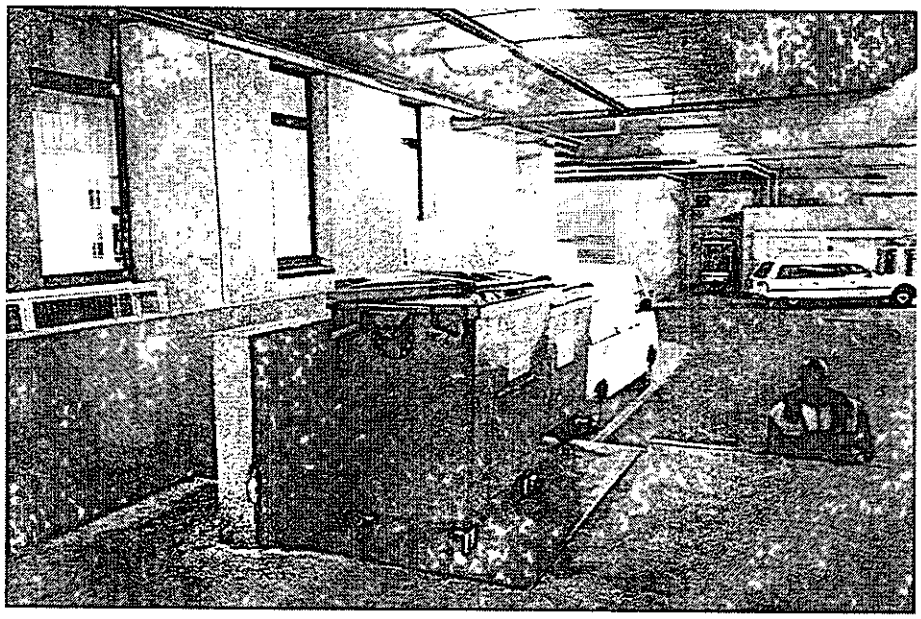
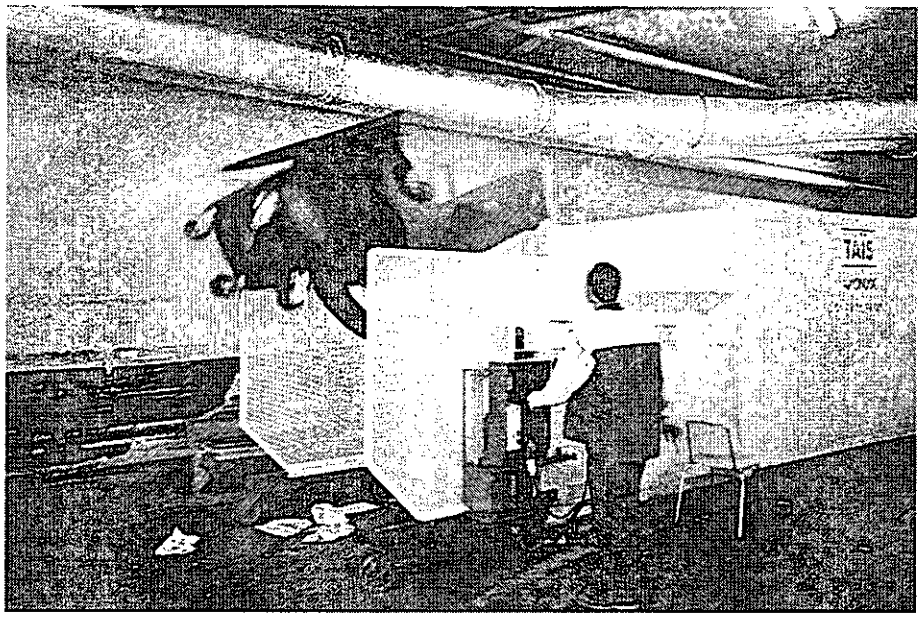
病棟内に新たに設けられたゴミ集積室に置かれた危険性廃棄物のゴミ箱


病棟内に新たに設けられたゴミ集積室に置かれた段ボール用のゴミ箱(左側)と，一般ゴミのゴミ箱(右側)．手前の黄色い箱は感染性廃棄物のボックス

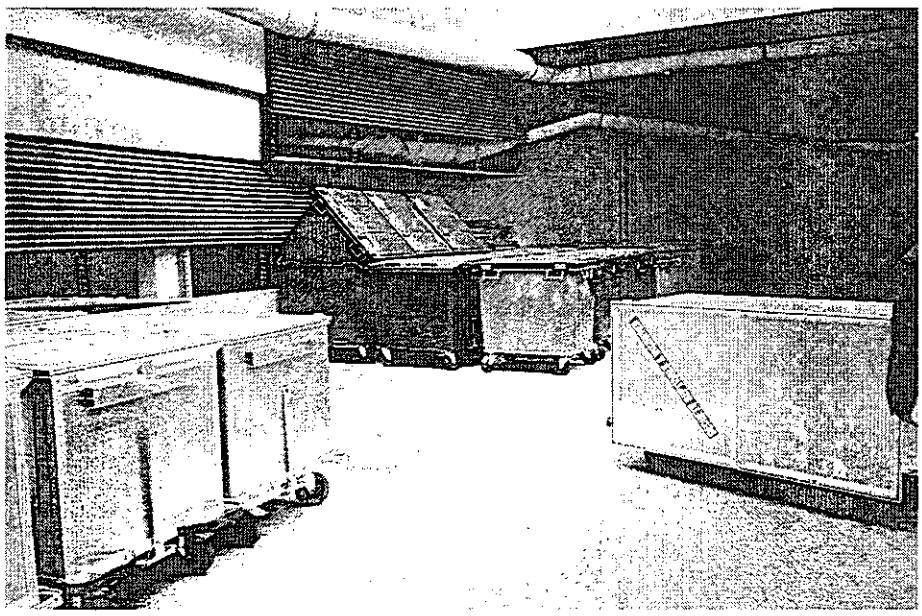
病棟から廃棄物の入ったワゴンの搬出は人手で行っている.



