THE MANAGEMENT OF HEALTHCARE WASTE

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Summary

Healthcare waste is a small but very significant waste stream perceived by the public as being the most dangerous and hazardous. In the low and middle-income countries of the world where there is little or no infrastructure for waste management it is usually the first waste stream to be tackled. Publications and training material are now available to help in dealing with the associated problems.

Healthcare waste can be divided into two categories, hazardous and nonhazardous. The nonhazardous can usually be disposed of by way of the normal municipal waste route. The hazardous healthcare waste needs to be segregated so that it can be treated properly. Incineration has always been the most popular method of treatment for healthcare waste. It has the advantage of being able to disinfect and reduce the waste and is suitable for all categories of hazardous waste. The unpopularity of incineration in recent years has been a result in part of the inadequate gas cleaning facilities on earlier plant and the greater awareness of environmental issues worldwide. This has led to the introduction of other treatment methods including heat and chemical treatment and the use of microwave technology. A large proportion of the world's hazardous healthcare waste is still deposited untreated in open dumps or landfill sites. Much therefore still remains to be done to improve the situation through education and training. The increasing use of complex and sophisticated treatment methods in healthcare, including chemotherapy and the use of radioactive isotopes, requires treatment and disposal methods that are able to cope with the rapid changes that are taking place. In addition, the mobility of the world's population means diseases can travel much quicker than before, so the basic safeguards of proper sanitation and healthcare are vital to preserve health, prevent epidemics, and ensure that the environment is adequately protected.

1. Introduction and Background

1.1. Introduction

The wastes produced while caring for the health of the community are quite special in that they have a higher potential to cause infection and injury than other categories of waste. Much greater care therefore has to be exercised when handling this type of waste, wherever it is generated. Sound and safe methods of management also have to be undertaken after careful risk assessments have been made. Inadequate handling of healthcare waste may have serious public health consequences and have a recognizable impact on the environment. Healthcare waste management is not yet carried out with a satisfactory degree of safety, in many parts of the world.

1.2. Background

It was during the late 1970s and the early 1980s that healthcare waste management became an issue of deep public concern. In higher income countries most healthcare hospitals and clinics already had their own incineration or boiler plant on site and were able to dispose of all their wastes while at the same time producing steam and hot water for the facility. Two significant changes then occurred at the same time. The first was increasing awareness among the general population of environmental issues, particularly air quality, which led to legislation to reduce atmospheric pollution. This in turn led to the closure of a number of boiler and incineration plants in hospitals. Many

items used in the provision of healthcare were of a reusable nature. Equipment was cleaned and sterilized and protective clothing was laundered. But with modern technology making possible the adoption of far more sophisticated techniques, the second change occurred. The situation then gradually developed whereby a considerable amount of equipment was designed for single use only, and instantly consigned to the waste stream after use. Disposable needles, catheters, probes, urine bags and special clinical packs, together with one-use and discarded protective clothing (for example, plastic gowns and latex gloves), linen, and dining equipment, became the accepted substitute for much of the long-life equipment previously used in the medical field.

However the reason that it became an international public issue was the number of incidents that occurred where healthcare waste had been handled in a criminally irresponsible manner. These incidents were widely reported by the media, thereby giving rise to considerable public concern. Instances of the mishandling of healthcare waste are still being reported worldwide.

The adverse publicity that these incidents have caused has resulted in the general public perceiving healthcare waste as being the waste stream creating the greatest risk to public health. Therefore, its importance is well established, and while the amount to be dealt with is a small proportion of the total waste production in any country, the overall effect if it is mishandled is proportionately greater.

Whenever national waste management strategies are being developed, particularly in low and middle-income countries, it is generally found that the first waste stream that has to be tackled is healthcare waste. In order to improve the arrangements, these countries have sought assistance from the World Health Organisation (WHO), the International Solid Waste Association (ISWA), and other international organizations to plan suitable management systems and regulatory regimes. The World Health Organisation has responded to these requests for assistance by producing three important documents to assist low and middle-income countries to develop suitable healthcare waste management systems, and with ISWA has organized conferences and seminars to promulgate the best practices worldwide.

