HOSPITAL POLLUTION PREVENTION CASE STUDY

by

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FOREWORD

Today's rapidly developing and changing technologies and industrial products and practices frequently carry with them the increased generation of materials that, if improperly dealt with, can threaten both public health and the environment. The U.S. Environmental Protection Agency is charged by Congress with protecting the Nation's land, air, and water resources. Under a mandate of national environmental laws, the agency strives to formulate and implement actions leading to a compatible balance between human activities and the ability of natural systems to support and nurture life. These laws direct the EPA to perform research to define our environmental problems, measure the impacts, and search for solutions.

The Risk Reduction Engineering Laboratory is responsible for planning, implementing, and managing research, development, and demonstration programs to provide an authoritative, defensible engineering basis in support of the policies, programs, and regulations of the EPA with respect to drinking water, wastewater, pesticides, toxic substances, solid and hazardous wastes, and Superfund-related activities. This publication is one of the products of that research and provides a vital communication link between the researcher and the user community.

In order to effectively implement its pollution prevention programs, the EPA is also investigating how the departments and agencies within the Federal community can help each other reduce their generation of wastes. As a part of these efforts, RREL provides staff and support to conduct waste minimization assessments under the Waste Reduction Evaluations and Assessments at Federal Sites (WREAFS) Program. Under the WREAFS program, the U.S. Department of Veterans Affairs Cincinnati - Fort Thomas Medical Center (DVA-Cin) offered to host an assessment of pollution prevention opportunities at their facility. The DVA-Cin study investigated the use of disposables in patient care in order to identify research opportunities for future solid waste minimization.

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ABSTRACT

In order to effectively implement its pollution prevention programs, the EPA is also investigating how the departments and agencies within the Federal community can help each other reduce their generation of wastes. As a part of these efforts, RREL provides staff and support to conduct waste minimization assessments under the Waste Reduction Evaluations and Assessments at Federal Sites (WREAFS) Program. Under the WREAFS program, the U.S. Department of Veterans Affairs Cincinnati - Fort Thomas Medical Center (DVA-Cin) offered to host an assessment of pollution prevention opportunities at their facility. The DVA-Cin study investigated the use of disposables in patient care in order to identify research opportunities for future solid waste minimization.

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INTRODUCTION

BACKGROUND

The United States Environmental Protection Agency (EPA) is promoting the implementation of pollution prevention as a cost-effective tool toward reducing the discharge of both hazardous and non-hazardous wastes. EPA's Risk Reduction Engineering Laboratory (RREL) is contributing to the Agency's efforts in promoting pollution prevention by conducting research and demonstration projects and programs.

As part of the Agency's efforts, RREL is conducting a series of pollution prevention assessments and demonstrations as part of a program known as Waste Reduction Evaluations at Federal Sites (WREAFS). The program involves conducting pollution prevention assessments at Federal facilities, with an emphasis on facilities involved in production and/or manufacturing.

As part of the WREAFS program, pollution prevention opportunities were assessed at the Department of Veterans Affairs' Cincinnati - Fort Thomas Medical Center (VA-Cin). This report serves as a case study for identifying opportunities for pollution prevention in a hospital setting. The report is based on the information gathered during a site visit to VA-Cin, additional materials provided by officials of the VA-Cin facility, and a literature search.

Hospital costs have skyrocketed throughout this decade. Some analysts attribute the increased costs in health care to the fact that the hospital's expenses are passed on to the patient and eventually reimbursed by medical insurance. Consequently, because costs are passed on, there is a decreased incentive to cut costs. Thus, hospitals may, in general, not readily recognize the cost benefits of incorporating pollution prevention opportunities. VA facilities, alternatively, are not reimbursed for the cost of health care services provided to patients, and therefore have an inherent incentive for achieving cost savings. From this perspective, conducting a pollution prevention case study at a VA hospital was an excellent choice for determining pollution prevention possibilities in a hospital setting.