地下に設けられた広大な廃棄物搬出場



一般ゴミを圧縮して搬送ボリュームを小さくしている.
ゴミの移し替えには人手を使わずに機械を利用して，作業員がゴミにふれるチャンスを極力なくしている.



両側の金属のワゴンが病院から廃棄物処理施設まで搬送するためのワゴン．中央の合成樹脂のワゴンは病院内での搬送用のワゴン.

# 資料

# 3. 米国調査結果

［対象病院］Beth Israel Medical Center, Phillips Ambulatory Care Center

［住所］10 Union Square EAST, New York, NY 10003

［ヒアリング対象者］

Ms. Rita E. Roberts, R.N.

Assistant Director of Nursing

Ambulatory Surgery, O.R.

Ms. Thelma Myers-Navarro, M.S.N., R.N.C.

Nurse Manager

Cancer Center

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[Day Surgery Unit の概要]

1994 年：外科検査ユニットとしてスタート

1997 年：Day Surgery Unit を開設、現在までに 5000 件以上の手術を実施している。

昨年度は 1 年間で 2532 件

一般外科、整形外科、形成外科、泌尿器外科等の手術を実施している。

[Cancer center の概要]

1996 年：1 月に開設

主な外来ケアが行われている。

プライマリケアとして放射線治療を含むいくつかの科が入っている施設なので、コンサルテーションがおこないやすいところが利点である．多くの患者がはじめにこの診療所を受診し、その後必要があれば病院で受信する．

