehmern aus 19 Ländern zählten Fachärzte, Wissenschaftler, Ingenieure und Verwaltungsbeamte.

Tagungszweck war die Besprechung der letzten Entwicklungen in bezug auf Handhabung, Transport, Behandlung und Entfernung von Abfällen, die aus Krankenhäusern und anderen Einrichtungen der Gesundheitsversorgung stammen, und die Ausarbeitung von Richtlinien für Administratoren, Ingenieure und sonstige betroffene Berufssparten in Industrieländern. Das spezifische Risiko bei Abfällen dieser Art ist die Infektionsgefahr. Daneben fallen auch kleinere Mengen an feuergefährlichen und giftigen Chemikalien sowie schwach radioaktiven Abfällen an. Trotzdem ist mehr als die Hälfte der Abfallmengen, darunter Lebensmittelabfälle, nicht gefährlicher als der normalerweise in einer Gemeinde erzeugte Abfall.

Diskussion

Die Arbeitsgruppe einigte sich auf drei Hauptaspekte des Themas:

- Gesundheitsrisiko für Personal und Patienten in einer Einrichtung der Gesundheitsversorgung

- Gesundheitsrisiken für Außenstehende, die mit Transport und Entfernung infektiöser und sonstiger gefährlicher Abfälle zu tun haben

- umwelttechnische und wirtschaftliche Auswirkungen der Abfallentsorgungsmethoden.

Unter „Abfall" werden hier alle in einer Einrichtung des Gesundheitsversorgungswesens anfallenden Abfallstoffe verstanden, einschließlich wässriger und sonstiger flüssiger Abfallsubstanzen.

Sowohl die interne als auch externe Abfallbeseitigung sollte behandelt werden, während die organisatorischen und gesetzlichen Vorkehrungen kommunaler und sonstiger Umweltbehörden in bezug auf Abfallbeseitigung nicht in den Bereich der Arbeitsgruppe fielen.

Obwohl die Arbeitsgruppe in bezug auf ihr Tätigkeitsgebiet ursprünglich den Ausdruck „Krankenhausabfall" benutzt hat, kam man auf der Tagung zu der Auffassung, daß man besser den Ausdruck „Abfälle von Einrichtungen der Gesundheitsversorgung" benützen sollte, da infektiöse und andere gefährliche oder unhygienische Abfallstoffe bei mehreren Arten von Einrichtungen im Gesundheitsversorgungswesen anfallen.

Die Arbeitsgruppe befaßte sich mit nachstehenden Einzelaspekten:

- Abfallkategorien
- abfallerzeugende Einrichtungen
- radioaktiver Abfall
- gesetzliche, administrative und wirtschaftliche Aspekte
- nach Herkunft aufgeschlüsselte Abfälle in der Gesundheitsversorgung
- berufliche Gefahrenquellen und Gesundheitsrisiken
- Handhabung, Lagerung und Transport
- Behandlung und Beseitigung
- Raumplanung im Zusammenhang mit der Planung der Abfallhandhabung in neuen bzw. zu renovierenden Gebäuden
- Verbrennungs- und ähnliche Anlagen
- Ausbildung und Aufsicht
- Die Abfälle in der Gesundheitsversorgung und ihre Auswirkungen auf Gesundheit und Umwelt
- Entwurf praktischer Fachrichtlinien
- Handhabung, Verpackung und Lagerung chemischer Abfälle.

Schlußfolgerungen und Empfehlungen

1. Die Abfälle aus der Gesundheitsversorgung lassen sich in acht Hauptgruppen unterteilen:

- gewöhnliche Abfälle
- pathologische Abfälle

- radioaktive Abfälle
- chemische Abfälle
- infektiöse und potentiell infektiöse Abfälle
- scharfe/spitze Abfallobjekte (z.B. Spritzen oder Glasscherben, die eine Verletzung verursachen können)
- pharmazeutische Produkte
- Druckbehälter.

2. Schwachradioaktiven Abfall sollte man sich abbauen lassen, bis eine ungefährliche Strahlungsintensität erreicht wird; dann sind solche Stoffe ihrer Art nach zu definieren und dementsprechend zu entfernen (als chemische, infektiöse oder normale Abfälle).

3. Krankenhäuser und andere Einrichtungen der Gesundheitsversorgung sollten für die Abfallhandhabung rechtlich zur Rechenschaft gezogen werden können.