The VA-Cin Medical Center segregates its waste so as to minimize the amount transported by the infectious waste hauler (unit costs for infectious waste disposal far exceed unit costs for disposal of general refuse). While extensive waste segregation may serve to minimize the amount of regulated medical waste generated and reduce the hospital's overall disposal cost, it is <u>not</u> considered a form of pollution prevention for purposes of this study. To qualify as pollution prevention, source reduction or recycling must occur. That is, the total volume of waste generated (medical and non-medical) must be reduced to achieve pollution prevention.

This study focuses on potential opportunities for minimizing the discarded medical supply wastestream. The study did not consider waste reduction opportunities associated with office wastes, cafeteria wastes, radioactive wastes, pharmaceutical wastes, or chemical/hazardous wastes. Although reducing those wastestreams not investigated in this report is critical to a complete pollution prevention effort, much of this information is available from other sources.

The remainder of the introduction provides a summary of project methodology, findings, and recommendations. More detailed discussions of each of these topics appear in Sections 2 and 3.

PROJECT METHODOLOGY

In assessing pollution prevention opportunities for disposable medical supplies, several questions had to be answered:

- What type of disposable medical supplies are used in a hospital?
- Who uses them?
- How are they used, treated, and disposed?
- Can practices be changed to reduce the generation of disposables?

By answering such questions, pollution prevention opportunities are evaluated through a "mass balance" analysis. A mass or material balance assumes that the material entering a system will be equal to the material leaving the system, plus the material accumulated. Material balances allow for realizing losses that may have gone undetected if a waste stream was characterized based solely upon disposal information (The EPA Manual for Waste Minimization Opportunity Assessments, EPA 625/7-88/003 July 1988). Knowing who uses the supplies within the facility serves to target the assessment to those areas where pollution prevention efforts are most likely to have an impact. Identifying how medical supplies are currently used, treated and disposed suggests whether current efforts already achieve pollution prevention goals. Finally, if current practices do not result in substantial pollution prevention, determining what practices can be changed to reduce a hospital's reliance on disposables will be essential in meeting the facility's pollution prevention goals.

For the purposes of this study, a case study assessment team was established comprising the Deputy Chief of Building Management Services of the VA-Cin facility, RREL project staff, EPA contractors, and an academic from Lamar University with an interest in hospital waste. The team worked closely with VA-Cin officials to gather information relevant to the aforementioned questions. VA-Cin officials were extremely cooperative in all phases of the study -- from the initial discussions through the fulfillment of requests after the site visit was completed. They provided access to information concerning the types and amounts of medical supplies ordered, how those supplies were distributed within the Medical Center and how they were subsequently treated and disposed. Additional information was gathered through a literature review of professional journals at medical libraries, including the National Library of Medicine in Bethesda, Maryland.

What types of medical supplies are used?

The case study team determined the type and degree to which disposable medical supplies were used in the Medical Center by accessing supply sheets from the VA-Cin's Acquisitions and Materials Management Department. These supply sheets list the majority of supplies ordered by the Medical Center's various wards. Certain supplies, not available through the central warehouse, are ordered as necessary by the wards directly from suppliers. To determine the degree to which direct-ordered supplies contribute to the wastestream, the case study team queried relevant ward staff during the site visit.

Who uses these medical supplies?

It was not necessary to gather supply sheets for all wards, because Medical Center professionals estimated that 85 to 90 percent of disposable medical supplies were ordered by the Supply and Processing Department (SPD), the laboratory, and the operating room. SPD is a central supply group that distributes supplies to designated wards and services, including the outpatient clinic, recovery room, and nursing services. Thus, the case study team accessed SPD's order sheets to determine the distribution of supplies from SPD to the wards. In this way, the case study team determined which departments/wards were most likely to generate large quantities of discarded medical supplies.

How are wastes disposed?

In accordance with EPA's definition of pollution prevention, product substitution, recycling and reuse are among the available approaches to pollution prevention. The case study team worked with ward staff to define the list of supplies used (and re-used) in each ward and the method of treatment/disposal employed by ward staff for various disposables. VA-Cin's infectious control practitioner completed a table defining which wastes were disposed of as infectious waste by the facility and which were disposed of as general trash. Also defined are the methods of waste treatment (i.e. autoclaving), if any, used in the hospital.