化学療法は 20～25 人／日：3 人の看護婦が担当

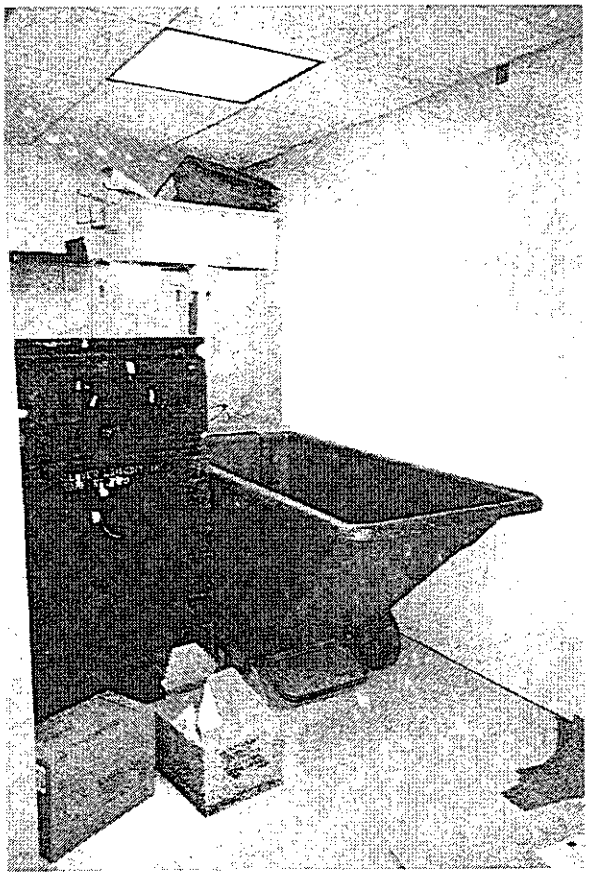
ここを訪れる患者は 1 日 100 から 200 人

点滴室は 10 床あり，すべて椅子である．また，その内個室が 1 室ある．

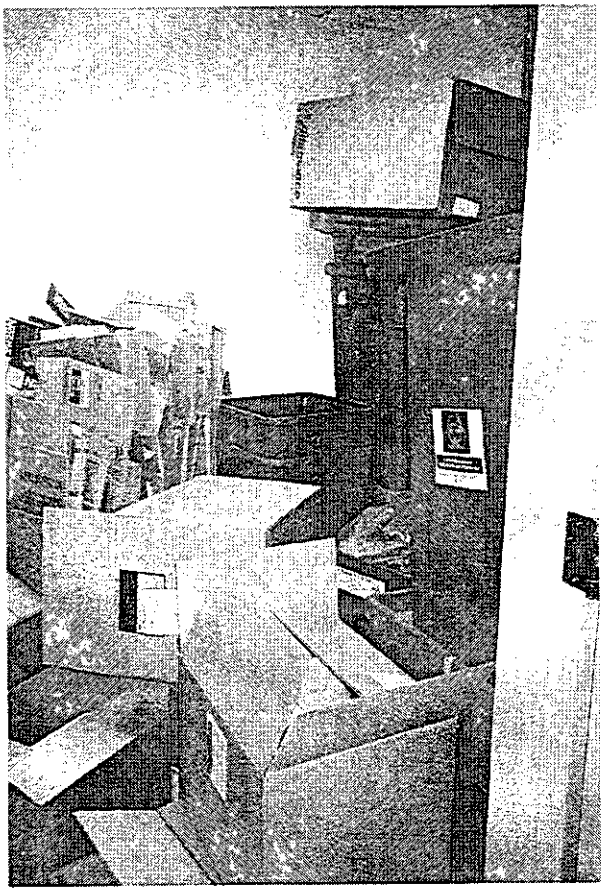
一名に要する時間は 2～3 時間。最長 10 時間程度実施する。

［医療廃棄物］

在宅で発生した医療廃棄物のうち針などの人体を傷つける可能性のある危険廃棄物は，ペットボトルなどの市販品を再利用して容器として利用し，その中に廃棄して当該センターに持参する場合がある．ただし，多くの場合一般の廃棄物と一緒に捨てられていると考えられ，担当者は問題であると認識している．尚，リネン・コットン等の血液，体液で汚染された廃棄物はそのまま一般廃棄物として市中において回収されている．



廃棄物一時置き場のワゴン
ここから搬出される



感染性廃棄物を廃棄するボックスのストック．潤沢にあり使い捨てている．

［施設名］Lennox Hill Hospital
［住所］100 East 77th Street New York, NY 10021
［ヒアリング対象者］
Ms. Vanessa Vincy
First Floor-Ambulatory surgery center

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［Day surgery unit の概要］
1984 年から日帰り手術を開始
1 日の手術件数：約 50 名

［手術適用診療科について］
耳鼻咽喉科
形成外科
婦人科
泌尿器科
整形外科
小児外科－そ径ヘルニアなど

［手術室からの廃棄物］
２名のハウスキーパー専従しており、手術と手術の間に手術室のクリーニングを済ませている．手術室の回転率を高めるために，その間隔は 15 分から 20 分の間である．その中で，廃棄物の回収は，ハウスキーパーとは別の専任職員が担当しており，針などの危険な廃棄物と一般の廃棄物とを分別して運搬する．

［帰宅後の患者の医療廃棄物について］
手術後に患者が帰宅する際に患者に付随した医療廃棄物は，その後のクリニックでの診療時に回収される。本病院の日帰り手術は General Physician（GP）の患者が，GP の紹介を受けて手術を受けることとなるために，術後の患者の在宅における管理は GP によっておこなわれるためにこの方法となる．ただし，血液や体液の付いたコットン等の廃棄物については一般廃棄物と同じ扱いとなって，市中で回収されている．

［対象病院］New York Hospital, Cornel Medical Center

［住所］525, East 68th Street, New York, NY 10021

［ヒアリング対象者］

Ms. Amy S. Vance, RN MA, CNOR, CAN, C

Patient Care Director

Ambulatory Surgery Center

Department of Perioperative Services

Mr. Anthony P. Dawson, RN, MSN

Clinical Director

Perioperative Services

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［病院概要］

ベッド数　約700床(プレスビテリアン病院とも同じ系列にあり，合計約2000床)

［実施している手術の形態］

Ambulatory Surgery(手術当日に来院して，その日に帰宅)

Same Day Surgery　(手術当日に来院して，術後に入院する場合)

(85％が循環器系の手術（心臓))

Same day surgery 用の手術室は14室（入院手術も含む）

［手術件数］

年間手術件数　約22,000件

| | |
|---|---|
| Ambulatory Surgery | 約11,000件 |
| Same Day Surgery | 約11,000件 |

［医療廃棄物の管理について］

・帰宅後に自宅にて発生する医療廃棄物の処理は，在宅看護を実施しているスタッフが回収することもある.

・必要な場合には，患者に針などの鋭利なものを入れるためのプラスチックボックスを配ることもあり，それを患者が病院に持ってきて廃棄することもある。

・ただし，現在，在宅の医療廃棄物の処理についてはかなりルールが曖昧であり，血の付いたものなどは一般廃棄物として処理されている。

・一方，病院内の医療廃棄物管理については，かなり厳しいルールが定められており，州のコードなどで，例えば医療廃棄物の袋は赤い袋とすることなどが決められている。

・また，病院内の管理システムとしても厳しいルールづくりをしており，一般廃棄物用の袋の中から針などが見つかると，証拠写真が撮られ，レポートが作成されて責任を追及される。

［施設名］Beth Israel Deaconess Medical Center (Boston)

［住所］One Deaconess Road, Baker 2, Boston, MA, 02215

［ヒアリング対象者］

Ms. Joyce C. Clifford, PhD, RN, FAAN
Executive Director
The Institute for Nursing
Healthcare Leadership

Ms. Pat Folcarelli, RN
Patient and Family Learning Center

Ms. Ellen Liston, RN
Nurse Manager Oncology Unit

Ms. Bessie Maniey, RN
Ambulatory Surgical Suite

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［Patient Family Learning Center］

平均在院日数が短くなると今までと違って，病気がある状態で帰宅をすることになり，そのためには療養に対する正しい知識を持つことが必要となる。そこで，このセンターで患者と家族に対して，在宅療養のための教育を行っている。在宅療養一般を扱っているので，教育内容としては，栄養療法，服薬の指導，術後の過ごし方，自己注射，母親学級など様々であり，医療廃棄物の処理についても指導をしている．