1.3. Framework

The United Nations Conference on the Environment and Development (UNCED) in l990 led to the adoption of Agenda 21 and the concept of **"**sustainable development." Sustainable development has been defined as "developments that meets the needs of the present without compromising the ability of future generations to meet their own needs." The application of sustainable development to healthcare waste management means among other things applying the hierarchy or "ladder principle" for dealing with waste. That involves finding management solutions as near as possible to the top of the hierarchy (shown below).

1. Prevent
2. Reuse
3. Recycle
4. Incinerate (with heat recovery)

5. Incinerate
6. Landfill.

Two other principles, the "proximity principle" and the "polluter pays principle" also need to be taken into account. The proximity principle means disposing of the waste as near as possible to the point of production. The polluter pays principle means ensuring that the producer will meet all of the costs of managing the waste (including the costs of regulation and control). The hierarchy principle has to be applied to healthcare waste with care, particularly as there may be a conflict between the effects on the environment and the protection of human health. The European Commission's Priority Wastes Stream Project on Healthcare Waste considered this issue and concluded that human health must come first, but every effort must be taken to reduce the risk to the environment.

The problems facing higher income countries are different to those in lower and middle-income countries. They relate to the increased awareness among the population at large of the environmental effects of waste production in both the use of valuable natural resources and the effects on the environment of the storage, transport, and disposal of waste. When companies have designed healthcare products in the past, they have neglected to consider how the product is to be disposed of when it has reached the end of its useful life, and its possible effect upon the environment. However, companies are now beginning to take waste management into account, and even carry out a lifecycle analysis of their products to demonstrate their compliance with the principles of sustainable development.

2. What is Healthcare Waste?

2.1. Definitions, Categories, and Risks

The following definitions assist in focusing upon the risks associated with healthcare waste and also categorizing the various sources within healthcare facilities.

Healthcare waste (HCW): includes all of the waste generated by healthcare establishments, research facilities, and laboratories, and includes the waste originating from minor or scattered sources, such as that produced in the course of healthcare being undertaken in the home.

Hazardous healthcare waste (HHCW): includes the wastes set out in Table 1.

Waste category	Description and examples
Infectious waste	Waste suspected of containing pathogens e.g. laboratory cultures, waste from isolation wards, tissues, materials or equipment having been in contact with infected patients, excreta
Pathological waste	Human tissue or fluids e.g. body parts, blood and other body fluids, human foetuses
Sharps	Sharp waste e.g. needles, infusion sets, scalpels, knives, blades, broken glass
Pharmaceutical waste	Waste containing pharmaceuticals

	e.g. pharmaceuticals which are expired or no longer needed, items contaminated or containing pharmaceuticals (bottles, boxes)
Genotoxic waste	Waste containing substances with genotoxic properties e.g. waste containing cytotoxic drugs (often used in cancer therapy), genotoxic chemicals, radioactive substances
Chemical waste	Waste containing discarded chemical substances e.g. laboratory reagents, film developer, disinfectants which are expired or no longer needed, solvents
Wastes with high content of heavy metals	e.g. batteries, broken thermometers, blood pressure gauges
Pressurised containers	Gas cylinders, cartridges and aerosol cans
Radioactive waste	Waste containing radioactive substances e.g. unused liquids from radiotherapy or laboratory research, contaminated glassware, packages or absorbent paper, urine and excreta from patients treated or tested with unsealed radionuclides, sealed sources

Source: Pruess and Townend, 1998.

Table 1. Categories of hazardous healthcare waste

The largest amount of waste produced in healthcare facilities, between 75% and 90%, is very similar to household waste. It arises from the administration, housekeeping, and catering duties of hospitals and clinics, and includes the waste from other ancillary buildings such as residential facilities for the staff. This type of waste should be disposed of with the normal household waste stream.

