11 Costs related to health-care waste management

11.1 Principles

According to the "polluter pays" principle, each health-care establishment should be financially liable for the safe management of any waste it generates. The costs of separate collection, appropriate packaging, and on-site handling are *internal* to the establishment and paid as labour and supplies costs; the costs of off-site transport, treatment, and final disposal are *external* and paid to the contractors who provide the service.

The costs of construction, operation, and maintenance of systems for managing health-care waste can represent a significant part of the overall budget of a hospital or health-care establishment. They should be covered by a specific allotment from the hospital budget. The total costs are generally made up of the elements listed in Box 11.1, all of which have to be carefully considered if the most cost-effective option is to be selected. Certain basic principles should always be respected in order to minimize these costs:

- Waste minimization, segregation, and recycling, as recommended in Chapters 6 and 7, can greatly reduce disposal costs. The benefits of producing less waste are evident, and segregation prevents the unnecessary treatment of general waste by the costly methods necessary for hazardous waste.
- Designing all elements of the system to be of adequate capacity will obviate the need for subsequent costly modifications.
- Future trends in waste production and the likelihood of legislation becoming more stringent should be foreseen.

The financial resources available from the public and private sectors will necessarily influence the choice of system and the standards of operations.

11.2 Methods of financing

Funds may come from the private sector or from one or more levels of government. For government-owned health-care establishments, the government may use general revenues to pay the cost of the waste management system. For private health-care establishments, the government may impose direct regulations, requiring them to implement their own waste management systems, compelling them to use public facilities, or allowing them the choice (as happens in the USA). These regulations may also impose limits on certain disposal options or specify the required treatment technology and standards of operation.

Over the past few years privatization has been increasingly adopted in a number of countries as an alternative method of financing various types

Box 11.1 Total costs of a waste management system

- Initial capital investment.
- Amortization over the effective life of plant and equipment.
- Operating costs for such elements as as labour and consumables.
- Utility requirements (fuel, electricity, water, etc.).
- Contractual and overhead costs.

of public works, including health-care waste management. Under such an arrangement a private entity finances, designs, builds, owns, and operates the treatment facilities and sells its collection and disposal services to government and private health-care establishments. It may be a desirable option, particularly for treatment methods other than incineration. The following are probably among the main reasons for considering privatization:

- inability of hospitals to raise the needed capital;
- expected greater efficiency in the private sector because of fewer constraints than in the public sector (e.g. greater flexibility in purchasing and personnel policies, allowing for more rapid adaptation to changing needs);
- transfer of responsibility for proper operation and maintenance to an organization with more resources for minimizing risk.

A disadvantage of privatization is the potential loss of overall control by the responsible public agency. It should be possible to minimize this by addressing the following issues in the agreement between the private operator and the public agency:

- minimum level of service, especially with regard to reliability, safety, public health risks, and future expansions;
- future increases in costs resulting from factors that cannot be fully assessed at the outset;
- environmental concerns;
- future transfer of ownership of the facilities;
- regular inspection and regulatory control.

The feasibility of cooperation between local health-care establishments should be explored as another means of minimizing costs.

11.3 Cost estimation

All hospitals need to establish accounting procedures to document the costs they incur in managing health-care waste. Accurate record-keeping and cost analysis must be undertaken by a designated individual. Health-care waste costs should be the subject of a separate budget line; this allows costs for different periods to be compared and helps to reduce management costs.

Box 11.2 Costs of construction and operation of a health-care waste incineration plant

Site
Cost of land
Rights of way
Site preparation and infrastructure
Provision of utilities to site

Consultancy fees
Environmental/waste management consultant
Engineering
Architectural
Legal fees

Construction costs
Incinerator building
Waste storage room
Offices

Incinerator
Cost of incinerator
Freight and storage charges

Waste transport costs
Waste collection trucks
Bins/containers for transporting waste from hospitals to incinerator site

Equipment costs
Trolleys for collecting waste bags from wards
Bag holders to be located at all sources of waste in hospitals
Weighing machines for weighing waste bags
Refrigerators for storage of waste if necessary

Financing charges
Interest
Taxes
Accounting and audit fees

Direct operating costs
Manpower requirements (manager, operators, drivers, . . .)
Yellow bags with tags for infectious wastes
Black bags for non-risk waste
Sharps containers
Transportation costs
Utilities (fuel, water, electricity)
Chemicals (for flue-gas cleaning)

Indirect operating costs
Training
Incinerator maintenance and parts replacement
Vehicle maintenance
Uniforms and safety equipment
Ash disposal cost
Compliance monitoring of flue-gas emissions
Project management and administrative costs for the organization responsible for the execution and long-term operation of the project

Box 11.2 lists the elements that should be included in the cost assessment for—in this example—a health-care waste management system comprising an incineration facility.

