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Center for International Development

Local Environmental Management Project

EXPANDED MEDICAL WASTE SURVEY

BORSOD-ABAUJ-ZEMPLEN COUNTY, HUNGARY

FINAL REPORT

AUGUST 1994

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Supported by:
Environment and Natural Resources Division
Bureau for Europe
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Washington, DC 20523

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LOCAL ENVIRONMENTAL MANAGEMENT (LEM) PROJECT

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1. INTRODUCTION

1.1 Local Environmental Management Project Overview

The Local Environmental Management (LEM) project is being conducted by the Center for International Development of the Research Triangle Institute (RTI), a not-for-profit organization based in the Raleigh/Durham area of North Carolina, with the financial support of the Environmental and Natural Resources Division of the Bureau for Europe of the United States Agency for International Development (USAID). The three-year project commenced in July 1992.

During the fall of 1992, it was decided to focus the efforts of the program in Poland and Hungary, with the following three objectives: (1) to demonstrate the extent to which local governments can effectively manage their environmental problems if given adequate and consistent support; (2) to assist project municipalities in producing reliable and technically acceptable proposals for the funding of environmental projects for presentation to national and international funding agencies; and (3) to make available for use to other municipalities the replicable details as a result of the former two activities. A subpurpose of the project is to act, through the project manager, as broker-liaison by matching municipal requests for technical assistance not supplied by LEM with various USAID-supported projects that may be able to provide the needed information, data, or assistance.

Over the course of 1993, a series of detailed assessments was conducted of wastewater projects in five municipalities in Poland and solid/hazardous waste projects in four municipalities in Hungary. The assessments examined the technical, managerial, and financial aspects of the projects and outlined technical assistance and training needs. The LEM project immediately began to provide specific technical assistance, develop manuals, and prepare training sessions in support of these projects. This report is one of a series of documents the LEM project has developed to build capacity at the local level to conduct environmental improvement projects.

1.2 Background

LEM received formal requests from Miskolc city and Borsod County government officials in August 1993 for technical assistance to help the region address its medical waste disposal problems. LEM arranged for a solid waste specialist, George Murray, to conduct an initial assessment of the existing medical waste disposal practices in Borsod County hospitals.

In January 1993, findings from the survey were presented to a coordinating committee consisting of Hungarian officials and hospital staff concerned with medical waste disposal. In response to the high level of interest and the request of the committee for a more in-depth study, LEM agreed to sponsor an expanded, more detailed follow-up study.

Medical waste specialist Eugene Cole visited Borsod County in April 1994 to expand on LEM's earlier work. The final medical waste report, including a detailed list of recommendations and an action plan, will be presented to the coordinating committee in the fall of 1994.

1.3 Objectives

The goal of the expanded survey was to provide all of the hospitals in Borsod County (with their associated clinics and dispensaries) with detailed information necessary to allow the hospitals to make informed medical waste management decisions regarding immediate/temporary and long-term/permanent approaches. Immediate/temporary solutions must comply with existing public health and environmental regulations, while any long-term/permanent approaches must also address future unknowns by being flexible in response to changing regulations and expected scientific and technical advances. Specifically, the objectives were to:

1. Investigate existing and/or pending medical waste regulations affecting Borsod County.

2. Assess the amounts of solid and liquid medical waste generated, along with current medical waste management practices within each of the 12 hospitals, in addition to clinics, dental offices, and numerous dispensaries in Borsod County.

3. Determine accurate estimates of costs associated with various medical waste management practices.

4. Identify operating parameters, advantages, disadvantages, and cost information for medical waste treatment technology alternatives to incineration.

5. Facilitate cooperative approaches to medical waste management among the hospitals, local governments, and regulatory agencies in Borsod County.

1.4 Who Should Read This Report?

This report should be used as a guide by Hungarian officials responsible for managing medical wastes. Although the report focuses on Borsod County, the study methodology and many of the recommendations should be relevant to other regions of Hungary.

Besides hospital staff directly responsible for managing medical waste, national, county, and local government officials responsible for establishing and enforcing medical waste regulations should also read this report.

1.5 Methodology

In preparing this report, the LEM team met with officials of the Miskolc city government, Borsod County government, Borsod County Health Institute, and Regional Environmental Inspectorate. They visited the 12 hospitals in the county, and at each one they met with individuals responsible for medical waste management, collected information, and observed medical waste practices first-hand. They also visited a typical dispensary, dental practice, independent polyclinic, and landfill. In Budapest, they met with waste management officials in the Ministry for Environment and Regional Policy, and with officials of the National Institute of Hygiene and the National Public Health Office.

This report is based on information made available to the LEM team. It is limited by the fact that some of the hospitals in Borsod County have kept few medical waste records, while many lack detailed information on all relevant aspects of medical waste management.

1.6 Definitions

For the purposes of this report, the following terms are defined:

Solid Medical Waste - Solid wastes such as needles, infusion sets, bandages, isolation waste, and other material contaminated with blood and body fluids resulting from medical treatment or research.

Liquid Medical Waste - Liquid wastes such as solvents, acids, heavy metal solutions, film developers, blood, and other body fluids resulting from medical treatment or research.

Isolation Waste - All disposable materials associated with a medical patient isolated from other patients to prevent transmission of a very infectious disease.

Communal Waste - Solid waste that does not contain solid medical waste. Communal waste originating from medical treatment centers includes uncontaminated waste such as office paper and some packaging material.

Medical Waste Treatment - Any method, technique, or process designed to change the biological character or composition of any regulated medical waste so as to reduce or eliminate its potential for causing disease. The treatment may or may not result in waste destruction.

Medical Waste Destruction - The process whereby waste is rendered unrecognizable, such as grinding or shredding. Destruction may be part of the treatment process, or may be implemented following treatment.

Medical Waste Disposal - The final placement of medical waste (or slag) following treatment.

1.7 Acknowledgments

This report was primarily drafted by an RTI Medical Waste Specialist, Dr. Eugene Cole, with assistance from RTI Engineer Jeff Hughes. Credit is also due Mr. George Murray, who conducted the preliminary medical waste assessment that formed the basis for this report. Appreciation is extended to Mr. Istvan Pinter of the Ecological Institute for Sustainable Development, Miskolc; Ms. Agnes Pintye and Ms. Katalin Lagler of Transdanubia-Waste, Budapest; and Mr. Kennedy Shaw of RTI for their invaluable assistance; and to the following individuals for their cooperation: Mr. Erno Kiss and Dr. Tamasne Biacs of the Ministry for Environment and Regional Policy; Dr. Amanda Horvath, National Institute of Hygiene; Dr. Maria Horvath, National Public Health Office; Dr. Maria Sedlak, Borsod County Public Health Institute; Dr. Sandor Kovasznai, Miskolc; and officials from the Regional Environmental Inspectorate.

This report would not have been possible without the assistance and support of the Borsod County hospitals, their directors and staff, and their representatives on the Medical Waste Coordinating Committee. The LEM team convened several meetings of this committee to obtain members' advice and input. Their suggestions have been incorporated into this final version of the report.

2. EXISTING MEDICAL WASTE MANAGEMENT PRACTICES

2.1 Regulations

Of major importance to present medical waste management in Hungary is Order No. 56/1981/XI.18, *On the Control of the Production of Hazardous Waste and the Activities Related to its Neutralization,* which pertains to infectious waste. The order calls for a reduction in the waste's level of hazardousness, and measures to prevent the waste from contaminating soil, water, or air during collection, storage, transportation, preliminary treatment, and neutralization. Neutralization is defined as an operation or a series of operations that prevents the waste from polluting the environment. It includes incineration, total chemical decomposition, and safe final disposal. Examples of medical wastes and hazard categories are given in the order as: most hazardous — body parts and residues of organs (I), and least hazardous — dressing wastes and similar articles, needles, and disinfected wastes (III). Although the definition of "disinfected" is not given, the term may be regarded to mean a process that reduces or eliminates the infectiousness of the waste. The order also requires the producer of the waste to keep a detailed record of information pertaining to the waste.

Also relevant to medical waste management is Order No. 11/1991 (V.16), pertaining to emission limit values of waste incineration. To comply with this regulation requires effective flue-gas treatment controls. Also, according to the Waste Management Section of the Ministry for Environment and Regional Policy, a new, expanded, and more restrictive Order should be effective by the end of 1994. This new Order will categorize incinerator residues as hazardous waste, and will require that all residue be tested so that the degree of toxicity can be determined and the waste can be appropriately classified before landfill deposition.

All residues of medical waste, whether disinfected or incinerated, and whether qualified as hazardous or not, require the approval of the Regional Environmental Inspectorate for landfill deposition.