There are risks to human health and the environment from the wastes set out in Table1 which need to be assessed and a waste strategy devised before they are handled or disposed of Contaminated sharps, particularly syringe needles, together with the concentrated cultures of pathogens are considered to be the waste items that pose the greatest risk to human health. Sharps may not only cause physical damage to those coming into contact with them, but may also infect the wounds so caused, by the pathogens present on the contaminated sharps. The double risk of injury and the possibility of the transmission of disease places sharps in the category of a very hazardous waste. The diseases of greatest concern are those that are likely to be transmitted by subcutaneous injection, for example, viral blood infections. Syringe needles are often contaminated with patients' blood and so therefore are of particular concern because they form the largest quantitative item in the sharps waste category. Recapping of syringe needles before disposal into containers causes many injuries from sharps. The unnecessary opening of sharps' containers and the use of non-puncture-proof materials are also major factors in causing sharps injuries.

Type of infection	**Examples of causative organisms**	**Transmission vehicles**
Gastroenteric infections	Enterobacteria, e.g. Salmonella, Shigella Vibrio cholerae, Helminths	Faeces and/or vomiting
Respiratory infections	Mycobacter tubercul., Measles virus, pneumococcus	Breathing secretions, spitting, sometimes saliva
Ocular infection	Herpes	Eye secretions

Genital infections	Herpes, Gonococcus	Genital secretions
Skin infections	Streptococcus	Pus
Anthrax	Bacillus anthracis	Skin secretions
Meningitis	Meningococcus	Cephalo-rachidian fluid
AIDS	HIV	Blood, sexual secretion
Haemorrhagic fevers	Junin, Lhassa, Ebola and Marburg viruses	All bloody products and secretions
Septicaemia	Staphylococcus	Blood
Bacteraemia	Candida albicans	Blood
Hepatitis A	HAV	Faeces
Hepatitis B & C	HBV, HCV	Blood and body fluids

Source: Pruess and Townend, 1998.

Table 2. Examples of infections caused by exposure to healthcare wastes, causative organisms, and transmission vehicles

In healthcare establishments, nurses and housekeeping personnel are the main groups at risk, with an annual injuries rate of 10 to 20 per 1000 workers. Of all workers who may be exposed to healthcare waste, cleaning personnel and waste handlers report the highest rate of occupational injuries; their overall annual rate reaches 180 per 1000 in the United States. The following case report briefly describes the experiences of one healthcare worker who developed a serious infection after occupational exposures to blood-borne pathogens, which in this case proved fatal. This case illustrates the preventable hazardous conditions and practices that can lead to needle stick injuries. After performing phlebotomy on a patient with AIDS, a healthcare worker sustained a deep needle stick injury with the used phlebotomy needle. Blood from the collection tube also spilled into the space between the wrist and cuff of the healthcare worker's gloves, contaminating her chapped hands. The healthcare worker removed the gloves and washed her hands immediately. She had a negative baseline HIV test and refused zidovudine prophylaxis. Because her patient was not known to have HCV infection and did not have clinical evidence of liver disease, the healthcare worker did not receive baseline testing for exposure to HCV. Eight months after the incident, the healthcare worker was hospitalized with acute hepatitis. She was found to be seropositive for HIV 9 months after the incident. Sixteen months after the incident, she tested positive for anti-HCV antibodies and was diagnosed with chronic HCV infection. Her clinical condition continued to deteriorate, and she died 28 months after the needle stick injury

Infections from healthcare waste may also occur from handling infectious materials. Table 2 lists examples of infections caused by exposure to healthcare wastes, the organisms concerned, and the ways by which they may be transmitted.

2.2. Quantities

In order to make comparisons and to assist in the preparation of a plan, Table 2 shows the total amount of healthcare waste produced in a healthcare facility on a kilogram per bed per day basis in different regions of the world.