If a waste treatment project is undertaken by a private concern, charges for the service should be computed, so that all costs can be recovered from those using the services, i.e. both government and private health-care establishments. To ensure that the project is self-supporting, charges should reflect the full cost of operations, maintenance, depreciation, debt

amortization, and interest. The inclusion of an amortization factor ensures the availability of funds for future plant and equipment replacements. If the charges levied do not cover all costs, the system will need to be subsidized and a financing plan should be designed accordingly.

Examples of investment costs of various types and sizes of incinerators available in southern Asia are shown in Table 11.1, waste disposal costs of Hungarian health-care establishments in Table 11.2, and costs of different treatment methods in Switzerland in Table 11.3. Box 11.3 lists additional examples of cost components.

More details on approximate costs of pyrolytic incinerators are provided in Table 8.1 (page 84).

Table 11.1 Investment costs for incinerators, southern Asia[a]

Capacity	Equipment	Costs (US$)
50 kg/day	Manual loading, manual de-ashing, one combustion chamber, without flue-gas cleaning	20 000
100 kg/day	Manual loading and de-ashing, secondary combustion chamber (temperature >1000 °C, residence time >1 s), without flue-gas cleaning	200 000
100 kg/hour	Mechanical loading and de-ashing, secondary combustion chamber (temperature >1000 °C, residence time >1 s), without flue-gas cleaning	400 000
200 kg/hour	Automatic loading, mechanical de-ashing, secondary combustion chamber (temperature >1000 °C, residence time >1 s), with flue-gas cleaning	800 000
400 kg/hour	Automatic loading and de-ashing, secondary combustion chamber (temperature >1000 °C, residence time >2 s), with flue-gas cleaning and emission monitoring	1 700 000

[a]Source: WHO (1994). *Regional guidelines for health care waste management in developing countries.* (Working document used at the WHO Regional Workshop on Clinical Waste Management, Kuala Lumpur, 28 November–2 December 1994.) Kuala Lumpur, World Health Organization Western Pacific Regional Environmental Health Centre.

Table 11.2 Examples of total health-care waste disposal costs, Hungary

Hospital	Beds	Treatment	Tonnes/year	Costs (US$/tonne)
Hospital A	2196	On-site	110	55
Hospital B	350	On-site	20	73
Hospital C	300	Off-site	0.2	111
Hospital D	300	On-site	9	104
Hospital E	70	Off-site	4.5	100

Table 11.3 Examples of health-care waste treatment costs, Switzerland

Treatment method	Costs (US$/tonne)
Pyrolytic incineration	380
Wet thermal disinfection	400
Chemical disinfection	200

Box 11.3 Examples of cost components of health-care waste management

Tunisia
- Cost of 1 hospital cleaner: US$ 240–300 per month.

France
- Average cost of health-care waste management according to European Union quality standards: US$ 1–3 per bed per day
- Personnel required: 1 cleaner per 30 beds, 1 waste operator per 175 beds
- All-inclusive personnel costs: US$ 28000 per operator per year
- Supplies costs:
  — plastic bags: US$ 0.2–0.6 each
  — small sharps containers: US$ 2 each.

11.4 Recommendations for cost reductions

Cost reductions can be achieved by taking particular measures at different stages in the management of wastes:

On-site management
- Comprehensive management of chemicals and pharmaceuticals stores.
- Substitution of disposable medical care items by recyclable items.
- Adequate segregation of waste to avoid costly or inadequate treatment of waste that does not require it.
- Improved waste identification to simplify segregation, treatment, and recycling.

Comprehensive planning
- Development and implementation of a comprehensive health-care waste management strategy, within the framework of the hospital waste management plan, which includes the above recommendations.
- Planning collection and transport in such a way that all operations are safe and cost-efficient.
- Possible cooperative use of regional incineration facilities, including private sector facilities where appropriate.
- Establishment of a wastewater disposal plan.

Documentation
- Waste management and cost documentation: assessment of the true costs makes it easier to identify priorities for cost reduction and to monitor progress in the achievement of objectives.

Choice of adequate treatment or disposal method
- Selection of a treatment and disposal option that is appropriate for waste type and local circumstances.
- Use of treatment equipment of appropriate type and capacity.

Measures at personnel level
- Establishment of training programmes for workers to improve the quality and quantity of work.
- Protection of workers against occupational risks.