2.2 Management Policy

A management policy may be defined as the total compilation of all practices and procedures regularly carried out in regard to medical waste, from generation to ultimate disposal. The objectives of an effective medical waste management policy are to reduce risks and liabilities,

to comply with health and environmental regulations, to control costs, and to plan for the future. Normally, a medical waste management policy is in written form and details all levels of responsibility from the highest administrative authority down. Detailed management policy recommendations are included in Chapter 4.

In Borsod County, an evaluation was made of each hospital's policy regarding medical waste separation, identification, storage, collection, transport, treatment, and disposal. A listing of the hospitals and a view of their medical waste management are shown in Table 1. Even though 5 of the 12 hospitals (42%) in Borsod County have some form of written policy addressing

Table 1. Medical Waste Management in Borsod County, Hungary

Hospital	City	Beds	Managing Government Organization	Written Medical Waste Management Policy
Megyei	Miskolc	2196	County	No
Semmelweiss	Miskolc	1262	Local	Yes[1]
Satoraljaujhely	Satoraljaujhely	576	Local	Yes
Ozd	Ozd	539	Local	Yes
Kazincbarcika	Kazincbarcika	493	Local	No
Vasgyari	Miskolc	421	Local	No
Szikszo	Szikszo	350	County	Yes
Szent Ferenc	Miskolc	330	County	No
Mentalhigienes	Issofalva	300	Local	No
Robert Koch	Edeleny	300	County	No
Rheumatology	Mezokovesd	156	County	No
General Hospital	Mezokovesd	70	Local	Yes

[1] "Yes" (a written management policy exists) does not necessarily mean that the policy is comprehensive or effective.

specific medical waste handling and personnel responsibilities, most of the policies are not sufficiently detailed or readily available to all personnel. Some hospitals could not find the policy, and one facility said that its policy was framed and hung on the wall somewhere in the hospital. One hospital employed a private consulting firm to write its medical waste management policy.

2.3 Medical Waste Generation

Medical waste production for all Borsod County hospitals is shown in Table 2.

2.3.1 Solid Medical Waste

This category includes all solid waste materials potentially contaminated with blood or body fluids produced during the treatment or laboratory diagnosis of patients, with the exception of body parts. Such waste typically includes needles, syringes, bandages, infusion sets, blood bags, and isolation waste. Based on figures reflecting current practices that the 12 hospitals provided during the LEM visits, and based on the hospital survey conducted by the Borsod County Health Institute, it is estimated that the hospitals produce 402 Tons/year of solid medical waste, exclusive of pathology waste (calculated from daily estimates of kg/day for 365 days per year). There is additional solid pathology waste (body parts) estimated at 25 Tons/year (calculated from a daily county estimate of 95 kg/day, 5 days/week). This total of 427 Tons calculates to 0.16 kg/bed/day, which is consistent with findings in other areas of Hungary, as recently reported by Gyori *(Országos Kórház-és, Orvostcchnikai Intézet közleménye).* It is estimated that dispensaries in the county produce 41 Tons/year of solid medical waste (2 kg/week for 400 dispensaries), while the several independent polyclinics in the county produce 4 Tons/year (1.5 kg/day, 5 days/week, for 10 clinics). It is estimated that dentists in the county produce 105 Tons/year (2 kg/day, 5 days/week, for 202 dentists). Thus, the estimated total amount of solid medical waste produced in Borsod County for one year is 577 Tons.

2.3.2 Liquid Medical Waste (undiluted)

This category typically includes solvents, acids, heavy metal solutions, film developer, and blood. Based on figures that the 12 hospitals provided during the LEM visits, and based on the survey conducted by the Borsod County Health Institute, it is estimated that the hospitals produce 74,000 liters of undiluted liquid waste per year (as calculated from daily estimates of 167 L of chemical waste and 36 L of blood per day for 365 days). Estimates of liquid waste from dispensaries, clinics, and dental offices were not calculated, as such waste production from those areas is regarded as minimal.

Table 2. Medical Waste Production for Hospitals in Borsod County, Hungary

Hospital	City	Beds	Solid Waste[1]		Liquid Waste[2]	
			Kg/Day	Tons/Yr	L/day	L/yr
Megyei	Miskolc	2196	300	110	65	24,000
Semmelweiss	Miskolc	1262	280	102	11	4,000
Satoraljaujhely	Satoraljaujhely	576	35	13	37	13,500
Ozd	Ozd	539	130	47	19	7,000
Kazincbarcika	Kazincbarcika	493	95	35	4	1,500
Vasgyari	Miskolc	421	*	*	24	7,500
Szikszo	Szikszo	350	55	20	*	*
Szent Ferenc	Miskolc	330[3]	50	18	15.1	5,500
Mentalhigienes	Issofalva	300	.5	.2	9.6	3,500
Robert Koch	Edeleny	300	25	9	6.5	2,300
Rheumatology	Mezokovesd	156	1.5	.5	.7	250
General Hospital	Mezokovesd	70	12.5	4.5	3.6	1,300

[1] Solid waste includes needles, infusion sets, bandages, isolation waste, and other materials contaminated with blood and body fluids.
[2] Liquid waste includes solvents, acids, heavy metal solutions, film developers, blood, and other body fluids.
[3] Number of beds when reconstruction is complete.
* Not available.

2.4 Waste Separation and Collection

Existing waste measurement, separation, and collection practices are presented in Table 3.

2.4.1 Waste Separation and Identification

Of the 12 Borsod County hospitals, 11 (92%) have some means of separating medical waste from communal waste. Normally, the solid medical waste is separated according to its components, such as needles, infusion sets, and other bulk wastes. Needles are normally separated and placed in puncture-proof plastic or other containers, or are treated immediately after use by electrical disinfection devices. Critical to the separation process is the use of receptacles that are properly identified to preclude the inadvertent mixing of medical and communal wastes. Of the hospitals performing waste separation, four (36%) use a color-coded system to assist separation and identify the waste as hazardous during storage, collection, and transport. Three hospitals use yellow bags for medical waste solids and blue bags for communal waste; one hospital uses red bags for medical waste and white bags for communal waste.

2.4.2 Waste Collection and Transport

In all of the hospitals, designated cleaning personnel collect the medical waste from storage areas on each floor, usually daily. The waste is transported to an on-site incinerator for treatment, or to a central transfer storage area to await transport to an off-site incinerator. In many of the larger hospitals, the cleaning staff with responsibility for medical waste spend half of their time performing that function. Such individuals are responsible for ensuring that waste collection and transport is performed safely, with minimal risk to themselves and the hospital environment.

2.4.3 Waste Measurement

All of the hospitals have some procedure for measuring medical waste. Four hospitals keep records about the actual amount of medical waste that they generate. Three of those weigh the waste prior to treatment and disposal, while one receives that information from the company that is contracted to transport the waste off-site for treatment. The remaining hospitals estimate the amount of medical waste produced daily.

Table 3. Medical Waste Measurement, Separation/Identification, and Collection for Hospitals in Borsod County, Hungary

Hospital, City	Beds	Waste Measurement[1]	Color-Coded Separation[2]	Collection Frequency[3]
Megyei	2196	No	Yes	Daily
Semmelweiss	1262	Yes	No	Daily
Satoraljaujhely	576	Yes	No	3 times/wk
Ozd	539	No	Yes	Daily
Kazincbarcika	493	No	No	Daily
Vasgyari	421	Yes	Yes	Daily
Szikszo	350	No	Yes	Daily
Szent Ferenc	330	No	No	Daily
Mentalhigienes	300	No	No	Weekly
Robert Koch	300	No	No	Daily
Rheumatology	156	Yes	No	Daily
General Hospital	70	No	No	Weekly

[1] Medical waste weight is routinely measured and recorded.
[2] Medical waste is separated from communal waste by the use of designated, color-coded containers.
[3] Frequency of collection of medical waste from throughout a hospital, with transport to storage or treatment location.

2.5 Medical Waste Treatment and Disposal

Table 4 summarizes solid medical waste treatment and disposal practices in Borsod County hospitals. For all twelve hospitals in Borsod County, the solid medical wastes are burned. One hospital contracts with a private firm for waste transport, incineration, and disposal. Three hospitals transport the waste to another hospital for incineration, with two of them sending the waste to a hospital outside the county. Of the eight hospitals that burn medical waste on-site, seven of the eight use incinerators dedicated to waste treatment, while one uses the hospital boilers.

Two of the seven incinerators have temporary approval of the Environmental Inspectorate to incinerate their own medical waste, but cannot accept waste from others. Of the eight hospitals that burn medical waste, two store the ash residue, five transport it to a landfill, and one stores it for a time and then transports it to a landfill. Two of the twelve hospitals treat needles by electric disinfection, two contract with a private firm, and eight burn them on-site.