［Hematology/Oncology Unit について］

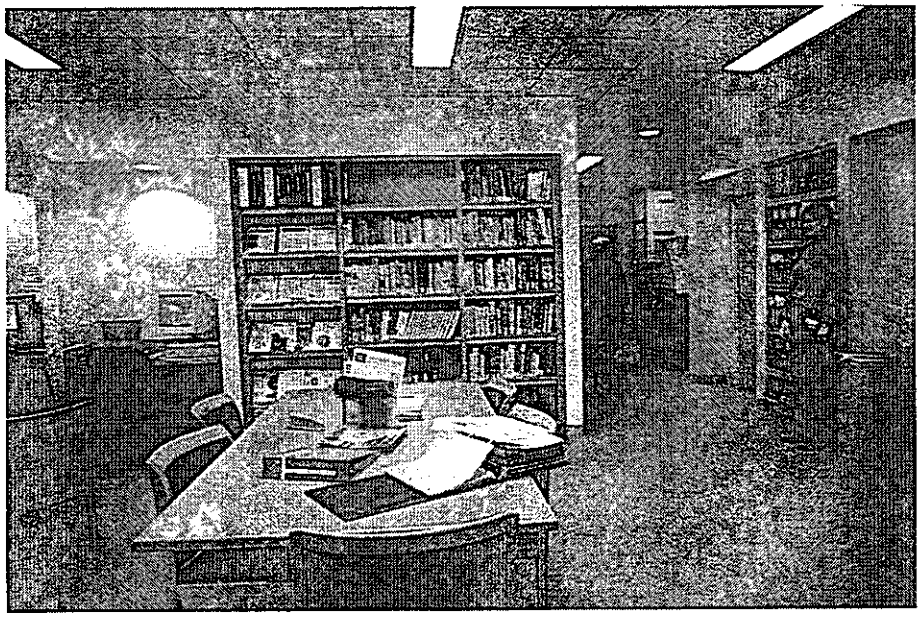
年間の取り扱い患者数は 36,000 人であり，1 日あたり 150 人となる．患者全体の 70%～80%が化学療法の対象者である。また，同時に疼痛療法もおこなっている．

［Ambulatory Surgical Suit に関して］

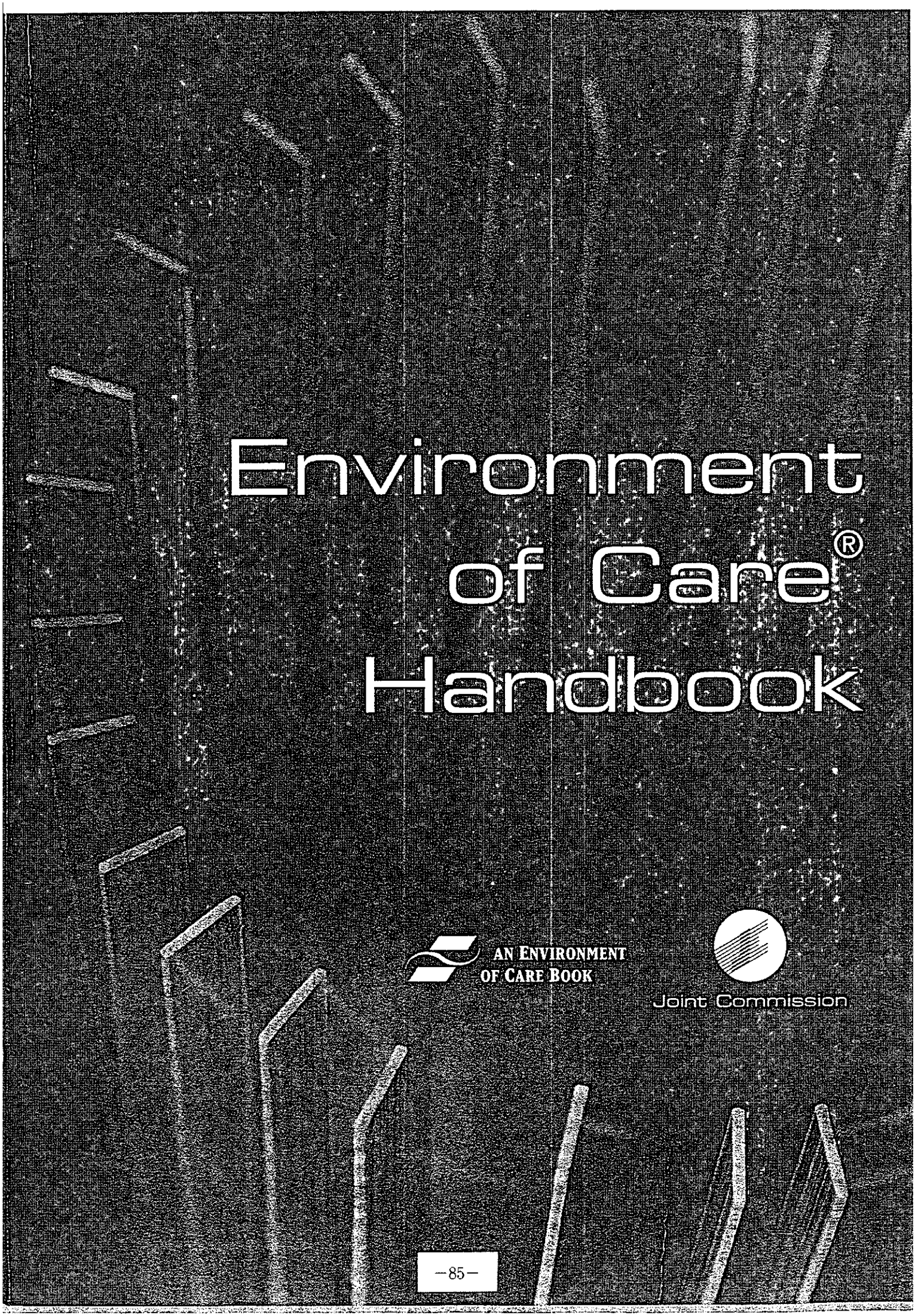
1996 年 8 月に現在の施設を開設した．1 日当たりの外来で手術を受けにやってくる患者数は 40 人から 50 人程度であり，調査日は 54 人であった．尚，入院患者の手術もおこなっているので，全体の手術件数は 80 から 100 人程度となっている．

