Chapter 6
Comparisons of Treatment Alternatives

However great the achievements of reduction and recycling efforts, there will continue to be a need for effective treatment and disposal for wastes that cannot be recycled. Although incineration remains, and is likely to continue to remain, a primary treatment method for medical wastes for the foreseeable future, a number of other treatment alternatives are available and will supplement incineration technology. As concerns over the cost, safety, and permitting/siting of incineration facilities continue, so too will the favorable climate for emerging nonincineration technologies. New variations of autoclave, mechanical/chemical, radiation, and microwave treatment methods are now commercially viable. Other emerging technologies are in the testing or even conceptual stages. Currently, States play the critical role in evaluating and approving alternative treatment technologies. Inconsistencies exist among the States and increasingly Federal guidance on evaluation and approval of treatment alternatives is suggested as necessary and desirable (e.g., suggestions of participants at the OTA Medical Waste Workshop, 1990).

An important given when comparing alternatives is that whatever treatment alternative is used, some form of additional solid waste disposal must occur. In all cases, ultimately, some degree of dependency on landfills remains. For medical waste incineration, the ash becomes a waste product requiring landfilling. For autoclaving, microwaving, and irradiation either incineration and/or landfilling is necessary. The residue from the chemical/mechanical treatment alternative will be discharged to the sewer or landfilled. The difficulty of landfilling even *treated* medical wastes, given refusals by some landfill operators, remains a significant obstacle for management in some areas of the country. Interstate shipment and international exportation of solid waste, including medical wastes, is an emerging environmental and political issue nationally (116).

Valid comparisons of various treatment alternatives for medical wastes are problematic because different types of treatment goals are served by different technologies (e.g., the goal can be treatment to render wastes noninfectious; or noninfectious and nontoxic; or noninfectious nonrecognizable, and/or nontoxic). This means that different techniques may be appropriate for different waste types. Treatment alternatives will differ in the nature of the emissions that warrant test protocols, control measures and operating parameters specific to each technology.

Obviously, costs and risks associated with the alternatives will vary. Further, a number of considerations concerning liabilities and costs influence generator decisions about on-site versus off-site treatment. Treatment alternatives are more easily scaled to various types and sizes of facilities. Comparisons between off-site and on-site applications of various alternatives can also be problematic. With all of these differences, clearly, comparisons of the treatment technologies must be made carefully. Such comparisons are imprecise, but helpful in highlighting the various features and considerations associated with the alternative treatment technologies.

CAPABILITIES AND RISKS

Table 8 compares the various treatment technologies discussed in chapters 3 and 4. **All of these treatment alternatives can effectively manage most infectious wastes; the only ones that are usually used to treat pathological waste are the incineration and mechanical/chemical disinfection systems.** Depending on the type of incinerator and the nature of its controls, incineration is the one treatment alternative that could manage all of a health-care facility's wastes, i.e., pathological and other infectious, hazardous (possibly, depending on the design and controls of the incinerator), administrative, food, and other non-patient wastes.

From other perspectives, nonincineration alternatives may have advantages over incineration. In general, there are more serious emissions concerns associated with incineration than most alternatives. Yet, it is true that because incineration is a more established technology, emission concerns have been more clearly identified. The human health and environmental risks may be presumed to be less from nonincineration treatment alternatives but additional study, particularly of water effluents from some of the systems, is necessary. Generally, health risks associated with the various treatment technolo-

Table 8—Comparison of Treatment Technologies

Treatment technology	"Regulated medical wastes" appropriate for treatment method to render wastes non-infectious	Volume reduction (%)	Costs (approximate)[d]	
			Operating or per pound charges (not including labor; depreciation; profit/return) ($/lb./hr.)	Capital (equipment and installation) ($ K)
Steam autoclave	All, except pathological	0	$0.05-$0.07	$100 K (on-site)
Autoclave with compaction	All, except pathological	60-80%	$0.03-$0.10	$100 K
Mechanical/chemical	All	60-90%	$0.06	$40-350 K
Microwave (with shredder)	All[a]	60-90%	$0.07-$0.10[b]	$500 K
Irradiation (with grinder)	All, except pathological	60-90%	$0.15	Not available
Incineration	All[c]	90-95%	$0.07-$0.50	$1,000 K (on-site)

[a]Pathological wastes are usually not treated by microwave due to esthetic reasons. Cytotoxical or other toxic chemicals cannot be adequately treated to reduce their hazardous nature.
[b]Including an energy cost of $0.07/kWh.
[c]Although separation of non-combustibles and items with problematic constituents improves combustion efficiency (see ch. 3).
[d]Reliable cost information is difficult to obtain and verify. Further, valid comparisons are difficult to make given the different circumstances under which various technologies operate (e.g., amount of waste treated and its effect on costs, etc.)

