Medical Waste Treatment Technologies:

Evaluating Non-Incineration Alternatives

A Tool for Health Care Staff and Concerned Community Members

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HEALTH CARE WITHOUT HARM • THE CAMPAIGN FOR ENVIRONMENTALLY RESPONSIBLE HEALTH CARE

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INTRODUCTION

Historically, many hospitals with on-site incinerators burned not only the infectious portion of their waste stream, but also solid waste and recyclable materials such as paper and cardboard.[1] Public concerns about incinerator emissions, as well as the creation of federal regulations for medical waste incinerators, are causing many health care facilities to rethink their choices in medical waste treatment technology.

One of the guiding principles of the Health Care Without Harm (HCWH) campaign is the commitment to eliminate the non-essential incineration of medical waste and promote safe materials use and treatment practices. Regulated medical waste (RMW), also called infectious waste, requires disinfection prior to disposal in a landfill. HCWH is committed to helping hospitals identify the waste considered to be regulated medical waste in order to minimize the environmental and human health impacts of treating that waste.

The Association of Operating Room Nurses has crafted a definition of regulated medical waste that includes four categories of waste: sharps (used and unused), cultures and stocks of infectious wastes, animal waste and selected isolation waste.[2]

According to the Centers for Disease Control and Prevention, "Hospital wastes for which special precautions appear prudent are microbiology laboratory waste, pathology waste, bulk blood or blood products, and sharp items such as used needles or scalpel blades. In general, these items should either be incinerated or decontaminated prior to disposal in a sanitary landfill."[3] The infectious or regulated medical waste stream accounts for about 15 percent of total hospital waste, while pathological waste is about two percent. In order to protect public health, decontamination is required, but incineration is not a federal legal requirement. (Individuals should check state and local regulations regarding pathological waste and chemotherapy drugs.)

REVIEWING ALTERNATIVES

Waste treatment is but one small piece of a much larger system of purchasing and materials management that determines the overall environmental and health impacts of a health care facility. In addition to regulated medical waste, health care facilities can be expected to generate recyclable materials, which may be handled by a single hauler or collected as individual commodities (e.g., cardboard, aluminum, glass); food waste, which may be composted or discarded with solid waste; solid waste, which is handled like municipal trash; hazardous waste, which must be handled according to federal regulations; radioactive waste, also subject to federal rules; and pathological waste (tissue, body parts, etc.) The types of care the facility provides, as well as purchasing choices (reusable versus disposable items, packaging), affect the amount and toxicity of the wastes generated.

It seems certain that, given aggressive waste minimization and pollution prevention practices in the health care facility and the treatment options available that don't involve combustion, there must be less toxic, equally cost-effective ways to treat medical waste. Thus, the Health Care Without Harm campaign decided to investigate those non-incineration options.

Non-incineration treatment technologies are a growing and developing field. Some technologies are still essentially prototypes, while others, such as autoclave technology, have been used for decades. Studies are being done of virtually all the technologies to assess safety, emissions, ease of operation, and reliability. For example, the Underwriters Laboratories are creating safety standards for non-incineration technologies.[4] One thing is clear and must always be addressed before assessing any technology: "What goes in, must come out (or up)." Careful waste segregation and management programs, as well as attention to materials purchased, are essential in minimizing the environmental and health impacts of any technology. These issues must be included in any analysis of alternatives.

As stated earlier, Health Care Without Harm does not support the incineration of solid waste or infectious waste. Infectious waste should not be disinfected or sterilized in order that it may be sent to a municipal solid waste incinerator. (For more information about HCWH's concerns about incineration, see Appendix A.)

Health Care Without Harm does not endorse any technologies. We do not recommend that this checklist serve as the sole means of evaluating any technology, but instead hope it will be used to obtain information and to support informed decision-making.