［医療廃棄物に関して］

Hematology/Oncology Unit や Ambulatory Surgical Suit で治療，手術を受けた後に帰宅した患者が在宅で排出する針などの鋭利な医療廃棄物（針など）は，専用の箱を事前に患者に配り，それを利用してもらって，一定の量がたまったところで，病院に持参して回収することとなる．また，一方で在宅医療を専門におこなっている Home care company が，在宅医療の提供と同時に医療廃棄物の回収をおこなうこともある．



患者用の Learning Center:患者が在宅での療養生活をすごす上での必要事項を自己学習，教育，トレーニングする場所．在宅での医療廃棄物処理についても教えている．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Joint Commission

# Chapter 5

# Hazardous Materials and Waste Management

Hazardous materials and waste are present in all sectors of business and are a concern in all areas of life. Health care organizations are no exception; in fact, they typically store and use a wider variety of materials in this classification than do many other industries. Common household items, such as cleaning products, paints and thinners, and lighter fluid can be hazardous if used incorrectly, stored under the wrong conditions, or used in excess of "normal household" conditions. All of these items are found in health care organizations in addition to chemicals used in laboratory processes, medical gases, and many other substances.

Although not labeled hazardous by federal regulation, blood, body fluids, and other potentially infectious medical waste (PIMW) (such as used needles and bandages) are taken into account in the Joint Commission's standards for managing hazardous materials and waste. Chemotherapy, radioactive waste, and hazardous energy sources are also considered. The standards are concerned with the appropriate handling of both hazardous waste and PIMW. Potentially infectious medical waste is generally believed to be an occupational rather than an environmental risk; however, all types of waste that require special handling to prevent undesired exposures should be included in a hazardous materials and waste management program.

## Types of Hazardous Materials and Waste

Hazardous materials and waste can be subdivided into two groups: hazardous substances and regulated medical waste. Each of these groups is described in detail in the following discussion.

### *Hazardous Substances*

Hazardous substances consist of three major categories: chemical, chemotherapeutic, and radioactive. Some of the substances commonly found in these categories are listed in Table 5.1 (page 40). The substances used most often—ethylene oxide, glutaraldehyde, formaldehyde, and waste anesthetic gas—have a higher potential for frequent exposure. Ethylene oxide is typically found in the central supply processing area, with waste anesthetic gases obviously in surgical areas. Glutaraldehyde is used extensively in special procedures rooms, exam rooms, endoscopy suites, and dialysis; formaldehyde is used extensively in laboratories, histology, and pathology. When using these and similar materials, adequate ventilation (and in some cases, a dedicated exhaust system) is essential.[1] Personnel exposed to some of these chemicals are required by the Occupational Safety and Health Administration

*Chemical*
- Glutaraldehyde
- Ethylene oxide (EtO)
- Formaldehyde
- Solvents (for example, xylene, benzene)
- Mercury
- Methyl methacrylate
- Waste anesthetic gas
- Bleach

*Hazardous Drugs*
- Aerosol-delivered drugs (for example, ribavirin and pentamidine)
- Antineoplastic drugs/cytotoxic agents

*Radioactive*
- Regulated radionuclides

*Source:* Adapted from Kelly MA, Marek R: Preventing exposure to hazardous materials. *Plant, Technology, and Safety Management Series* 3:20, 1991.

*Table 5.1 Potentially Hazardous Substances*

(OSHA) to undergo exposure monitoring.

## Regulated Medical Waste

There is no universal definition of medical waste. Various organizations and agencies use different criteria to identify what substances fit into this category. However, regulated medical waste (as defined by the federal government) originates from a patient's care, treatment, or immunization. The following list provides the Environmental Protection Agency's classifications for regulated medical waste:

- *Cultures and stocks.* Cultures and stocks of infectious agents and associated biologicals, including cultures from medical and pathological laboratories; cultures and stocks of infectious agents from research and industrial laboratories; waste from the production of biologicals; discarded live and attenuated vaccines; and culture dishes and devices used to transfer, inoculate, and mix cultures.
- *Pathological waste.* Human pathological waste, including tissues, organs, body parts, and fluids that are removed during surgery, autopsy, or other medical procedures, and specimens of body fluids and their containers.
- *Human blood and blood products.* Liquid waste, human blood, blood products, items saturated and/or dripping with human blood, and previously saturated items that are now caked with dried human blood. These divisions include serum, plasma, and other blood components and their containers which were used or intended for use in either patient care, testing and laboratory analysis, or the development of pharmaceuticals. Intravenous bags are also included.