Can practices be changed to reduce the reliance on disposables?

As discussed in more detail in Section 3, the use of disposables became popular in hospitals about 10 to 15 years ago and, with the spreading of the acquired immune deficiency syndrome (AIDS), the use of disposables has escalated in the last 2 to 3 years. VA-Cin Medical Center staff estimated that approximately 80 percent of hospital supplies are now disposables, as compared to an estimated 20 to 30 percent 10 to 15 years ago. According to VA-Cin staff, the reasons for changing from reusables to disposables include: convenience to the staff, improved quality assurance/quality control that can be achieved at a central manufacturing facility, the absence of space and skilled staff to conduct re-processing, and infection control concerns.

The case study team's research at medical libraries, including the National Library of Medicine (NLM) in Bethesda, Maryland, revealed that professional journals aimed at hospital administrators, plant engineers, nurses, and infection control practitioners have considered the general topic of substituting reusables for disposables, and the possibility of reusing disposables. The literature revealed that factors behind the medical profession's preference for disposables include:

Cost - The use of disposables eliminates the costs associated with in-house reprocessing.

Convenience - Items such as disposable operating room packs provide all of the needed materials for a given procedure presterilized and prepackaged.

Labor shortages/wages - The manpower needed to reprocess reusables is eliminated along with the costs associated with the labor.

Space constraints - Because disposable products can be ordered as they are needed, only limited storage space is required.

Health and safety - Prepackaged and presterilized products reassure medical professionals of a product's sterile integrity.

FINDINGS

The review of supply sheets indicated that the largest requisitioners of disposable supplies in the hospital are the SPD (serving patient wards and the outpatient clinic), the laboratory, and the operating room. This corresponded to the Chief of Acquisitions and Materials Management's estimation that 85 to 90 percent of disposables consumed by the hospital are used by these three wards/departments. This

parallels the results of an earlier EPA study[1] that reported that the largest sources of medical waste within hospitals were: the laboratory, the operating room, and medical/surgical units (Appendix C). The case study team focused its site visit on these three waste-generating wards/departments as well as the inpatient and outpatient wards.

Hospitals make use of a large number of disposable medical supplies. As mentioned above, reasons for using disposables, as opposed to recyclables, include cost, convenience, labor shortages/wages, space constraints, and health and safety factors. Two general types of disposable medical supplies are currently used in hospitals: plastics and paper (non-woven) products. Plastics have replaced much of the glassware previously found in hospitals. Hospitals have turned to plastic disposables for a variety of reasons, including health and safety concerns. VA-Cin Medical Center staff, and the literature review, revealed almost uniform reluctance to return to glassware. Thus, source reduction may not be possible. However, recycling opportunities may exist for plasticware.

The VA-Cin facility, unlike most hospitals, continues to make extensive use of wovens (as opposed to disposable paper products) for items such as gowns and drapes. This practice is an extremely effective form of pollution prevention. If paper products were used, the volume of material disposed would increase greatly.

As a result of cost considerations, the VA Medical Center has not replaced wovens with paper/plastic products. The facility has access to a VA operated laundry and continues to make use of that laundry. However, even within the VA-Cin facility, there has been a recent interest, and increase, in the use of paper gowns. Concern over worker health and safety, especially with the advent of AIDS, is the primary reason for the increased use of paper in hospitals, even when a facility has access to laundry services. Unlike industrial/commercial facilities where cost serves as the primary incentive for pollution prevention, in a hospital setting, cost incentives are second to health and safety concerns.

RECOMMENDATIONS

This study generally recommends that hospitals should review their lists of disposable medical supplies and determine which of these disposable supplies can be replaced with reusables or whether disposables can be reused after sterilization, without sacrificing safeguards to protect worker and patient health and safety. Where source reduction is not possible, recycling opportunities should be investigated. Current literature suggests that there are innumerable concerns associated with reuse of medical supplies. The basic rule has been to reuse supplies where risks of infection are judged to be sufficiently low, and costs make reuse viable.