CONSIDERATIONS FOR MANAGING HOSPITAL WASTE

Health care facilities, including hospitals, clinics, doctors, dentists, morgues, or veterinary offices, generate a tremendous amount of waste in the course of treating patients. They generate "regulated medical waste" or infectious waste, hazardous chemical waste, recyclable, reusable and solid waste. In order to fulfill the medical ethic to "do no harm," it is the responsibility of the health care industry to create and implement waste disposal polices for all of these waste streams that include worker safety, public health and environmental considerations, as well as regulatory compliance. Fulfilling this ethic also calls for a cultural shift to consider disposal technologies and services as part of a total waste management system. This system should include upstream waste management (elimination or minimization of some wastes, reuse and recycling of others) and the proper, accountable operation of all disposal equipment, post-treatment technology management and services (e.g., shredding, landfilled material, incineration ash, air and water emissions).

In the United States, regulated medical waste — about seven to fifteen percent of the total waste[5] — must be treated in order to protect public health from the spread of potentially infectious diseases. But many facilities, particularly those with medical waste incinerators on-site, have routinely burned most or all of their waste (with the exception of hazardous chemicals, which would be illegal). Incineration, as previously stated, has significant health and environmental impacts. There are alternative treatment technologies that render the waste non-infectious and are believed to be less harmful.

Furthermore, much of the waste produced in health care facilities resembles household trash. Therefore, it is not unreasonable to expect that at least 30 percent of this waste can be recycled, reused, reduced or eliminated, and up to 50 percent reduction could be achieved with aggressive actions. Tossing resources in the trash is not only a waste of resources, but can be extremely expensive. The economic benefits to managing and reducing the waste can have a significant benefit to the health care facility's overall costs. A case in point: Beth Israel Medical Center in New York City has found that a combination of employee education, monitoring of the waste stream and strategic placement of "red bag" waste containers has cut the facility's medical RMW disposal costs by 60 percent.[6]

In order to give full consideration to the effects of the waste it generates, the health care industry should reconsider its environmental and waste impacts. These issues must be included in facility-wide policies—the culture around trash and environmental programs must be institutionalized. Pollution prevention, recycling, reuse, environmental procurement, safer disposal choices—these programs will not only benefit the environment and the health of the community, but will provide cost-effective care and instill in healthcare workers a sense of pride and commitment to the delivery of effective care while doing no harm.

QUESTIONS TO ASK BEFORE CONSIDERING ANY TREATMENT TECHNOLOGIES

The decision about which medical waste treatment technology to utilize is a complicated process and goes far beyond cost considerations.

The following list of questions is designed to help health care decisionmakers identify criteria to be evaluated and information needs to be addressed when deciding what technology and/or disposal services to use.

This checklist may also help to increase overall awareness of environmental, economic and worker safety and health considerations.

Decisions about the type of waste treatment technology chosen often have significant impacts on the surrounding community, and the community should be well informed so that they may participate fully in siting discussions and technology choices.

The objective of this checklist is to provide a basic set of questions that should be considered. The health care facility or community might have specific issues that these criteria do not address.

Using this list: Many of the following questions are addressed to health care facility staff who will be involved in technology selection and possibly even maintaining and operating the equipment. However, in discussing concerns about waste treatment and disposal, concerned residents are encouraged to confirm that the healthcare staff are addressing the range of the issues mentioned below.

The questions can also be used as an opportunity to bring together health care decisionmakers and community members to discuss which criteria are most important to their respective constituencies and to identify areas of common concern or conflict.

Waste Management in Health Care Facilities - Past, Present and Future

WASTE SEGREGATION PRACTICES

Properly sizing your equipment has cost, labor, facility and operational implications. If you size your equipment prior to waste segregation and minimization activities, you may purchase more capacity than you need. Consider your current practices. If significantly more than 15 percent of your facility's waste is considered regulated medical waste, you may have opportunities for reductions.

- Has your facility done a comprehensive audit of all of the various waste streams and products/supplies purchased to better identify impact on disposal systems and services?