Liquid medical waste treatment and disposal practices are listed in Table 5. For liquid wastes, seven of the twelve hospitals dispose of chemical medical waste liquids (other than film developer) by dilution and discharge to the sewer, four contract with a private firm for disposal, and one stores all of its liquid chemical waste. All hospitals that produce developer fluid waste, except one, sell it or have it transported off-site for silver recovery. Most of the hospitals with blood and body fluid wastes either discharge them to the sewer or use incineration; one hospital autoclaves its blood waste and then buries it.

Regarding special or unusual medical waste, two hospitals produce small amounts of laboratory microbiological waste, which they autoclave, dilute, and discharge to the sewer; one hospital produces chemotherapy waste, which it incinerates; and one hospital produces radioactive medical waste, which it stores appropriately, according to regulations, for radioactive decay.

Table 4. Solid Medical Waste[1] Treatment for Hospitals in Borsod County, Hungary

Hospital	Solid Medical Waste Treatment System	Needle Treatment/Disposal	Slag (Ash) Disposal
Megyei	Incineration on-site	Private contractor	Municipal landfill (temporary storage on hospital grounds)
Semmelweiss	Incineration on-site	Electric disinfection	Municipal landfill
Satoraljaujhely	Incineration on-site	Incineration on-site	Municipal landfill
Ozd	Incineration on-site	Incineration on-site	On-site storage
Kazincbarcika	Incineration on-site, microbiological waste autoclaved	Incineration on-site	Treated with hypochlorite and sent to municipal landfill
Vasgyari	Private contractor	Private contractor	*
Szikszo	Incineration on-site	Incineration on-site	Municipal landfill
Szent Ferenc	Incineration on-site	Electric disinfection	Municipal landfill
Mentalhigienes	Incineration off-site	Incineration off-site	*
Robert Koch	Incineration on-site (hospital boiler)	Electrically charged disinfection	On-site storage (used on icy walkways)
Rheumatology	Incineration off-site	Incineration off-site	*
General Hospital	Incineration off-site	Incineration off-site	*

[1] Solid waste includes needles and other drugs, bandages, and other materials contaminated with blood and body fluids. It does not include body parts.
* Handled by another facility.

Table 5. Liquid Medical Waste[1] Treatment for Hospitals in Borsod County, Hungary

Hospital	Blood	Developer	Other Liquid Medical Wastes
Megyei	Diluted, chemically treated, discharged to sewer	Sold for silver recovery	Diluted, chemically treated, and discharged to sewer
Semmelweiss	Incinerated	Sold for silver recovery	Diluted, chemically treated, and discharged to sewer
Satoraljaujhely	Autoclaved, buried	Stored on-site	Stored on-site
Ozd	*	Sold for silver recovery	Diluted, chemically treated, discharged to sewer
Kazincbarcika	Incinerated	Private contractor	Private contractor, Agar diluted, chemically treated, discharged to sewer
Vasgyari	Diluted, chemically treated, discharged to sewer	Sold for silver recovery	Private contractor
Szikszo	*	Sold for silver recovery	Diluted, chemically treated, discharged to sewer
Szent Ferenc	*	Sold for silver recovery (some on-site processing)	Lung waste to sewer, solvent disposal by private company
Mentalhigienes	*	Sold for silver recovery	Diluted, chemically treated, discharged to sewer
Robert Koch	Incinerated	Sold for silver recovery	Diluted, chemically treated, discharged to sewer
General Hospital	Centrifuged, incinerated off-site	Sold for silver recovery	Diluted, chemically treated, discharged to sewer
Rheumatology	Diluted, chemically treated, discharged to sewer	N/A	Diluted, chemically treated, discharged to sewer

[1] Liquid waste includes undiluted solvents, acids, heavy metal solutions, film developers, blood, and other body fluids.
* Not available.
N/A = Not applicable.

2.6 Existing Waste Disposal Costs

Estimating medical waste disposal costs accurately for Borsod County is extremely difficult due to insufficient record-keeping, high inflation, and budgeting practices that rarely separate medical waste disposal costs from other hospital expenses. All hospitals need to give greater attention to the costs they are incurring in managing medical waste.

Costs associated with the on-site and off-site treatment of medical waste solids by incineration in Borsod County vary widely. Expenses that must be considered include labor, collection materials and supplies, fuel, transportation, landfill, and capital equipment depreciation. Labor costs include all personnel with medical waste responsibilities: collection, transport, treatment, training, materials procurement, record-keeping, consultation, operation and maintenance of incinerators, ash disposal etc. Materials and supplies include waste collection containers, disinfectant, gloves, gowns, etc. Fuel may consist of coal or natural gas to burn waste, or fuel for trucks to transport waste off-site. Transportation costs include labor (truck driver) and fuel to ship off-site, or the cost of a private contractor to do the same.

In addition to routine medical waste costs, many hospitals presently incur large fines for not meeting existing regulations. One hospital paid as much as 8 million Ft in fines during a single year.

Current medical waste expenses in certain hospitals were estimated based on the limited information made available during interviews with hospital staff. Estimates are listed in Table 6.

One hospital that produces 300 kg/day of medical waste pays for private needle disposal and incinerates the other materials. Last year, the hospital calculated the overall cost of medical waste handling to include materials, transportation, incineration, and personnel costs, and arrived at a figure of 55 Ft/kg.

Another hospital produces 50-60 kg/day of medical waste and burns it in an on-site, oil-fired incinerator. It spends 256,000 Ft each year for oil and plastic collection bags, in addition to 100,000 Ft/month for personnel time. This calculates to a cost of 66 Ft/kg for 60 kg/day, and 80 Ft/kg for 50 kg/day.

Another hospital produces 25 kg/day of medical waste, which it burns in its coal-fired boilers. Costs include 1.5 persons/day at 50,000 Ft/person/month, and medical waste collection bags at 50,000 Ft/year, resulting in a final cost of 104 Ft/kg.

Table 6. Estimated Solid Medical Waste Disposal Costs for Hospitals in Borsod County, Hungary, Based on Available Information

Hospital	Beds	Tons/Yr	Total Cost (1000 Ft)	Ft/kg	Treatment
Megyei	2196	110	6,050	55	On-site
Semmelweiss	1262	102	*	*	On-site
Satoraljaujhely	576	13	*	*	On-site
Ozd	539	47	*	*	On-site
Kazincbarcika	493	35	*	*	On-site
Vasgyari	421	*	*	>100	Contract
Szikszo	350	20	1,460	73	On-site
Szent Ferenc	330[3]	18	*	*	On-site
Mentalhigienes	300	.2	20	111	Off-site
Robert Koch	300	9	936	104	On-site
General Hospital	70	4.5	158	100	Off-site
Rheumatology	156	.5	<5	<10	Off-site

* Not available.

Another hospital produces 12.5 kg/day solid medical waste, which it transports to another hospital for incineration. Costs include incineration at 66.5 Ft/kg, a transportation fuel cost of 1580 Ft/month, a driver cost of 1,000 Ft/month, a cleaning person 4 hours/day to collect the waste at 9,000 Ft/month, and time for the hospital environmentalist to prepare the report and interact with the Environmental Inspectorate at 1,300 Ft/month, resulting in a final cost of 100 Ft/kg.

For even a small medical waste producer, the cost for handling can be expensive. One hospital in the county only generates 15 kg/month of medical waste solids, which it transports to another hospital to be incinerated. Costs are approximately 20,000 Ft/year for collection bags, transport costs, and incineration fee, resulting in a final cost of 111 Ft/kg.

One hospital has elected to contract with a private company, Septox, to provide assistance for medical waste collection, storage, transport, treatment, and final disposal. Costs include 76-78 Ft/kg for incineration, plus transportation (18 Ft/m^3/km), plus 10% tax, plus the cost of containers, plus the cost of hospital personnel. While providing for safe and effective medical waste management, such an arrangement can be quite costly. Another hospital investigated the cost of such a private contract and found the total cost to be 300 Ft/kg of waste.

As can be seen by the above examples, there are basic and mandatory costs involved with a hospital setting up and managing its own medical waste treatment; yet once a system is in place, costs per kilogram can be minimized as waste amounts increase. Thus, it can be very cost-effective for a single hospital to establish a waste processing system that can handle large amounts of waste, especially those from other hospitals, for which a fee can be charged. The main factor, of course, is the investment funding necessary to purchase and install the equipment. Cost information regarding incinerator purchase, operation, maintenance, and testing, in addition to costs for alternative treatment methods, are presented in Chapter 3.