- *Sharps.* Sharps that have been used in animal or human patient care or treatment, or in medical, research, or industrial laboratories, including hypodermic needles, syringes (with and without the attached needle), Pasteur pipettes, scalpel blades, blood vials, needles with attached tubing, and culture dishes (regardless of the presence of infectious agents). Also included are other types of broken or unbroken glassware that were in contact with infectious agents, such as used slides and cover slips.
- *Animal waste.* Contaminated animal carcasses, body parts, and bedding of animals that were known to have been exposed to infectious agents during research (including research in veterinary hospitals), production of biologicals, or testing of pharmaceuticals.
- *Isolation waste.* Biological waste and discarded materials contaminated with blood, excretion, exudates, or secretions from humans who are isolated to protect others from certain highly communicable diseases, or isolated animals known to be infected with highly communicable diseases.
- *Unused sharps.* Unused hypodermic needles, suture needles, syringes, and scalpel blades that have been discarded.[2]

Although all of these types of infectious waste do not apply to all health care organizations, they are the most directly involved with patient care.

It should be noted that many forms of biomedical waste are noninfectious. Miscellaneous biomedical waste, such as slightly soiled (not grossly bloody) dressings, sponges, disposable gloves, and so forth, do not need to be classified as infectious unless generated in the care of an exposed patient.[3]

Waste generated by support functions—paper, cardboard, nonmedical glass products, and so on—do not fit into this category and do not require special handling or disposal methods.

## Regulatory Issues

The hazardous materials and waste management program must conform to all relevant federal, state, and local laws and regulations. All required permits, licenses, or manifests must be obtained and kept current. Hazardous chemical materials have been defined by OSHA's Hazard Communication standard and by various state regulations. Biohazardous materials are regulated by both state laws and OSHA's Bloodborne Pathogens standard. Hazardous chemotherapeutic materials are defined in the OSHA technical manual and also in professional guidelines (American Society of Healthcare Pharmacists). Laser safety is also covered in the OSHA technical manual. Radioactive materials are licensed by the Nuclear Regulatory Commission, OSHA, and state agencies. Asbestos is also hazardous when disturbed or removed and prepared for disposal, and must be handled according to OSHA guidelines (29 CFR 1910.1001).

## Basic Program

A hazardous materials and waste management program needs to be designed to identify all types of materials and waste that require special handling. The program should define how materials and

waste should be managed from the time they enter a facility until they are removed and legally disposed. This is frequently referred to as "cradle to grave" responsibility. A written program for managing hazardous materials and waste should include the following points: identification, information, labeling, handling, disposal, responsibility, training, emergency preparedness, and monitoring.

## *Identification*

The first step in identifying materials and waste to be included in the program is establishing criteria for inclusion. These criteria may be chemical hazard, biological hazard, radioactivity, or regulatory classification. It should be noted that an organization's definitions are regulated by a variety of governmental agencies, as already mentioned, and there is therefore limited leeway or interpretation within these regulations.

OSHA regulations state that "Chemical manufacturers and importers shall evaluate chemicals produced in their workplaces or imported by them to determine if they are hazardous. Employers are not required to evaluate chemicals unless they choose not to rely on the evaluation performed by the chemical manufacturer or importer for the chemical to satisfy this requirement" [29 CFR 1910.1200 (d)(1)]. The regulations also list specific references to consult if the organization chooses not to rely on the manufacturer's information, and there are some guidelines given for determining the hazards of mixtures that have not been tested as a whole.

OSHA's Bloodborne Pathogens standard defines *contaminated* as "the presence or the reasonably anticipated presence of blood or other potentially infectious materials on an item or surface" (29 CFR 1910.1030). Other potentially infectious materials include a variety of body fluids, unfixed tissues or organs, and cultures. Regulated waste is defined as "liquid or semi-liquid blood or other potentially infectious materials; contaminated items that would release blood or other potentially infectious materials in a liquid or semi-liquid state if compressed; items that are caked with dried blood or other potentially infectious materials and are capable of releasing these materials during handling; contaminated sharps; and pathological and microbiological wastes containing blood or other potentially infectious materials."

All radioactive materials and waste are strictly regulated by and used under license from the Nuclear Regulatory Commission, as outlined in 10 CFR, 0-50. Employee exposure to radioactive materials is regulated by OSHA's Ionizing Radiation standard (29 CFR 1910.96).

There is overlap in the regulations. For example, personal protective equipment (PPE) is discussed in each of the OSHA regulations, but there is also a separate standard on PPE. The Hazard Communication standard relates to all chemicals, but there are separate standards for formaldehyde, glutaraldehyde, ethylene oxide, hazardous chemicals in laboratories, and asbestos. This is not an exhaustive listing, and it is imperative that the person responsible for hazardous materials and waste management be familiar with all of the pertinent regulations.

Once an organization's criteria are developed, a thorough search for all applicable materials and waste should be conducted. All those found should be inventoried and listed by area. Classification

by type of hazard is also recommended. Storing such information in a computerized database can be extremely helpful in locating information about a particular chemical with widespread use in the organization or what chemicals are used in a particular area. The materials management or purchasing department, through which most of the materials enter the facility must be included in the process. Department staff can be of assistance in identifying new chemicals coming into the system and in coordinating and controlling chemical purchases.

For each substance included in the inventory, the following questions should be asked:

- "How is the product used?";
- "How much of it is used?";
- "How much of the product is stored and where?";
- "How is the product disposed of?";
- "Who uses the product?";
- "Is a Material Safety Data Sheet (MSDS) available?"; and
- "Is there a less toxic substitute?".