- Does your facility have or plan to implement aggressive waste and pollution prevention, reuse and recycling programs as part of this process? This includes defining waste streams, providing clearly designated waste containers and signage for different waste streams, and educating staff on the proper waste segregation.
- Can your facility's waste streams be separated by type (e.g., corrugated cardboard, office paper, aluminum cans, food waste)? Have the volume and weight of each waste stream been measured or estimated?
- Can your facility's staff identify from which departments or areas of the facility certain types of waste are more common? And which have the greatest potential for reduction or elimination?
- Has your facility considered a facility-wide computerized tracking system to help identify waste streams and assist in the waste segregation program?
- Are all employees trained to identify infectious and hazardous materials and dispose of them according to safety and disposal regulations?
- Does your facility use mercury-containing products? If so, what steps are being taken to ensure that mercury is not being disposed with infectious or solid waste?
- Does your staff know the procedures for handling and disposal of low level radioactive wastes? Do the loading dock and/or packaging areas have functioning equipment to detect, prior to disposal, any low-level radioactive wastes (LLRW) that were discarded?
- Does your facility have a recovery program for utensils and surgical instruments? (Loss of these items can be a substantial annual avoidable cost. Some waste companies can provide this additional recovery and sterilization service.)
- Does your facility have a battery recovery program?

ORGANIZATIONAL/STAFF ISSUES

Most facilities undertaking a comprehensive approach to managing their waste have an infrastructure to facilitate the program.

- Has a task force been identified in your facility to examine current waste treatment and disposal technologies and become informed, "in-house experts" on available options? Are members of the following departments represented: administration, infection control, engineering, health and safety, laboratory staff, physicians, nursing, housekeeping and environmental services, procurement/ contracts/ purchasing, and union representatives?
- What education needs to happen to change historical or cultural habits for current disposal systems and waste services?
- What level of commitment is your facility willing to undertake to ensure all parameters will be considered?

FACILITY AND OPERATIONAL ISSUES

The type of treatment technology chosen will most likely affect current practices and procedures in your facility's waste management operations. This includes labor considerations, waste handling practices, implications on physical space, loading docks, all utility costs, trucking and transportation. The decision to go with on-site or off-site treatment involves at least some of the considerations listed below. Questions listed under on-site treatment should also be asked of your off-site treatment vendors. Some issues are joint considerations.

- Does your facility currently have the labor and staff expertise to maintain the equipment, or would additional training be needed?
- Does your facility have the physical space and adequate facility design? (e.g., if you are using offsite treatment, is your facility already equipped with adequate storage space, loading docks, etc.?)
- Are off-site treatment options limited, expensive or does your facility have concerns about the local options? (e.g., the local commercial treatment facility has numerous emissions violations; your hospital/clinic is in a rural area and the nearest commercial treatment facility is hundreds of miles away.)
- Cost