4. Durch infektiöse und andere gefährliche Abfallstoffe gefährdete Personen sind:

- Personal und Patienten in Einrichtungen der Gesundheitsversorgung
- Personal, das beim Abfalltransport und der weiteren Entsorgung eingesetzt wird
- die allgemeine Bevölkerung.

5. In den Bereichen Automatisierung und Verpackung sollten eine Forschungs- und Entwicklungstätigkeit zum Schutz der genannten Personengruppen betrieben werden; außerdem ist für eine ausreichende Informierung und Ausbildung der genannten Personengruppen zu sorgen.

6. Die Abfallstoffe sollten den verschiedenen Handhabungsmethoden und Gefahrenmerkmalen entsprechend voneinander getrennt und durch Farbmarkierungen auf der Verpackung sowie durch allgemein geltende Symbole gekennzeichnet werden. Man sollte versuchen, international gültige Farbmarkierungen und Symbole zu vereinbaren.

7. Es sind in diesem Sinne Richtlinien und Methoden zu entwerfen, um die Luft-, Wasser- und Landverschmutzung zu minimieren.

8. Die Richtlinien für die Plazierung von Abfallbehandlungsanlagen und Mülldeponien richten sich nach den örtlichen Verhältnissen. Beide Arten von Anlagen können sich, wenn es sich nur um ein einziges Krankenhaus handelt, auf dem Krankenhausgelände befinden; bei einer gewissen Gruppierung mehrerer Einrichtungen der Gesundheitsversorgung können die Anlagen an einer zentralen Stelle eingerichtet werden. Gegebenenfalls kann man auch externe Behandlungs- und Beseitigungsanlagen benutzen.

9. Die Verbrennung ist meist das wirksamste Verfahren zur Beseitigung nicht wiederverwertbarer Abfallstoffe.

10. Alle Einrichtungen der Gesundheitsversorgung sollten Vorschriften über die Handhabung von Abfallstoffen erstellen und ihr Personal entsprechend unterweisen.

11. Die Menge der chemischen Abfallstoffe ist auf ein Mindestmaß zu beschränken, indem man in diesen Institutionen möglichst wenige Chemikalien benutzt und statt gefährlicher Stoffe möglichst ungefährliche anwendet. Chemische Abfälle sind soweit möglich wiederzuverwerten. Nicht verwertbare chemische Abfälle sollten verbrannt oder aber durch zugelassene gewerbliche Betriebe gehandhabt und beseitigt werden.

12. Es wäre angebracht, praktische Fachrichtlinien für den Umgang mit Abfallstoffen der Gesundheitsversorgung zu entwerfen, eine entsprechende Gliederung hat die Arbeitsgruppe bereits aufgestellt .

13. Ein weiteres Vorhaben könnte der Einsatz von Verbrennungsanlagen auf regionaler, örtlicher oder gemeinschaftlicher Basis darstellen.

РЕЗЮМЕ

Введение

В работе совещания приняли участие 34 представителя 19 стран, включая специалистов в медицинских областях, ученых, инженеров и руководящих работников.

Цель совещания состояла в рассмотрении последних достижений в области сбора, транспортировки, переработки и удаления отходов, получаемых в больницах и других медицинских учреждениях, а также в подготовке руководящих указаний по данному вопросу для их последующего использования руководящими работниками учреждений здравоохранения, инженерами и другим персоналом в промышленно развитых странах. Единственная опасность, которую представляют собой отходы, получаемые в медицинских учреждениях, связаны с потенциальной возможностью передачи инфекции. Кроме того, в этих отходах могут содержаться большие количества огнеопасных, токсичных химических и слаборадиоактивных веществ. Однако более половины получаемых отходов, включая пищевые отходы, не представляют собой большую опасность, чем обычный городской мусор.

Дискуссия

Участники Группы согласились в том, что следует подвергнуть рассмотрению три основные аспекта данной проблемы:

- состояние здоровья персонала и пациентов, находящихся в медицинских учреждениях;
- опасности для здоровья населения, связанные с транспортировкой и удалением инфекционных и опасных отходов;
- экономические последствия внедрения методов удаления отходов и их воздействие на окружающую среду.

Под термином "отходы" следует понимать любой вид отходов, получаемых в медицинских учреждениях, включая водянистые и другие жидкообразные отходы. Необходимо учитывать как внутренние, так и внешние аспекты проблемы удаления отходов, однако в задачу Рабочей группы не входило рассмотрение организационных и законодательных аспектов деятельности городских властей по обеспечению удаления отходов, а также учреждений по охране окружающей среды.