Management may use the answers generated by these questions to develop criteria for further classification. Opportunities for reduction in use or storage, alternative products, and consolidation in purchasing may also be identified in this process. Table 5.2 (below) lists five types of hazardous materials and waste and identifies where they may commonly be found in health care organizations.

Hazardous materials must be tracked through the organization from their arrival to the point at which they become waste. Each type of waste should then be tracked from its source to its final disposal (this progression is called a *waste stream*). Tracking does not imply the need for measuring or

| | Chemical Wastes | Infectious Wastes | Sharps | Chemo-therapeutic Wastes | Radioactive Wastes |
|---|---|---|---|---|---|
| Patient care area | Rare | Yes | Yes | Yes | Rare |
| Laboratory | Yes | Yes | Yes | Rare | Yes |
| Physical plant services | Yes | Rare | Yes | Rare | Rare |
| Laundry area | Yes | Yes | Yes | Yes | Rare |
| Food services | Yes | Rare | Yes | Rare | No |
| Occupational therapy/ physical therapy areas | Some | Rare | Yes | Rare | Rare |
| Sterile preparation services | Some | Some | Yes | Yes | Rare |
| Operating room/ intensive care units | Yes | Yes | Yes | Some | Rare |
| Outpatient clinic | Rare | Yes | Yes | Yes | Rare |

Note: This is not an exhaustive list of all hazardous materials and wastes or of all areas where they may be found.

*Table 5.2 Areas of a Health Care Facility Where Hazardous Materials and Wastes May Be Found*

following the details of each discrete part of the waste; rather, it is the generic process from collection, separation, and segregation through transport, storage, processing, and final disposal. The various waste streams need to be tracked to the extent necessary to ensure that hazardous waste is actually captured, handled, and stored appropriately, and processed safely for disposal. When initially evaluating a waste stream, it may be easier to trace it backwards through the organization.

## *Information*

The information used to support the hazardous materials and waste program comes from several sources and must be gathered on an ongoing basis. This information is used to make changes in the program, including training, protective equipment, and specialized work spaces. Primary data sources are manufacturers, regulatory agencies, hazard surveillance tours, the materials management department, and infection control findings. Manufacturers and vendors of hazardous chemicals are required by law to provide MSDSs that give information about their products. In addition, many suppliers provide information and training on the proper use of their products and pertinent safety practices.

The organization is legally required to obtain an MSDS for each hazardous chemical used or stored on the premises. All MSDSs must be available at any time to people who work with the chemicals involved. Some organizations choose to maintain MSDS hard-copy files with 24-hour access; others may store them electronically, either computerized on-site or quickly available from an off-site service. Any of these methods are acceptable for meeting Joint Commission standards. Other sources of information may include manufacturer training, appropriate safety references, or data pertaining to biohazardous materials obtained from the Centers for Disease Control and Prevention (CDC) or from the organization's own infection control and safety programs. The constant changes and multitude of new products in this area make it imperative that organizations be aggressive in obtaining and maintaining current information and in passing it along to employees.

## *Labeling*

Various types of hazardous materials and waste need to be identified with adequate, legible labels. The labels themselves are part of the information system. On a day-to-day basis, they make the hazardous materials and waste management system visible and effective. The OSHA Hazard Communication standard states that labeling should include the following information:

- The name of the material, which must be the same as the name appearing on the MSDS and the chemical inventory;
- Appropriate hazard warnings, which provide at least general precautions, as well as other information that employees may need to have immediately available; and
- The name and address of the manufacturer, the importer, or other responsible party.

These items represent the minimum labeling requirements; many labels have additional informa-

tion provided voluntarily.

Labeling of blood, body fluids, and other PIMW is regulated by OSHA's Bloodborne Pathogens standard (29 CFR 1910.1030). The universal biohazard symbol is frequently required, but red bags or red containers may be substituted for these labels to help identify materials and waste as hazardous. Chemotherapeutic agents must be labeled in a manner that plainly warns handlers of the hazards.

No matter what hazardous materials and waste may be present, there should be an organization-wide labeling system that all employees understand. The effectiveness of such a system depends on its visibility and recognizability by staff and others as appropriate.

## *Handling*

An organization needs to provide adequate space and facilities for the handling and storage of flammable, corrosive, teratogenic, and other materials, and for the handling and processing of biohazards (for example, laboratory specimens). The space available must be appropriate to the type of hazard and secure from unauthorized access. Handling and processing areas must be kept sanitary. In addition, biological and chemical hoods must be provided as appropriate to maintain separation between humans and hazards. Appropriate administrative, engineering, and work practice controls should always be employed, in addition to the use of personal protective equipment.

Waste processing areas should be separated from "clean" areas. Hazardous waste should be separated from ordinary trash and segregated by type of waste. Each type must be handled in a manner that minimizes the hazard to the handler, staff, patients, and visitors. Consideration should be given to the travel paths of waste and sterile or clean supplies within the building so that the two do not come into regular contact. A key component of a successful waste handling system is a minimal travel distance between the final use site and a protected disposal container. One example of this is the installation of sharps containers at patient bedsides. Documentation of the collection and handling of these materials needs to be maintained to allow continuous monitoring and evaluation of the program and, in some cases, to meet legal requirements.

## *Disposal*

Although regulation now restricts some methods of hazardous waste disposal, a variety of developing processes and technology still provide several choices.