ON-SITE TREATMENT TECHNOLOGY ISSUES

- How important is volume reduction in choosing a technology? What is the ratio of waste produced by your facility to the waste treated by the treatment technology? Is the technology dependent on a certain volume of material?
- How would waste reduction programs affect the process? If the waste volume changes radically for any reason (e.g., reduced patient-days, merger, better waste minimization efforts), will this technology still meet the treatment needs?
- Have staff from your facility talked to colleagues at other facilities about their disposal options, made comparisons, discussed technologies, contracts and services, as well as violation histories and ranges of service costs?
- What is the local and state regulatory climate for onsite treatment technologies? (Some types of technologies require more complicated permits than others. Incinerators typically have more complex—and thus expensive—permits than most autoclaves, as an example). Does your facility have staff on-site who are trained and certified to fulfill the testing requirements, time, etc., involved in these permits? If not, consider those staffing and testing costs in your evaluation.
- How long has the treatment technology been in use, and where? Has your facility's staff researched the various vendors within a type of technology (e.g., autoclaves, microwaves, chemical treatment)? Will the vendor give you a list of references to contact?
- What is the estimated "life" of this equipment?
- What volume of waste can the technology treat? Will it always be operating at peak capacity, or will there be wide variations in the amount of waste treated?
- What are the operational cost implications of using this technology? What are the environmental and fiscal impacts of utilities usage (electricity, water and sewer)?
- What is the safety and repair history of the waste disposal equipment?
- What worker safety and ongoing equipment education is required and who provides it?
- What are the cost(s) of equipment failure and need for a back-up or alternative system?
- Is waste fed into the treatment system automatically (by machine) or by hand (stop feed)? What impact does this have on your facility's staff limitations?
- Can equipment repair be completed within 24 hours without an emergency clause and/or additional costs?
- Does the technology require ancillary equipment such as shredders? Are they an integral part of the treatment process? Does the landfill require them? What are the total associated costs for this equipment? Are there any worker-safety concerns with this equipment?
- How is the volume and weight of the waste measured with the disposal equipment? Who measures it? Is it cost-effective to weigh the wastes on-site?

MANAGEMENT OF SHARPS AND SPUTUM CANISTERS

- How are sharps treated in your facility? Has your facility considered a sharps container reuse program? How would this impact the disposal system? How does the waste treatment technology your facility is considering handle sharps?
- How are sputum canisters treated in your facility? How does the waste treatment technology your facility is considering handle them?

OFF-SITE TREATMENT ISSUES (COMMERCIAL TREATMENT FACILITIES)

- What are the line-item transportation costs for intra- or interstate taxes, tipping fees, etc?
- How many trucks will enter and leave the facility daily? Will traffic vary by day of the week, or remain fairly constant?
- From what geographic area will waste be accepted? What sort(s) of waste?
- Is it possible to bargain collectively with area healthcare facilities for RMW treatment waste disposal services?

- Are there any violations against the treatment site your facility is considering? Is that facility fully permitted? Are there any community concerns about the facility?
- Have staff from your facility or a contracted consultant visited the waste treatment site for a comprehensive audit and evaluated environmental health and safety and operational issues?
- Are there any community or environmental health concerns associated with this off-site facility? If so, in what ways could the health care facility facilitate positive changes and reconciliation of those concerns?

COST

There are cost issues associated with every type of treatment technology. When summarizing cost implications for each treatment and disposal option, also consider the following issues:

- Capital equipment costs;
- Installation and facility costs: installation labor, facility modifications - cement pad(s), curb cuts, sewers, electricity, space, security, etc.;
- Direct labor costs: number of employees needed to operate the RMW treatment and disposal equipment;
- "Down time" costs: including repair (parts and labor), and alternative treatment;
- Utility costs;
- Permitting and compliance fees: water and air testing fees should be included in annual operating costs. For comparison purposes, testing fees for incinerator ash should be included;
- Fines: depending upon permitting requirements and state and federal regulations, violations of permits or emissions may result in fines;
- Compare cost per-ton of disposal for each technology under consideration. If your facility is currently using on-site or off-site incineration, be sure to include ash disposal in your estimate of current costs to contrast with potential future costs of new technology. Regular testing of incinerator ash may designate periodic loads to be hazardous and must be sent out as hazardous waste. Estimate at least an annual occurrence;
- All transportation, processing and tipping fees;
- Supply costs - personal protective equipment, spill supplies, special bags (for example, some autoclave systems require particular bags), collection containers (boxes or reusable containers);
- Indirect costs/benefits - community satisfaction, environmental leadership.