Хотя в названии Рабочей группы фигурирует термин "больничные отходы", по мнению участников совещания, было бы правильнее говорить об "отходах учреждений медико-санитарного обслуживания", поскольку инфекционные и другие опасные и вредные отходы возникают в процессе функционирования различных учреждений медико-санитарного обслуживания.

Рабочая группа отнесла к кругу своего ведения следующие конкретные вопросы.

- Виды отходов
- Учреждения, в процессе деятельности которых возникают отходы
- Радиоактивные отходы
- Законодательные, административные и экономические аспекты проблемы
- Классификация различных видов отходов учреждений медико-санитарного обслуживания в зависимости от их источника
- Профессиональные опасности и факторы риска для здоровья человека
- Сбор, хранение и транспортировка отходов
- Обработка и удаление отходов
- Региональное планирование и планирование мероприятий по сбору отходов в новых или реконструированных зданиях
- Сжигание отходов и другое оборудование по их удалению
- Подготовка кадров и надзор
- Воздействие отходов, получаемых в учреждениях медико-санитарного обслуживания, на здоровье населения и окружающую среду
- Проект предложений по своду практических правил
- Сбор, упаковка и хранение химических отходов

Выводы и рекомендации

1. При классификации отходов, получаемых в учреждениях медико-санитарного обслуживания, можно выделить восемь основных категорий:

- общие отходы
- патологические отходы
- радиоактивные отходы
- химические отходы
- инфекционные и потенциально инфекционные отходы
- острые предметы (любые острые предметы в отходах, например разбитые шприцы или осколки других стеклянных предметов, могут быть причиной порезов и других повреждений)
- Фармацевтические средства
- прессованные контейнеры.

2. Низкий уровень радиоактивных отходов следует снижать до безопасных пределов, а затем приступать к их удалению, используя при этом адекватные методы, разработанные для удаления различных категорий отходов (химических, инфекционных или общих).

3. Больницы и другие учреждения медико-санитарного обслуживания должны нести юридическую ответственность за осуществляемую ими практику удаления отходов.

4. К числу подверженных опасности воздействия инфекционных и вредных отходов относятся следующие лица:

- персонал и пациенты учреждений медико-санитарного обслуживания
- работники, занятые при транспортировке и удалении отходов
- население в целом.

5. Необходимо осуществлять научные исследования и разработки в области автоматизации удаления отходов и создания безопасных технологий с целью защиты вышеупомянутых групп от воздействия Факторов риска. При этом вышеупомянутые категории лиц должны получать соответствующую подготовку и информацию по указанным вопросам.

6. Необходимо осуществлять раздельный сбор различных видов отходов с учетом разработанных методов, а также свойств отходов. При этом упаковки с ними должны иметь установленную в странах для контейнеров с такого рода отходами расцветку или обозначение. Следует принять меры к разработке международных стандартов в отношении расцветки или обозначения контейнеров с больничными отходами.

7. Следует разработать политику и методы удаления отходов, позволяющие сводить к минимуму загрязнение атмосферного воздуха, воды и земли.

8. Принципы размещения и захоронения обработанных отходов могут различаться в зависимости от местных условий. Обработка и удаление отходов могут осуществляться на территории больницы, если речь идет лишь об одном обЪекте, получающем отходы, или в специально отведенном для этого месте, если речь идет об удалении отходов, получаемых рядом учреждений медико-санитарного обслуживания. В случае необходимости для этих целей могут использоваться и более отдаленные предприятия по обработке и удалению отходов.

9. Сжигание отходов является наиболее эффективным способом удаления большей части нерециркулирующих отходов.

10. Все учреждения медико-санитарного обслуживания должны иметь письменные инструкции относительно политики и процедур обработки отходов. Персонал этих учреждений должен пройти соответствующую подготовку в соответствии с разработанной политикой.

11. Следует снижать обЪемы химических отходов путем максимально возможного сокращения использования химических веществ в учреждениях медико-санитарного обслуживания, а также путем замены, когда это возможно, опасных химических веществ на неопасные. Во всех возможных случаях химические отходы должны подвергаться рециркуляции. Удаление химических отходов следует производить посредством сжигания. Представляется возможным также транспортировка отходов для их последующей обработки и удаления в специализированные предприятия.

12. Представляется целесообразным разработать свод практических правил по руководству удалением отходов, получаемых в учреждениях медико-санитарного обслуживания. Соответствующий проект свода практических правил был подготовлен участниками Группы.

13. Следует продолжить работу в области использования методов сжигания отходов на региональном и местном уровнях, а также на коллективной основе.