Most landfills will not accept chemical or biohazardous waste, being typically limited by regulation or community choice to ordinary waste. Some processing methods for biohazardous waste, which render it nonhazardous, may yield an end product acceptable to some landfill sites.

Sewage disposal is the method of choice for liquid bodily waste, such as urine and some blood specimens. Disposal of chemicals in this manner is strictly regulated by local authorities and depends on the type and quantity of the chemical. The local sewage treatment authority's policies must be

consulted and followed to avoid fines and sanctions. These agencies' tolerance of health care-generated waste varies widely.

Incineration has traditionally been a common method for disposing of many types of waste, including chemotherapeutic and biohazardous. Advantages of incineration include the destruction of the hazard and of the material's identity, reduction of the volume of material to be ultimately discarded, and potential recovery of heat and energy. Disadvantages include the cost of the incinerating facility, the need for controls to prevent air pollution, and the related problems of obtaining permits for building and using the incinerator. In addition, the Environmental Protection Agency has passed additional regulation pertaining to incineration which tightens the limits on resulting pollutants and may, in some cases, make this disposal method cost-prohibitive.

Autoclaving, or steam sterilization, is another common disposal method. The saturated, pressurized steam used in the process gives off no chemical discharge, and the system is relatively inexpensive to institute and use. It is also quite effective for disposable products, such as plastics, that are not regulated wastes. Autoclaving is often used in combination with shredders and other destruction systems because autoclaving alone does not significantly reduce the volume of waste or render it unrecognizable, which is a concern in disposal regulations, especially for anatomic and pathologic waste. New approaches to steam sterilization are being developed, with advances toward greater volume reduction, although recognizability is still a problem.

Mechanical/chemical treatment uses high-speed hammermill or shredder blades and exposes the waste to a chlorine-based disinfectant. This system affords both volume reduction and unrecognizability, as well as lack of emissions. The chief concerns associated with it are the resulting chemical discharge into the sewer system and disposal staff's possible overexposure to chlorine.

Microwave technology for waste disposal was introduced in the United States in early 1990. Waste is first shredded to about 80 percent of its original volume and then exposed to a succession of microwave ovens, which heat the waste from the inside out. This method allows for more thorough sterilization than systems using external heating sources. Microwaving is also environmentally advantageous because it produces no chemical discharge. Costs for microwaving waste range from $0.03 to $0.16 per pound.[4]

Gamma irradiation was originally used in the 1980s in certain types of food applications. When it was found that the dosage could be adjusted to the requirements of various waste materials, it became a viable method of waste disposal, especially when a preheating process was added for greater efficiency. This technology produces no chemical discharge, but there are perceived risks to users from gamma radiation. These perceptions can make it difficult to obtain the permits needed to operate the system. There is also no destruction nor volume reduction of material.

Electro-Thermal-Deactivation™* (ETD™) was originally the preheating process applied to waste prior to gamma irradiation. It is now a stand-alone process in which waste, placed in a high-strength

*Electro-Thermal-Deactivation™ and ETD™ are registered trademarks of Stericycle, Inc Rolling Meadows, Illinois.

oscillating electrical field, absorbs the energy and heats to a minimum temperature of 90°C. The method is similar to microwaving in that the heat is produced simultaneously throughout the material rather than on the surface, but the ETD™ electrical waves are longer, making preshredding unnecessary. The waste must be shredded after treatment to render it unrecognizable. No discharge or chemical use is involved, and certain types of waste may be recycled after treatment.[5,6]

Encapsulation was developed in response to the increasing concern about safe ways to dispose of needles and sharps, the discharge of potentially hazardous substances into sewer systems, and the disposal of contained liquids into other treatment systems. This method is particularly advantageous for small facilities in rural areas where disposal options are limited. With this technique, small amounts of disinfectant are added to standard-looking sharps containers, disinfecting the syringes on contact. When enough sharps have been collected, the container is filled with water and an oxidizing agent that acts as a catalyst to encase the items in a polymer matrix. This, in effect, "fixes" the material and renders it noninfectious.[7] Although there is no chemical discharge or emission, there is also no volume reduction of the waste, and the process is limited to sharps and liquid waste.

Other technologies currently available or in development for use in waste disposal, include thermal systems, pyrolysis, and biocycle systems.[8,9]

Recycling programs are common in health care organizations. They are used for disposal of waste paper, cardboard, glass, batteries, and other items. Recycling may also be appropriate for some types of chemical waste. In some cases expired drugs can be "recycled" back to the manufacturer.[10]

Hazardous waste disposal contractors are the only choice for disposal of some waste, such as most chemical waste, and, in some areas of the country, biohazardous, chemotherapeutic, radioactive, and physical waste. The choice of contractor is critical because the organization cannot delegate the responsibility (and the liability) for the waste. The contractor insures the organization, but the actual liability still rests with the generator of the waste—the health care organization. The contractor chosen must therefore be reputable and experienced. A wide variety of services may be obtained from the contractor. Depending on the location of the facility and the contractor's service fees, an organization may be able to hire one contractor to operate its entire hazardous waste disposal program, or it may engage several specialized contractors to handle each type of waste. Organizations need an ongoing process to evaluate a contractor's effectiveness to be sure the contracted services are being delivered in an appropriate manner.

When choosing disposal methods, organizations must address a variety of factors, including

- environmental concerns;
- cost-efficiency;
- reliability;
- scope of the method (amount and types of waste to which it can be applied); and
- volume of waste generated.