ENVIRONMENTAL AND ETHICAL AND COMMUNITY ISSUES

- What are the organic and inorganic emissions to the environment and to what media (air, water, land)? Dioxin and mercury are examples of such emissions. In what volume are these pollutants released?
- Which emissions are regulated and by which authorities? (Local, state or federal regulators may monitor different pollutants. Total emissions of any pollutant should be considered, not only releases to one medium, such as air.)
- Of the emissions that have been identified, which, if any, are harmful to human health or the environment? What are those effects (such as cancer, hormone disruption, reproductive effects or cumulative impacts)?
- What is the reputation and reliability of the waste disposal company, and/or treatment technology?
- Should facility waste be disposed outside of the city/county/state in which it is generated if there is an economical alternative?
- What opportunities have been provided for community input into the waste treatment decision process?
- Does the treatment process produce odors? Has the facility documented all available options to reduce odors and related complaints?
- How many years is the facility scheduled to operate?
- How will the surrounding community be informed of any accidents or emissions violations from the treatment facility?
- Will the facility increase traffic in the neighborhood (e.g., through trucks hauling waste, chemicals, etc.)?

- Is the technology noisy (for workers as well as the community), and how is this defined and documented?
- Is a permit for the treatment facility issued only once, or is it periodically reviewed, with opportunity for renewed public input?
- What are the zoning issues related to the project?
- Are there other facilities in the community or neighborhood that pose the same or similar problems as those of the proposed treatment technology?

REGULATORY AND COMPLIANCE ISSUES

- What permits does the technology require in order to operate?
- Is a public hearing required?
- Does everyone working on waste issues in the facility know the pertinent federal, state, county or city regulations and are they working to maintain compliance?
- What pollution control equipment is required for this technology? Is there additional equipment that is available to reduce environmental emissions? What equipment will be used to monitor emissions, and how often?
- Can the facility and surrounding community's sewer or septic system handle the waste treatment equipment's discharges?
- Has someone at your facility estimated the cost(s) associated with environmental, health and safety violations related to prospective waste disposal equipment?
- What are the estimated costs for emissions testing, liability, violations and clean-up?

HAZARDOUS WASTE MANAGEMENT

- What residuals (waste still left after treatment) remain when the treatment process is complete? Can all potential residuals be fully identified before disposal? Will any require treatment as hazardous waste? What are the estimated costs associated with this disposal? What is the liability attached to this residual waste?
- If chemicals are used to treat the waste, are they hazardous by themselves? If so, what are the potential health and environmental impacts for the workers and the community? Does someone in your facility know what potential reactions may occur from a combined mix of facility wastes and sewer disposal wastes?
- Does the production of any chemical required by the treatment process have harmful environmental or health impacts?
- Does the treatment process release radioactive isotopes? If so, how are those isotopes contained?

VENDOR ISSUES

- Does the vendor (of the equipment or waste hauler) or any of its subsidiaries or contractors have any violations (environmental, criminal, etc.)? If so, how have those violations been handled?
- Is the vendor willing to meet with your facility's staff committee to answer specific questions about the equipment and technology?

CONTRACT ISSUES

- Has your facility reviewed current contracts, whether in a Group Purchasing Organization (GPO) or not, to better understand disposal options, obstacles and potential discussion areas from a waste and energy perspective?
- Has your facility's staff discussed the length of contract that best suits your needs? How does that compare with the contract being offered?
- What is the waste management plan/back-up service option for down times? Is there an extra fee, or is it part of the contract?
- Have current waste service contracts been reviewed and rewritten for educational, health and safety standards, and to maximize reuse, recycling, and recycled-content?
- What contract constraints are negotiable in order to get the best equipment and services for your facility?
- What is the length of the contract? Is it a "put or pay" contract, (i.e., one that guarantees the health care facility will supply a certain amount of waste or pay to make up the difference)?

Please keep in mind that there may be additional issues that are not raised here but may be very important to your health care facility or your community. These questions are meant to help people identify and prioritize issues of concern, as well as to stimulate the collection and release of new data about non-incineration technologies to the health care industry and the public.

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APPENDIX A

Why is Health Care Without Harm Opposed to Incineration?