3. AVAILABLE MEDICAL WASTE TREATMENT TECHNOLOGIES

Traditionally, incineration has been a method of treatment and destruction of hazardous chemical waste, municipal solid waste, and pathological waste. It was logical then that when concern regarding infectious disease agents such as the AIDS and hepatitis B viruses prompted the treatment of all medical waste, and hence a new industry, that incineration would be used. In the past several years however, environmental pollution concerns have fostered the development of a variety of medical waste technologies that are presently regarded as viable alternatives to incineration. Such technologies include steam autoclave disinfection, microwave disinfection, and mechanical/chemical disinfection. The parameters that influence each type of technology, as well as advantages and disadvantages of each, are shown in Table 7. These technologies, regulations governing them, and related policy approaches are still in the early stages of evolution throughout Europe and North America; thus, examples given here of their application are necessarily somewhat limited.

Note that in order to gather cost information, LEM contacted several private companies that manufacture treatment equipment. The inclusion of product descriptions and cost data is meant for comparison **only**, and in no way represents an endorsement by LEM of the companies or products mentioned.

3.1 Technology Approval

At present in Hungary, strict air emission regulations aimed at reducing environmental pollution have turned attention to the alternative treatment technologies for medical waste. These are new technologies for Hungary, however, and no alternative technologies have approval yet for medical waste treatment, although one hospital has begun the approval process for use of steam autoclave disinfection.

During a meeting with officials of the National Institute of Hygiene and the National Public Health office, the process for approval of any medical waste treatment technology was defined as: (1) preferably, approval should be obtained first from a lower level of government, such as a region or state; (2) the Health Institute will examine in depth all documents addressing the method's operation, safety, and effectiveness and, if appropriate, issue its approval; (3) the

Table 7. Medical Waste Treatment Technologies

Parameters Influencing Incineration	Advantages of Incineration	Disadvantages of Incineration
• Turbulence and mixing • Moisture content of waste • Filling of combustion chamber • Temperature and residence time • Maintenance and repair	• Reduction of waste volume, weight • Ability to make waste unrecognizable • Acceptability for all waste types • Heat recovery potential	• Public opposition • High investment, operation cost • Formation of dioxins and furans • High maintenance, testing, and repair costs • Vulnerability to future restrictive emissions laws
Parameters Influencing Steam Autoclave Disinfection	**Advantages of Steam Autoclave Disinfection**	**Disadvantages of Steam Autoclave Disinfection**
• Temperature and pressure • Steam penetration • Size of waste load • Length of treatment cycle • Chamber air removal	• Low investment cost • Low operating costs • Ease of biological testing • Creation of residue that is less hazardous than for incineration	• Inability to change waste appearance • Inability to change waste volume • Lack of suitability for some waste types • Production of uncharacterized air emissions
Parameters Influencing Microwave Disinfection	**Advantages of Microwave Disinfection**	**Disadvantages of Microwave Disinfection**
• Waste characteristics • Moisture content of waste • Microwave source strength • Duration of microwave exposure • Extent of waste mixture	• Ability to make waste unrecognizable • Significant volume reduction • Absence of liquid discharges	• High investment cost • Increased waste weight • Lack of suitability for some waste types • Potential to expose workers to contaminated shredder • Production of uncharacterized air emissions
Parameters Influencing Mechanical/Chemical Disinfection	**Advantages of Mechanical/Chemical Disinfection**	**Disadvantages of Mechanical/Chemical Disinfection**
• Chemical concentration, temperature, pH • Contact time with chemical • Waste and chemical mixing • Recirculation versus flow-through	• Significant waste volume reduction • Ability to make waste unrecognizable • Rapid processing • Waste deodorization	• High investment cost • Lack of suitability for some waste types • Production of uncharacterized air emissions • Need for chemical storage and use

hygiene officer of the city in which the hospital is located will review the proposed equipment and make a recommendation; (4) the National Hospital Technical Institute (ORKI), which is responsible for hospital equipment, will review the proposed equipment, taking into account the hygiene officer's recommendation, and approve the equipment if appropriate; (5) an environmental impact assessment must be conducted and have approval from the Regional Environmental Inspectorate; (6) the local Public Health Institute must grant its approval; and (7) the city in which the equipment will be located must approve the plan.

3.2 Incineration

Incineration must be a very carefully controlled and monitored process to be technologically and economically effective. The parameters influencing the effectiveness of incineration, as well as the advantages and disadvantages of the technology, are shown in Table 7. Incineration has the advantages of being acceptable for all waste types, reducing waste volume and weight, rendering the waste unrecognizable after treatment, and providing the potential for heat recovery. Disadvantages include strong public opposition; high investment, operation, maintenance, repair, and testing costs; formation of dioxins and furans; and an unknown future regulatory climate surrounding air emissions.

The establishment of new incinerators in Borsod County may be the least desirable option for medical waste treatment. Initial investment costs are high, with an estimated minimum cost for a new incinerator of at least 50 million Ft, and often much more. A flue-gas treatment system to control emissions and comply with current air regulatory requirements costs approximately 3-4 million Ft, and there is no assurance that future regulatory requirements can be met without additional expense. Emissions and residue testing are expensive — one air analysis for dioxin can cost 300,000 Ft, as can one ash residue analysis. Approval of the Regional Environmental Inspectorate is required for landfill disposal of the ash residue. Options for the use of selected existing incinerators in Borsod County are discussed in Section 4.3.2.

3.3 Steam Autoclave Disinfection

Steam autoclave treatment of medical waste is presently used in many countries. The technology, which is used at hospitals throughout the world to sterilize clean medical supplies, is simple and cost-effective. It employs steam under high temperature and pressure to destroy even the most resistant infectious disease microorganisms. The parameters influencing the effectiveness of steam autoclaving, as well as the advantages and disadvantages of the technology, are summarized in Table 7. Advantages include low investment and operating costs, ease of biological testing, and the production of residues recognized as less hazardous than for incineration. Disadvantages include unchanged waste volume and appearance, production of uncharacterized air emissions, and unsuitability for treating some waste types, such as body parts, chemotherapy waste, and other hazardous chemicals.

Investment cost depends on the size of the equipment, and can range from 5 million Ft for small units serving only the needs of one hospital, to 25 million Ft for large units that can process waste from a large geographical area. Additional expenditures are required for site preparation (steam, electricity, drainage, etc.). The cost of waste processing can be low, depending on costs for steam, electricity, bags, personnel, and transport following treatment. The expected lifetime of a steam autoclave system is at least 15 years. To comply with Hungarian regulations, waste residue would have to be qualified, and approval obtained for landfill disposal. The Toldy Forenc Hospital in Cegled is considering a German medical waste autoclave with an investment cost of 8 million Ft and an operational cost (with electricity) of 60 Ft/kg. Required space is 30-40 m^2, and it has a capacity of 35 kg/h. G.K. Moss, USA, sells an autoclave treatment and destruction system that processes and shreds 250-450 kg/hour for 35-38 million Ft. Without shredder, the cost is 18-20 million Ft.

The LEM survey found that 11 of the 12 hospitals in Borsod County use steam autoclaves for sterilizing clean medical supplies, and so are already knowledgeable regarding the technology. Some hospitals have many autoclaves, including some located away from their central sterilization area. In that regard, depending upon circumstances, it might be possible for one or more of those autoclaves to be dedicated to medical waste treatment. It must be remembered, however, that steam autoclaving has not yet been approved for medical waste treatment in Hungary. Additionally, if such a method is used, some means for treating waste not appropriate for steam autoclaving must be identified, and final disposal of the waste slag must be approved by the Environmental Inspectorate.

3.4 Microwave Disinfection

Microwave treatment of medical waste has been approved by some states in the United States, and is presently in use in a number of hospitals. The parameters influencing the effectiveness of microwave treatment, as well as the advantages and disadvantages of the technology, are shown in Table 7. The combined treatment and destruction process involves medical waste being deposited into a chamber where it is shredded, ground, and moisturized by steam. It is then exposed to the sequential effects of several 2450-MHz microwave units, while being continually mixed and transported through the unit. The disinfected waste then exits the unit into a collection receptacle for transport to an approved landfill. While the microwave treatment system may be used for many types of medical waste, body parts, large volumes of liquids, and hazardous chemicals are normally excluded. Ground, shredded, or otherwise destroyed metal items (e.g., needles, scalpel blades) are suitable for treatment in microwave systems, with the exception of bulk metal materials (such as metal hip replacements).

Advantages of microwave treatment include waste volume reduction (80%), waste destruction to render it unrecognizable, and the absence of any liquid discharges from the system. Disadvantages include a high investment cost, increased waste weight due to moisturization, production of uncharacterized air emissions, and potential worker exposure to infectious agents

when access to the grinding chamber is required during the treatment process. Microwave disinfection should not be used for chemical waste, and its use for treating body parts is generally discouraged.