However, the literature suggests that as a result of the multitude of factors involved in making the decision of disposable versus reusables (including functional reliability, legal and liability issues, economics, work place hazards, and ethics), health care institutions must make their decisions on an individual basis. The Medical Center's Commodity Standardization Committee offers an ideal forum to review opportunities for pollution prevention. While other concerns such as health, safety, cost, or convenience may be at issue, opportunities to undertake pollution prevention should be considered. Specific recommendations are provided in Section 3.

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[1] Characterization of Medical Waste Generation, Treatment, and Disposal Practices in New York and New Jersey, USEPA Region II, January 30, 1989. This document is alternatively referred to as the NY/NJ study in this report.

ORGANIZATION OF THIS REPORT

The remainder of this report is divided into two sections. The next section provides the information gathered from the site visit conducted at the VA-Cin Medical Center and includes lists of the major disposable supplies used in each waste-generating ward observed and how those supplies are currently treated and disposed. The information reported in Section 2 includes observations made by the case study team and statements made by VA-Cin staff. The final section describes the opportunities and limitations for minimizing the disposable medical supply wastestream.

SECTION 2

SITE VISIT

GENERAL FACILITY DESCRIPTION

The Veteran Affairs' Medical Center in Cincinnati (VA-Cin) is a government-owned, general medical and surgical hospital offering four principal areas of service: medical, surgical, psychiatrical, and neurological. The facility maintains 415 authorized and 342 operating beds. The Medical Center is large relative to other private and government-owned hospitals. In the same manner that hospital size is expressed in terms of number of beds, hospital waste generation studies express generation rates in terms of volume of waste generated per occupied bed.

Table 1 lists the number of beds and occupancy rates for the Medical Center's four major service areas. As shown, the medical and surgical service departments maintain 246 beds, with approximately 128 occupied or 52 percent occupancy. The American Hospital Association (AHA) determined the national average to be 65 percent occupancy for general hospitals and 73.2 percent occupancy for Federal general hospitals (Hospital Statistics, AHA, 1988). According to facility staff, the relatively low occupancy rate at the VA Medical Center is partly a result of the lack of available nursing staff for all of the patient beds.

The VA-Cin facility provides outpatient services for approximately 500 individuals per day. The outpatient clinic conducts medical exams and surgical procedures and its sections include chemotherapy, dermatology, ear, nose and throat (ENT), orthopedics, plastic surgery, and urology.

In addition to the medical waste generated through inpatient and outpatient services, the VA-Cin facility also manages wastes for an associated research facility, nursing home, and home health care services.

METHODOLOGY

As stated in Section 1, the case study assessment team conducted the pollution prevention opportunity review using a mass balance approach. Such an approach requires that each component of a process be evaluated. To achieve this objective, a program task force was established by the VA-Cin. The task force included hospital employees involved with supply, use, treatment, and disposal activities at the Medical Center.

At the initial meeting between the EPA and the VA task force, the following task force representatives were present:

- Chief, Building Management Services (Chair)
- Assistant Chief, Building Management Services (EPA contact)
- Infectious Control Practitioner
- Industrial Hygienist
- Facility Engineer.

In addition to these representatives, an industrial hygienist from VA Headquarters in Washington, D.C. attended as an observer. Individual task force members and their professional responsibilities are listed

TABLE 1. NUMBER OF BEDS AND OCCUPANCY RATE[a]

Service/Ward	Number of Operating Beds	Number of Occupied Beds	Average Occupancy Rate (%)
Medical Services			--
Patient Floors	74	47	--
MICU/CCU	8	8	--
Hemodialysis Unit	9	6.2[b]	--
Inactive Ward	33	0	--
Total	124	61.2	49.4
Surgical Services			--
Patient Floors	32	30.5[c]	--
SICU	8	7	--
GU/Orthopedics	37	18	--
Neurosurgery	12	11	--
Inactive Ward	33	0	--
Total	122	66.5	54.5
Total	246	127.7	51.9
Psychiatric Services	75	70	99.3
Neurology	24	17	70.8
TOTAL	345	214.7	62.2

[a]SOURCES: Medical Center Bed Status Report, Period Ending Midnight, Tuesday June 27, 1989 (VA Medical Administration Service) and Site Visit Interviews.