Region	**Daily waste generation (kg/bed)**

North America	7 to 10
Western Europe	3 to 6
Latin America	3
Eastern Asia (high income) (middle income)	2.5 to 4 1.8 to 2.2
Eastern Europe	1.4 to 2

Source: WHO, 1999.

Table 3. Total healthcare waste production per region

Beds in use	1493
Volume produced	5972 litres
Weight	656 kg./litre
Density	0.ll kg./litre
Per bed volume	4.0 litre
Per bed weight	.44 kg

Source: Liberti et al., 1994.

Table 4. General hospital average daily production of infectious waste

In contrast, Lorenzo Liberti and his colleagues carried out a two-year research and development project in 1991 and 1992 to develop an integrated management system for infectious hospital waste only. A full survey was carried out where the infectious hospital waste was characterized both quantitatively and qualitatively. The results are shown in Tables 4, 5, and 6.

Material	**Percentage (wet-weight basis)**
Paper	34%
Plastics	46%
Glass	7.5%
Metals	0.4%
Anatomic waste	0.1%
Liquids	12%
Others	0.1%

Source: Liberti et al., 1994.

Table 5. Average composition of hospital waste in Italy

Calorific value (dry)	5370 k cal/kg
Calorific value (wet)	3900 k cal/kg
Chlorine	0.42%
Mercury	2.41mg/kg
Cadmium	1.53mg/kg
Lead	28.84mg/kg

Source: Liberti et al., 1994.

Table 6. Physico-chemical results (excerpts)

In recent years a wholly new phenomenon has developed with the indiscriminate discarding of sharps in public places (for example, toilets at motorway service stations, railway stations, places of entertainment) by drug abusers. Public authorities and those working in the field of drug misuse are aware of the problems caused by the casual disposal of injecting equipment and have established a growing network of places where such items can be disposed of safely, including various drug agencies, needle exchange schemes, and local community pharmacies. The problem is unlikely to disappear and may become more widespread.

Products used for human hygiene such as nappies, incontinence pads, and sanitary towels can accumulate at a particular location, and this is a matter of some concern. Nappy changing can take place at motorway service centers, airports, and large department stores. Nappies are also generated at nurseries, just as incontinence pads may be at residential homes for the elderly. Aggregated materials containing blood, human excreta, or other body fluids are considered by consultant microbiologists to be hazardous. As pathogenic viruses and bacteria may be excreted in the faeces and urine of healthy adults and babies, and some viruses may be present in menstrual blood, conditions may be created where they can continue to survive outside the body. In these cases special attention is clearly warranted and arrangements need to be made for their storage, handling, and disposal.

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Biographical Sketch

William K. Townend OBE, MPhil., F.Inst.Wastes Management, has had over 37 years professional experience in the waste management industry as both an operator and a regulator. He is the current President of the UK Institute of Wastes Management and was, until February 1998, Senior Adviser in the Waste Management and Regulation Policy Group of the Environment Agency for England and Wales. He is also Joint Deputy Chairman of the UK Waste Management Industry Training and Advisory Board. He has had considerable national and international experience in healthcare waste management and led the Clinical Waste Enquiry in London (CWEL) from 1987 to 1989, which produced Guidelines for Clinical Waste Management that were adopted nationally. Working with the World Health Organisation (WHO) and other international aid agencies, he has carried out healthcare waste management assignments in Hungary, Palestine, Jordan Argentina, Portugal, and Turkey. In 1996 he was instrumental in forming the International Solid Waste Association's (ISWA) Working Group on Healthcare Waste, becoming its Founder Chairman. He was the WHO representative on the European Commission's Priority Waste Stream Project on Healthcare Waste.

Key publications are: joint author of the WHO publication *A Teachers Guide to Management of Waste from Healthcare Activities*; The evolution of the UK system for education, training and competence in the waste management industry, *Waste Management and Research* **17**(2) (April 1999), and *The Implications of Sustainable Development and the Zero Option for Healthcare Waste* (International Solid Waste Association Annual Congress, Yokohama, Japan, October 1996).