At present, ABB Sanitec Inc., USA, is the only worldwide manufacturer of a microwave disinfection system for medical waste. Two sizes are available: a large unit that can process 250-409 kg/hour and costs 65 million Ft, and a smaller unit that processes 100-160 kg/hour and costs 37.5 million Ft. Cost of electricity may be a limiting factor. Manufacturer data indicate that in the U.S., the operating cost can be as low as 31 Ft/kg, a figure that is likely to be higher in Hungary. A small unit has the potential to effectively serve the needs of several hospitals, clinics, and dispensaries.

3.5 Mechanical/Chemical Disinfection

Mechanical/chemical treatment and destruction systems grind and shred the waste while mixing it with a chemical disinfectant. The parameters influencing the effectiveness of mechanical/chemical disinfection, as well as the advantages and disadvantages of the technology, are shown in Table 7. Of critical importance to the process are the optimum chemical concentration, temperature, pH, and contact time with the waste. Advantages of mechanical/chemical disinfection include rapid processing, waste deodorization, and significant waste volume reduction through destruction, which also renders the waste unrecognizable. Disadvantages include high investment cost, the need to use and store chemicals, creation of uncharacterized air emissions, and unsuitability for treating some waste, such as body parts. Final disposal of the waste slag must be approved by the Environmental Inspectorate.

Efficient recirculating mechanical/chemical disinfection systems can rapidly process medical waste and not pollute the environment. One example of such a system is the Condor, manufactured by Winfield Industries, USA. The unit simultaneously grinds and shreds the waste while mixing it with chlorine dioxide (ClO_2). Chlorine dioxide is a widely used industrial disinfectant that degrades to water and sodium chloride. The unit can process at least 200 kg/hour (10 kg of waste in 3 minutes), with automatic documentation of treatment conditions. The investment cost is 45 million Ft. The company charges a service fee that covers all chemicals, major maintenance, replacement parts, labor, etc. The yearly service fee for operating the system for 6 hours/week (1750 kg/week) is 3.6 million Ft, or 40 Ft/kg/year. The system is warranted for 2,272,000 kg or 10 years of operation, whichever occurs first. Wastes excluded from processing include body parts, large volumes of liquids, and chemical waste.

4. RECOMMENDED ACTIONS

Recommendations in this section focus on improving existing waste management practices within hospitals, short-term measures the hospitals can take to meet existing treatment regulations, and a longer-term strategic plan for treating waste in the future. Many of the recommendations in this section can be carried out immediately with little or no expense to the hospitals. Other recommendations require additional funds, more time, and the cooperation of several parties including hospital staff, national, regional, and local government officials.

An **action plan** is included as Appendix A. It lists the actions to be taken in implementing the recommendations, proposes specific target dates by which the actions should be accomplished, and identifies the individuals and organizations that are likely to be involved. Most of the actions are keyed to one or more of the numbered recommendations named below. Of course, the action plan and the target dates are meant to be flexible and realistic; they undoubtedly will be modified as some actions are unavoidably delayed while others are accomplished more quickly than planned. The important point in having the action plan is to make the report a working document, a problem-solving tool. LEM believes that only when the responsible organizations and officials put the report into action will the effort invested in producing it be justified and its value be demonstrated.

4.1 Medical Waste Management Plans

Borsod County hospitals need to foster a cooperative effort, and write and adopt a uniform medical waste management policy.

The objectives of an effective medical waste management policy are to reduce risks and liabilities, comply with health and environmental regulations, control costs, and plan for the future. Each hospital must have a written waste management policy as required by law. This policy should be prepared by the person or committee responsible for overseeing waste management. It should identify specific responsibilities of all persons involved, and provide a system of accountability. Such a policy will describe criteria and methods to be used for waste categorization, separation, identification, collection, storage, transport, treatment, and disposal. It should identify employee training requirements, describe waste minimization efforts, address employee health and safety, describe emergency response procedures, and provide for continuing cost assessment. The policy should be communicated effectively to all personnel with medical waste responsibilities, be available for reference at all times, and be reviewed and updated

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periodically to reflect management changes. A selected portion of one waste management policy, from a hospital in the United States, is included as Appendix B. Issues that should be covered in the plan are listed below.

Action 1:
Prepare waste management cost documentation

All hospitals need to establish accounting procedures to document the costs they are incurring in managing medical waste.

This step involves accurate record-keeping and cost analysis by someone with the assigned responsibility. Also, medical waste costs should be carried as a separate budget line item so that costs for different periods can be compared, and so that efforts to reduce management costs can be assessed effectively. The annual cost for medical waste management should be included in each hospital's yearly report. Figure 1 shows one method, used in a major U.S. medical center, of presenting costs.

Action 2:
Initiate waste minimization and categorization programs

All hospitals should assess their existing medical waste generation and establish a waste minimization program.

Minimization is the first and foremost means of reducing medical waste costs. To minimize waste, medical personnel must separate materials even before starting a procedure that produces medical waste. An example would be separating a sterile, disposable, plastic syringe from its package. After use, the syringe becomes medical waste, but the original package does not, and can be placed into a communal waste receptacle. Many other items can be categorized in advance, thus reducing the amount of material that has to be treated as medical waste.

Figure 1. Example of Cost Documentation

MEDICAL CENTER Department of Environmental Services Biomedical Waste Disposal Report						
Period: July 1, 1993 to August 31, 1993				Prepared by: M. Smith		
Shipment Number	Date Shipped	Date Unloaded	Number of Boxes	Cumulative Number of Boxes	Date Shipment Certified as Destroyed	Estimated Treatment Cost
935990	07/01/93	07/01/93	338	338	07/03/93	$2,298.40
935991	07/07/93	07/08/93	280	618	07/15/93	$1,904.00
935988	07/14/93	07/14/93	279	897	07/25/93	$1,897.20
647999	07/20/93	07/20/93	194	1,091	07/26/93	$1,319.20
647998	07/26/93	07/26/93	300	1,391	07/30/93	$2,040.00
371403	07/30/93	07/30/93	232	1,623	08/05/93	$1,577.60
647996	08/05/93	08/05/93	357	1,980	08/12/93	$2,427.60
648000	08/11/93	08/11/93	85	2,065	08/13/93	$578.00
647995	08/11/93	08/12/93	208	2,273	08/18/93	$1,414.40
647997	08/18/93	08/18/93	226	2,499	08/18/93	$1,536.80
502854	08/25/93	08/25/93	352	2,851	08/29/93	$2,393.60

This plan will require the Medical Waste Coordinating Committee to draft a uniform, working definition of medical waste items, under the guidance of the Public Health Institute and the Environmental Inspectorate, since the existing hazardous waste regulation is not all-inclusive and gives only a few examples. A working example of a medical waste that needs defining is plaster casts that are used for broken bones. The committee might decide that these can be considered communal waste, thereby reducing the amount of medical waste to be disposed. For reference, the medical waste categories of the U.S. Environmental Protection Agency (EPA) are: (1) contaminated sharps, (2) cultures and stocks of infectious agents, (3) blood and blood products, (4) pathological waste, (5) isolation waste, and (6) contaminated animal carcasses, body parts, and bedding. Wastes considered optional for special handling include surgery/autopsy waste, laboratory waste, dialysis waste, contaminated equipment, and unused sharps. Where appropriate, consideration should be given to recycling and reusing materials, which not only reduces medical waste but also reduces new purchases.

Action 3:
Improve waste separation and identification

All hospitals should establish waste separation and identification procedures.

The separation of medical waste from communal waste must be done effectively. The containers for each of the two types must be clearly identified, and personnel must be trained to understand and faithfully carry out the separation process. Proper management policy should ensure that the same color-coded system is used throughout each hospital, and preferably that all hospitals in the county use the same identification system. The use of the international biohazard symbol on all medical waste bags and containers is encouraged.

Action 4:
Regulate collection and transport

All hospitals should evaluate their existing medical waste collection and transport systems, and establish formal, acceptable collection and transport procedures.

Individuals responsible for ensuring that waste collection and transport is performed safely, with minimal risk to themselves and the hospital environment, require training and personal protective equipment. All actions should be taken in consultation with appropriate government officials to ensure that practices conform to existing government regulations concerning the transportation of waste.

Action 5:
Initiate waste measurement

Those who collect and transport the waste should ensure that it is properly weighed, and the results recorded.

At a minimum, records should indicate type of waste, where the waste originated, and quantity (e.g., number of needles) and weight. Such information is critical to assessing medical waste costs, as well as evaluating minimization efforts.

Action 6:
Establish worker training programs

Each hospital should have an ongoing medical waste worker training program.