We have several concerns regarding the burning of waste generated by health care (both solid waste and regulated medical waste).

- Incineration produces both toxic air emissions and toxic ash residue.[1] The air emissions affect the local environment, and in many cases, may affect communities hundreds or thousands of miles away. The ash residue is sent to landfills for disposal, where the pollutants have the potential to leach into groundwater. (It must be noted that waste treated by other methods and then landfilled will also produce leachate.)
- In addition to releasing the pollutants contained in the waste stream to the air and into the ash, burning medical waste actually creates new toxic compounds, such as dioxins.
- Medical waste incineration has been identified by the U.S. Environmental Protection Agency as the third largest known source of dioxin air emissions,[2] and contributes about 10 percent of the mercury emissions to the environment from human activities.[3]
- Many, if not most, on-site medical waste incinerators burn not only infectious waste, but also readily recyclable items such as office paper and cardboard. This destroys resources and prevents cost savings that could be recouped through recycling.
- Medical waste incineration's identification as a primary source of some very toxic pollutants stands in direct contradiction to physicians' oaths to "do not harm."

DIOXIN

Dioxin belongs to a family of 419 chemicals with related properties and toxicity, but the term "dioxin" is often used to refer to the 29 that have similar toxicity.

Dioxin is one of the most toxic chemicals known to humankind. While exposure of the general population occurs through the ingestion of many common foods, children exposed *in utero* during critical periods of development appear to be the most sensitive and vulnerable to the effects of dioxin.[4] Dioxin exposure has been linked to disrupted sexual development, birth defects and damage to the immune system. Specifically, dioxin has been associated with IQ deficits, hyperactive behavior and developmental delays.[5, 6]

The International Agency for Research on Cancer (IARC), an arm of the World Health Organization, last year acknowledged dioxin's cancer-causing potential when they classified it as a known human carcinogen.[7] The U.S. Environmental Protection Agency (EPA) has determined that most Americans are exposed to dioxin through ingestion of common foods, mostly meat and dairy products. Dairy cows and beef cattle absorb dioxin by eating contaminated feed crops. The crops become contaminated by airborne dioxins that settle onto soil and plants. Dioxins enter the air from thousands of sources including incinerators that burn medical, municipal and hazardous waste.[8]

MERCURY

Mercury is a potent neurotoxin, which means it attacks the body's central nervous system; it can also harm the brain, kidneys and lungs. It can cross the blood-brain barrier as well as the placenta. Mercury poisoning can cause slurred speech, impaired hearing, peripheral vision and walking, muscle weakness, mood swings, memory loss and mental disturbances. The risks of damage to the nervous systems of developing fetuses and young children are primary reasons for fish-consumption advisories, aimed at discouraging pregnant women, women of child-bearing age, and young children from eating too much fish. Studies done on women who ate methylmercury-contaminated fish or grain showed that even when the mothers showed few effects of exposure, their infants demonstrated nervous-system damage.

If mercury-containing items are put into a "red bag" for infectious waste and sent to an incinerator, mercury

will contaminate the air. (This can happen with non-incineration technologies as well. If mercury goes into treatment equipment, it will come out.) Airborne mercury then enters a global distribution cycle in the environment, contaminating fish and wildlife.

OTHER HAZARDOUS POLLUTANTS

Many other hazardous pollutants have been identified in the emissions from medical waste incinerators: arsenic, ammonia, benzene, bromodichloromethane, cadmium, carbon tetrachloride, chromium, chlorodibromomethane, chloroform, cumene, 1,2-dibromoethane, dichloromethane, dichloroethane, ethyl benzene, lead, mesitylene, nickel, particulate matter, naphthalene, tetrachloroethane, toluene, trichloroethane, 1,1,1-trichloroethane, trichloroethylene, trichloromethane, vinyl chloride, and xylenes.[9] Analysis of emissions of other treatment methods is necessary to determine if these emissions occur in the absence of combustion.

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