SOURCE: Office of Technology Assessment, 1990.

gies have not been thoroughly studied. Presumably, pollution controls could adequately control pollutants of concern for both nonincineration and incineration alternatives. Of course, the more pollution controls necessary, generally, the more expensive the treatment.

COSTS

The concern that the already generally precarious economic state of the health-care industry could be jeopardized by further regulation of medical waste management warrants examination. Presently, the exact amount a health-care facility spends on medical waste management is often not known with certainty even by the facility's management. The additional cost that new controls, alternative treatment technologies, or management practices might entail can not be accurately assessed unless current costs can be understood with some certainty.

Available cost estimates for various treatment technologies indicate that on-site incineration can be comparable or significantly higher in costs than other *on-site* alternatives (30; 104). While costs for on-site alternatives can be estimated fairly constantly, the same is not true for off-site alternatives. OTA contractors found from informal discussions with generators of medical wastes and operators of medical waste services throughout the country that the price charged for any type of *off-site* treatment is never determined solely on the basis of costs, but rather by "what the market will bear." Given that it is a highly competitive industry, this does not necessarily mean that off-site waste facilities reap an unusually high profit, but, as noted in chapter 3, the medical waste industry is healthy.

It appears that hospitals and other health-care facilities eligible to receive Medicare reimbursement can theoretically be reimbursed for some on-site medical waste management costs. Although there is no specific category for waste management reporting, some percentage of capital costs and some operating costs could be covered (54). In the State of New York the eligibility of health-care facilities for Medicare reimbursements for some on-site medical waste costs (and regional utilization of an on-site hospital treatment facility) is explicitly addressed by the Department of Health (85). Although no hospitals have been known to request Medicare reimbursement to date, it was part of the New York State legislative debate over increasing the reimbursement rates for hospitals (80).

Other types of grants offered by some State energy offices, such as those that will cover some portion of the capital costs for waste-to-energy facilities, may also reduce a facility's share of costs for this type of incineration (31). For example, in New York State, a proposed Environmental bond issue, which will be on the ballot in November 1990, will provide $50 million in State assistance for regulated medical waste projects. The grant program would be administered by the State Department of Health and would provide funding for up to 50 percent of the project costs. To be eligible, a facility must participate in a waste audit and must develop

a plan for recycling, product reuse, and waste reduction (94).

The volume of waste handled by a treatment unit and its effect on the operating cost of the unit is highly variable, but generally costs are lower for on-site incineration and nonincineration alternatives. The capital costs associated with incineration are significantly higher than those for most alternative treatment technologies. Yet, heat recovery (and, as noted, programs that will reimburse up to half the capital costs for waste-to-energy facilities) and efficient operation (e.g., including recycling in conjunction with incineration) may reduce incineration costs to the facility and result in a more favorable cost comparison of incineration to the other technologies (31). Nonetheless, the potentially high cost of disposal of incinerator ash, if it is classified as a hazardous waste, is also a potential significant cost factor associated with incineration that must be considered. Other factors that affect costs, such as reduced cost of transportation, reduced disposal costs, and reduced liability, are relevant to a decision to manage wastes on-site v. off-site.

Costs, even so, are only one of a number of factors (e.g., nonrecognizability, liability, and ability to render wastes non-infectious) that health-care facilities consider when deciding what type of treatment alternative to use and whether to manage wastes on-site or off-site. Clearly, a facility may be able to reduce its costs and liability and have greater control by managing wastes on-site; however, on-site management also represents a major institutional commitment of resources to waste management, which is not the primary function of the health-care facility. As has been noted throughout this report, a number of factors favor off-site treatment as well.

Ultimately, each generating facility must weigh the various factors and determine which waste reduction and management alternatives are most appropriate for its circumstances. Public policies should recognize and not preclude the variable solutions necessary to meet individual generators' waste management needs. In addition, medical waste policies should help through the use of some sort of protocols to reduce uncertainty over the reliability and safety of various treatment alternatives.

It remains to be seen what direction Congress and Federal agencies, and the medical and health-care industry and community will define for medical waste management. It will be important, though, that any legislative or regulatory activity acknowledges and appropriately addresses the variety of management issues and available treatment technologies discussed in this report. Experiences with management of other components of our society's wastes indicate that effective waste management is based on a recognition that there are a variety of viable management options available and appropriate to meet particular site-specific circumstances, and prevention or reduction and recycling efforts are included in these options. Adopting a more comprehensive approach to medical waste policy may offer the greatest prospect for adoption of a program that will ensure the safe, cost-effective management of medical wastes.