None of the Borsod County hospitals had a structured medical waste training program at the time this survey was completed. Such a program should focus on all aspects of medical waste management, to include minimization, separation and identification, collection and transport, treatment (operation of equipment, etc.) and disposal, and health and safety. Training should be provided to all personnel who have any medical waste handling and/or management responsibility. Such training should be a part of new employee orientation, and should be extended to any existing employees who are newly assigned to medical waste tasks.

Action 7:
Protect workers

The hospitals must provide protective equipment for those directly involved in the handling of medical waste.

Currently, most workers are given thick gloves to use, and often double-thick protective gowns. Most hospitals make the hepatitis B vaccine available to medical waste handlers, although many workers have elected not to receive it. Health and safety training should ensure that workers know the potential risks associated with medical waste, and understand the importance of using the personal protective equipment made available to them.

Action 8:
Establish slag disposal plan

Hospitals must work together with environmental inspectorates and landfill managers to establish a formal slag disposal plan.

This disposal plan must take into consideration the health risks associated with slag, as well as the resources that hospitals and municipalities have for slag disposal. The incineration of medical waste results in the production of bottom ash and fly ash. Bottom ash is the non-combustible component of the waste that remains in the incinerator chamber after burn down. Fly ash consists of the lighter particulates that are entrained in the flow of combustion gases. In accordance with Hungarian law, the bottom ash is considered hazardous waste, and therefore it is not recommended that the ash be stored at any facility, or made available to the general public. The ash must be deposited in an approved landfill, either as hazardous waste if shown to be toxic according to laboratory testing, or as nonhazardous if shown to be nontoxic. In many parts of the world, including the United States, medical waste incinerator ash is not considered to be hazardous waste and can be safely disposed in municipal landfills.

Action 9:
Establish liquid medical waste disposal plan

Hospitals must work together with environmental inspectorates and wastewater treatment plant operators to establish formal, acceptable liquid waste disposal procedures.

Many hospitals discharge their liquid waste into the sanitary sewer system. In some cases, liquid waste is chemically treated before discharging. In other cases, hospitals store liquid waste on-site; this practice is dangerous and must be discontinued. The appropriateness of liquid waste discharges to the sewer depends on existing regulations, and the level of available wastewater treatment. In the United States, sewer discharges are permitted as long as the wastewater treatment includes secondary (advanced) treatment. Discharges are not appropriate when advanced treatment is unavailable, or when a combined wastewater and storm water system allows wastewater to go untreated during large rainstorms.

4.2 Use of Approved Incinerators

In the short term, hospitals should take measures to increase their use of existing approved incinerators.

In most cases, use of approved facilities will bring facilities into compliance with existing regulations, thereby resulting in fewer fines. The use of such facilities involves transporting untreated medical waste and reducing associated risks by implementing safe practices and procedures. At present, there are no hospitals with incinerators approved to accept waste in Borsod County or the other areas of the Environmental Inspectorate region. Also, there are no hospitals approved to accept waste from other regions in either the Upper "Tisza" Regional Environmental Inspectorate (Nyiregyhaza), the "Tisza" Regional Environmental Inspectorate (Debrecen), or the Middle "Tisza" Regional Environmental Inspectorate (Szolnok).

Action 10:
Use approved hospital incinerators in other parts of the country

Borsod County hospitals should contact hospitals in other regions of Hungary that have approved incinerators, to investigate the possibility of off-site incineration.

There are hospitals with approved incinerators in the Middle Danube Valley Regional Environmental Inspectorate (Budapest), that can accept medical waste from Borsod County. These include: the County Hospital in Salgotarjan, City Hospital in Paszto, Hevesi Hospital in Balassagyarmat, Albert Schweizer Hospital in Hatvan, and Flor Ferenc Hospital in Kerepestarcsa. Borsod hospitals must contact the hospitals directly to determine incineration costs.

Action 11:
Initiate cooperative use of the Dorog hazardous waste incinerator

Hospitals in the county should consider sharing the cost of a truck and driver to transport medical waste to the Dorog hazardous waste incinerator.

The current cost of incineration of medical waste at the Dorog incinerator is 40 Ft/kg. Additional cost is involved in transporting the waste to the incinerator. The incinerator is located 230 km from Miskolc.

4.3 Future Medical Waste Treatment in Borsod County

Although the measures outlined in Sections 4.1 and 4.2 would greatly improve existing medical waste treatment conditions, the county hospitals and medical facilities still must identify and adopt a longer-range strategic treatment solution.

Action 12:
Halt large incinerator projects

*Borsod County should **not** construct a new, large, county-wide medical waste incinerator at this time.*

As has been discussed, a new incinerator, particularly a very large one, requires substantial investment, demands continual and costly maintenance and repair, may not meet future regulatory requirements, and usually faces public opposition. Present estimates from Transdanubia-Waste put the cost of a new 2000 Ton/year incinerator, with flue-gas treatment and controls to meet current regulations, at 300 million Ft. Every 10 years, an incinerator's "hot" operation must be renovated, at a cost that approaches 50% of the initial investment. If extensive roads, energy sources, etc. have to be provided, the initial investment cost could easily double. Also, the Hungarian central government is emphasizing reduction of environmental pollution. Additionally, indications are that the planned, commercial construction of new incinerators in Miskolc and Rudabanya may no longer be financially viable projects. For this, and perhaps other reasons, both projects remain dormant. Based on the reasons outlined above, it is recommended that only fairly new incinerators in strategic geographic locations be considered for modification, testing, and approval for medical waste treatment.

Action 13:
Establish medium-sized medical waste treatment centers

Borsod county hospitals, as well as national, regional, and local governments, should work together to establish medium-sized medical waste treatment centers.

With careful planning and coordination, modifications to existing equipment, and a modest investment (compared to the cost of a large new incinerator) in new systems, Borsod County can establish a series of medical waste treatment centers capable of treating all existing hospital waste as well as waste from the more than 400 small dispensaries and 200 dentist facilities throughout the county.

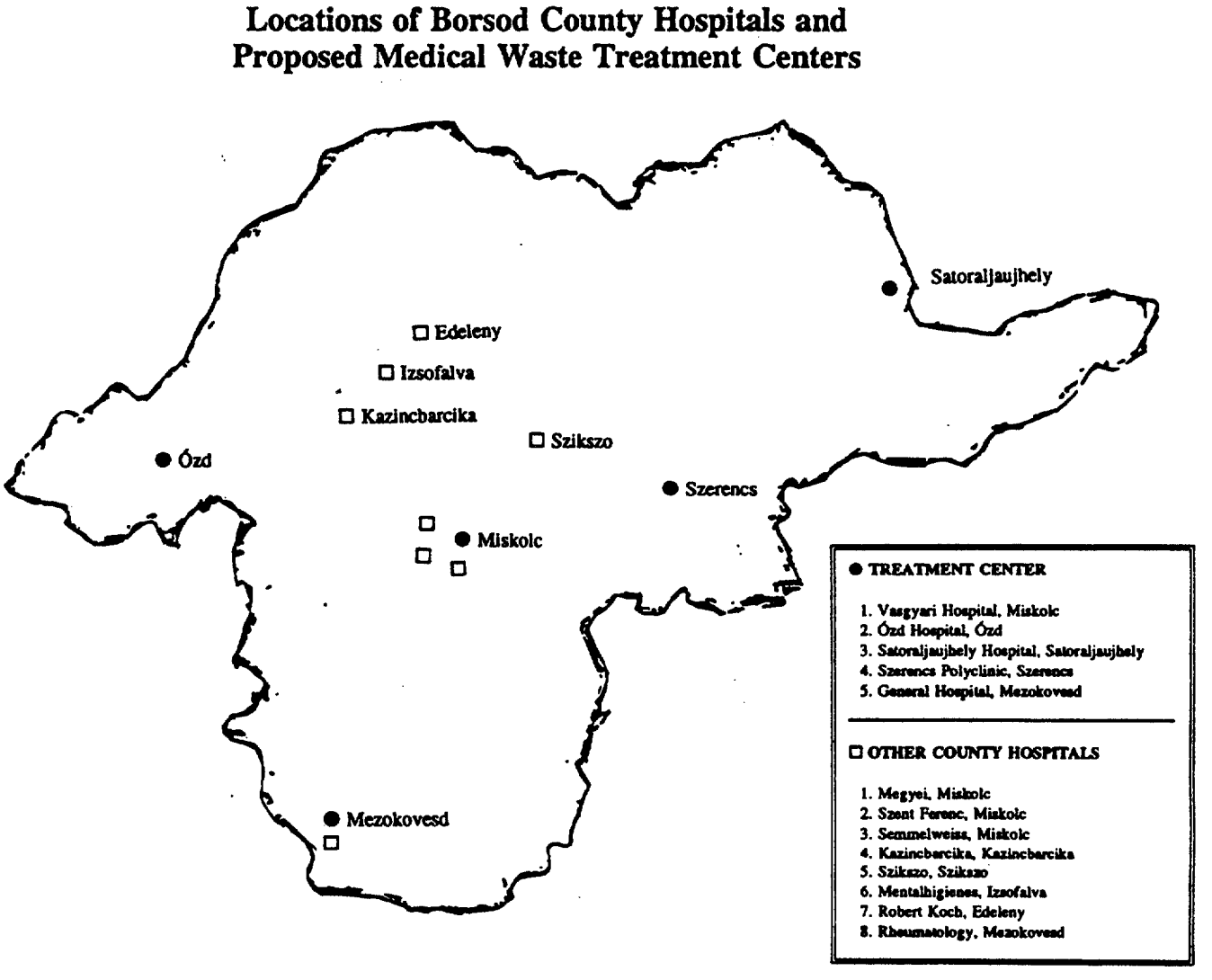
The treatment center approach should make it possible to maximize the use of existing treatment technologies, reduce medical waste management costs to participating facilities, and help to protect the environment in northeastern Hungary. For those hospitals interested in alternative technologies, the initial investment costs may be considerably reduced if companies marketing the technologies are willing to lease the equipment, with resultant fees applied toward the purchase price; or they may be willing to donate the equipment in order to establish a demonstration unit in Eastern Europe. It must be remembered, however, that alternative technologies have not yet been approved in Hungary, and the approval process will take considerable time.

Once hospitals have more accurate estimates of medical waste disposal costs, each hospital will be able to analyze existing and projected costs for on-site treatment versus costs for transport and treatment at an approved facility. The decision making process can be assisted by the identification of facilities in the county that could potentially serve as treatment centers based on their geographical locations, and their existing or potential medical waste treatment equipment. Table 8 presents one possible set of treatment centers that could treat all the medical waste in the county. The map in Figure 2 shows the geographic location of the treatment centers and surrounding hospitals. Final selection of the treatment centers will require the collaboration and cooperation of all hospitals and appropriate government officials. Key features of each of the treatment centers are outlined below.

Table 8. Potential Borsod County Medical Waste Treatment Centers

Treatment Center	Location	Treatment	Notes
Vasgyari Hospital	Miskolc	Incineration	Requires final inspection, and approval
Ózd Hospital	Ózd	Incineration	Requires flue-gas treatment, inspection, and approval
Satoraljaujhely Hospital	Satoraljaujhely	To be determined	Requires approved technology
General Hospital	Mezokovesd	To be determined	Requires approved technology
Polyclinic	Szerencs	To be determined	Requires approved technology, existing vacant medical waste treatment building

Figure 2. Map of Treatment Centers



Vasgyari Hospital, Miskolc. The Vasgyari Hospital has a seven-year-old, two-chamber, gas-fired incinerator that has been modified with a flue-gas treatment system. It has received permission from the Inspectorate for a one-month test period. If final approval is granted, and the incinerator is operated continuously, it could serve the needs of most of the county's hospitals, clinics, dispensaries, and dentists. Economically, an incinerator is most effective when operated in a continuous mode. The potential cost of incineration to other hospitals has not yet been determined. Of additional concern, however, is that the hospital would also like to make other modifications to the incinerator. These would, of course, take additional time. And to be able to accept waste from other hospitals, final approval could only be given after air emissions and ash testing is completed. This would also take additional time. Modifications to the incinerator and estimated costs might include a new door and waste feed system (500,000 Ft), and electro-filter (2-3 million Ft) for air emissions.

It is possible that modifications, testing, and approval could be completed by the end of 1994. This would then preclude the need for flue-gas treatment modification of the Semmelweiss Hospital incinerator, which could cost 3-4 million Ft, and if operational, would be an additional source of pollution for Miskolc. It would not appear to be an economical, healthful, or environmentally responsible situation to have two medical waste incinerators in the same city. Likewise, for the same reasons, there would be no need for the county to plan to build a new incinerator in Miskolc, as has been proposed.

Ozd Hospital, Ozd. The Ozd Hospital has a fairly new, two-chambered, gas-fired incinerator that could meet the needs of that part of the county. At present, it has no flue-gas treatment system, and the process to acquire funds to modify the unit and have it tested and approved apparently has not begun. It is recommended that such a process begin immediately. The cost for flue-gas treatment is 3-4 million Ft.

Satoraljaujhely Hospital, Satoraljaujhely. The hospital has an old incinerator that is not efficient and cannot be effectively modified. It must find an acceptable solution for medical waste treatment and disposal. Because of its location in the outskirts of the county, the hospital (with its surrounding dispensaries) would continue to benefit from on-site treatment, unless the cost is less to transport the waste to Miskolc or another city for incineration. If on-site treatment is preferred, consideration might be given to purchasing an existing, functional, but no longer needed incinerator from another hospital in the county. Transdanubia-Waste Ltd. has estimated the total cost for flue-gas treatment modification, and transport and installation at the Satoraljaujhely Hospital, at 6-8 million Ft. Alternatively, one of the non-incineration technologies could be considered. The hospital could begin investigating such a possibility immediately.

Polyclinic, Szerencs. This facility provides a broad array of medical services to its area of the county, and could potentially serve as a treatment center, to include area dispensaries, the Satoraljaujhely Hospital, and possibly the Szikszo Hospital as well. Although its medical waste is presently handled by a private company, it has a building that was constructed to house an on-

site medical waste treatment unit, such as an incinerator with a heat-recovery system. Alternatively, the clinic could investigate one of the alternative technologies that might be less expensive than incineration, and more friendly to the environment.

General Hospital, Mezokovesd. The two hospitals in Mezokovesd are also in a unique geographical location in the county. Medical waste options include cooperative transport to an approved treatment facility, and perhaps cooperative investment and operation of an alternative technology that might also serve the needs of dispensaries in the area.

4.4 Workshop

A workshop should be held after the delivery of the final report.

> ***Action 14:***
> ***Plan and carry out a workshop***
>
> *Local and other organizers should hold a workshop to discuss the content of the survey report; to review the recommendations; and to develop an action plan that is compatible with the resources, needs, and commitments of the organizations and the officials involved.*

Although LEM's involvement in the medical waste report is outside of its original work plan agreed upon with the Hungarian government, the critical nature of the medical waste situation in Borsod County impel's LEM's attention. At the same time, the value of the report will be realized only if a concerted, cooperative, and committed effort is made to act upon it. From LEM's perspective and experience, commitment is especially important. To this end, if local, regional, and national organizations find this problem sufficiently urgent that they wish to begin planning and to find appropriate resources, the LEM project would be pleased to help these groups develop and sponsor a workshop.

APPENDIX A

Action Plan

APPENDIX A

Tentative Action Plan*

Action	Action Number (from Chapter 4)	Target Date	Suggested Key Participants
Hospitals receive LEM medical waste report		September 20, 1994	Translators, technical proofreaders, hospital staff, coordinating committee
Medical waste planning (eg. planning meetings, workshop (tentative), etc)	14	Fall 1994	Coordinating committee, hospital staffs, LEM, other donors, public health and environmental officials, other government agencies
Hospitals without approved incinerators make arrangements to use approved incinerators	2	November 1, 1994	Hospital staff, approved incinerator operators
Purchase protective equipment and train workers in its use	7	November 1, 1994	Hospital staff
Draft formal opposition to new, large incinerator projects	12	December 1, 1994	Coordinating committee, public health and environmental officials, other government agencies
Establish worker training programs	6	December 1, 1994	Hospital staff
Establish cost documentation systems	1	December 1, 1994	Hospital staff
Establish medical waste measurement and tracking systems	5	December 1, 1994	Hospital staff
Establish color-coded separation system	3	January 1, 1995	Hospital staff

* For guidance purposes only. The final list of actions, especially those requiring collaboration among several individuals or groups, should be planned and scheduled by key participants. Many of the actions could be facilitated by the involvement of an advisory group such as the coordinating committee for this report.

Action	Action Number (from Chapter 4)	Target Date	Suggested Key Participants
Establish waste minimization program	2	January 1, 1995	Hospital staff
Evaluate and establish improved waste collection and transport procedures	4	January 1, 1995	Hospital staff, public health and environmental officials
Arrange off-site incineration in other counties	10	February 1, 1995	Local and nonlocal hospital staff
Arrange to transport waste to Dorog incinerator	11	February 1, 1995	Local and Dorog governmental regulators
Establish liquid waste disposal procedures	9	March 1, 1995	Hospital staff, public health and environmental officials, local wastewater plant operators
Establish slag disposal procedures	8	March 1, 1995	Hospital staff, public health and environmental officials, landfill operators
Treatment center plan adopted for Borsod County	13	April 1, 1995	Hospital and government staff
Vasgyari Hospital granted treatment center approval	13	April 1, 1995	Environmental Inspectorate
Install flue-gas treatment at Ozd incinerator	13	April 1, 1995	Ozd Hospital, contractor, (outside funder?)
Ozd incinerator granted treatment center approval	13	June 1, 1995	Environmental Inspectorate
Conduct employee medical waste worker training	13	June 1, 1995	Hospital staff, outside experts
Satoraljaujhely Hospital acquires treatment technology	13	July 1, 1995	Hospital staff, public health and environmental officials
General Hospital acquires innovative treatment technology	13	July 1, 1995	Hospital staff, public health and environmental officials

Action	Action Number (from Chapter 4)	Target Date	Suggested Key Participants
Polyclinic in Szerenc acquires innovative treatment technology	13	July 1, 1995	Hospital staff, public health and environmental officials
Satoraljaujhely Hospital granted treatment center approval	13	September 1, 1995	Hospital staff, public health and environmental officials
General Hospital granted treatment center approval	13	September 1, 1995	Hospital staff, public health and environmental officials
Polyclinic granted treatment center approval	13	September 1, 1995	Hospital staff, public health and environmental officials

APPENDIX B

Duke Medical Waste Management Policy

SECTION
IV

Medical Waste

MEDICAL WASTE MANAGEMENT POLICY

July, 1992

Regulated medical waste is a new designation for wastes that may contain pathogenic microorganisms and which was previously termed "infectious waste". The following guidelines define management practices designed both to minimize potential personnel exposures and to assure environmentally sound disposal of medical waste. Specific waste handling practices will vary depending on the individual type of medical waste being generated, and consequently, general guidelines for a variety of different work areas have been presented. If you have any questions regarding appropriate waste management practices for your area, contact the Biological Safety Office at 684-8822.

A. CATEGORIES OF REGULATED MEDICAL WASTE

Regulated medical waste requires special packaging, labelling, and must be decontaminated prior to disposal. Categories of regulated waste include:

1. Liquid or semi-liquid human blood, human blood components, and products made from human bloods >20 ml in volume.
2. Liquid volumes of human body fluids including: semen, vaginal secretions, cerebrospinal fluid, synovial fluid, pleural fluid, pericardial fluid, peritoneal fluid, amniotic fluid, >20 ml in volume.
3. "Contaminated items that would release blood or body fluids in a liquid state when compressed" such as soaked surgical sponges.
4. "Sharps" including needles, syringes with attached needles, capillary tubes, slides and cover slips, scalpel blades.
5. "Pathological Waste" includes human tissues, organs and body parts; and the carcasses and body parts of all animals that were known to have been exposed to or infected with pathogens that are potentially dangerous to humans.
6. "Microbiological Waste" includes cultures and stocks of infectious agents.

AREA SPECIFIC MANAGEMENT PRACTICES

1. IN-PATIENT AREAS

a. Bulk blood and body fluids (>20ml) such as those found in suction liners, blood bags, and pleurevacs are placed in the biohazard containers located in the soiled equipment rooms. The biohazard containers are shipped for incineration. Environmental Services (681-2727) is responsible for the collection and distribution of these containers. Urine and feces may be carefully poured down the sewer (commode).

b. "Sharps" including needles, syringes with attached needles, slides and cover slips, or scalpel blades are placed in the puncture-resistant containers located in every patient room, the medication carts, and the code 5 carts. To prevent needlestick injuries, needles must not be recapped, purposely bent or broken by hand, removed from disposable syringes or otherwise manipulated by hand. Recapping by a one-handed technique or by a mechanical device for designated procedures must be approved by Environmental Safety.

   Environmental Services is responsible for supplying and disposing of the sharps containers in patient areas. If a box is found to be two-thirds full, it will be picked up and replaced. Needle boxes are packaged in biohazard boxes and sent for incineration.

c. Solid waste from patient rooms (used gloves, masks, disposable gowns, gauze, etc.) need not be decontaminated prior to disposal as routine trash, but must be sufficiently contained in leakproof bags for transport and disposal.

2. OPERATING ROOMS

a. Bulk blood and body fluids (>20ml) such as those found in suction liners, blood bags, and pleurevacs are placed in the leakproof bags in the operating room. The bags are transported to the utility room in the operating suite and placed in biohazard containers. Operating Room personnel are responsible for the distribution, collection and disposal of these containers.

b. Contaminated items that would release blood or body fluids in a liquid state when compressed (soaked surgical sponges) are also placed in the leakproof bag in the OR and transported to the biohazard containers in the utility room.

c. " Sharps" are placed in the puncture-resistant containers in each operating room. To prevent needlestick injuries, needles must not be recapped, purposely bent or broken by hand, removed form disposable syringes or otherwise manipulated by hand. Recapping by a one-handed technique or by a mechanical device for designated procedures must be approved by Environmental Safety.

   Anesthesia techs are responsible for transporting used sharps containers to the utility room in the operating suite for disposal. Environmental Services will then package the containers in the biohazard boxes for ultimate disposal by incineration.

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d. Solid waste from the operating rooms (disposable gloves, masks, disposable gowns, gauze, etc.) other than that above need not be decontaminated prior to disposal as routine trash, but must be sufficiently contained in leakproof bags for transport and disposal.

3. CLINICS

a. On-Site:

(1). Bulk blood and body fluids (>20ml) such as those found in suction liners, blood bags, and pleurevacs, as well as trace chemotherapy waste are placed in the biohazard containers located in the utility rooms of the clinics. Environmental Services is responsible for the distribution, collection, and disposal of these containers. Urine and feces may be carefully poured down the sewer.

(2)."Sharps" are placed in the puncture-resistant containers in areas of use throughout the clinics. To prevent needlestick injuries, needles must not be recapped, purposely bent or broken by hand, removed from disposable syringes or otherwise manipulated by hand. Recapping by a one-handed technique or by a mechanical device for designated procedures must be approved by Environmental Safety.

Sharps containers are placed in red bags and collected by Environmental Services for disposal in the biohazard containers.

(3). Solid waste from patient rooms (disposable gloves, mask, disposable gowns, gauze, etc.) need not be decontaminated prior to disposal as routine trash, but must be sufficiently contained in leakproof bags for transport and disposal.

b. Off-Site:

(1). Bulk blood and body fluids (>20ml) such as those found in suction liners, blood bags, and pleurevacs, as well as trace chemotherapy, are placed in the biohazard containers located in the utility rooms in the off-site clinics. Environmental Services makes rounds in the off-site clinics at least once a week, or upon request, for collection and distribution of these containers. Urine and feces may be carefully poured down the sewer.

(2). "Sharps" are placed in the puncture-resistant containers in areas of use throughout the clinics. To prevent needlestick injuries, needles must not be recapped, purposely bent or broken by hand, removed from disposable syringes or otherwise manipulated by hand. Recapping by a one-handed technique or by a mechanical device for designated procedures must be approved by Environmental Safety.

Sharps containers are placed in red bags and collected when needed by Environmental Services for disposal in biohazard containers.

(3). Solid waste from patient rooms (disposable gloves, mask, disposable gowns, gauze, etc.) need not be decontaminated prior to disposal as routine trash, but must be sufficiently contained in leakproof bags for transport and disposal.

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4. HOSPITAL/DEPARTMENTAL LABORATORIES

a. Microbiological wastes (cultures and stocks of etiologic agents) are placed in autoclavable bags, and steam sterilized prior to disposal.

b. Patient specimens (<20ml) are discarded in autoclavable bags, and steam sterilized prior to disposal.

c. "Sharps", including needles, syringes with attached needles, slides and cover slips, capillary tubes, or scalpel blades are placed in the puncture-resistant containers located in areas of use throughout the laboratory. To prevent needlestick injuries, needles must not be recapped, purposely bent or broken by hand, removed from disposable syringes by or otherwise manipulated by hand. Recapping by a one-handed technique or by a mechanical device for designated procedures must be approved by Environmental Safety.

   Sharps containers are placed in autoclavable bags and steam sterilized before disposal.

   Pipets are placed in a "pipet" biohazard box that is lined with small autoclavable bags. Pipet boxes are bagged the same as sharps containers in autoclavable bags, and steam sterilized before disposal.

d. All anatomical pathological waste must be incinerated in a pathological incinerator.

e. Solid wastes from laboratories (disposable gloves, gauze, etc.) need not be decontaminated prior to disposal as routine trash, but must be sufficiently contained in leakproof bags for transport and disposal.