[b]See Appendix B for calculation of hemodialysis occupied beds.

[c]The site visit estimate was 30-31 occupied beds.

TABLE 2. VA PROGRAM TASK FORCE

Task Force Member	Professional Responsibility
Raynold Cole (Task Force Chair)	Chief, Building Management Services
Patrick Barry	Assistant Chief, Building Management Services
Ron Sollberger	Industrial Hygienist
Dave Ninneman	Plant Engineer
Linda Danko	Infectious Control Practitioner

in Table 2. Each of the members was selected to serve on the program task force based on their responsibility for waste management services within the hospital. Among other things:

- Building Management Services is responsible for collection of wastes within the hospital including laundering;
- Engineering is responsible for establishing contracts with waste haulers, and for operation of the facility incinerator; and
- The Infectious Control Practitioner and Industrial Hygienist are responsible for establishing policies and ensuring compliance with waste handling procedures.

Notably absent from the program task force were professionals responsible for the ordering and distribution of medical supplies throughout the facility. Program task force members associated with Building Management Services and the Infectious Control Practitioner also served on the facility's Commodity Standardization Committee. The Commodity Standardization Committee is responsible for reviewing products currently in use or of potential use, in the hospital from cost, comfort, safety and convenience perspectives. As the authority to implement new products resides with the Committee, the ultimate success of any pollution prevention effort would necessarily involve consideration of pollution prevention objectives by the Commodity Standardization Committee.

As described in the EPA Waste Minimization Opportunity Assessment Manual, the initial responsibilities of the program task force are:

1) Obtain a commitment from management
2) Establish priorities for assessing the wastestreams or facility areas
3) Select case study assessment team
4) Conduct (or supervise) assessment.

In addition, at the completion of the assessment, the task force's responsibilities include defining pollution prevention goals, conducting further detailed evaluations of technical/economic feasibility, selecting options for implementation, obtaining all necessary funding, and monitoring performance. Given these responsibilities, the importance of integration between the program task force and the Commodities Standardization Committee becomes more apparent. The following briefly describes how the program task force executed each of the four aforementioned initial tasks:

1) Obtain a commitment from management: From the onset, VA-Cin officials showed strong support for a pollution prevention opportunity assessment. Their commitment and interest was immediately manifested in their offer to charter the task force.

2) Establish priorities for assessing wastestreams or facility areas: Much of the initial meeting, and subsequent conversations between EPA and the VA-Cin facility, concerned which hospital wastes should be the focus of the assessment. Disposable medical supplies were selected as the waste of interest. In addition, the site assessment focused in on those wards/departments ordering the majority of disposable supplies.

3) Select case study team: The task force chair assigned the Assistant Chief of Building Management Services to be the hospital's representative on the case study team. Other members of the team included two EPA staff members, two contract employees, and an outside observer. In addition, as the case study team progressed through each ward/department, a designated hospital staff member, familiar with the activities within that ward/department, provided assistance and pertinent information.

4) Conduct (or supervise) assessment: The case study team's schedule and access to VA staff and departments was managed by the Assistant Chief of Building Management Services. All subsequent information requests were funneled through Building Management Services.

Following an initial meeting with the program task force, VA-Cin officials provided the following materials to the case study team:

1) A blueprint of the case study facility, clearly labeling various wards/departments, soiled utility rooms (waste storage rooms), and treatment/disposal areas

2) A completed inventory (based on a checklist provided by EPA) of wastes generated at the facility, along with waste handling methods

3) A listing of relevant VA-Cin policies

4) Estimates of wastes burned in the facility's onsite incinerator, and

5) Estimates of wastes generated by ward/department.

These documents, along with the information gathered during the meeting, were used to produce an operations summary. The summary preliminarily identified the points of interest for the site visit. The two information sources most useful to the development of the operations summary were the completed inventory of waste generation and treatment/disposal methods and the facility blueprint. These appear in Appendices B and E, respectively.

The VA-Cin infectuous waste control practitioner provided an inventory identifying areas within the hospital where wastes are generated and how they are handled. She noted that the VA-Cin facility defines its medical waste handling practices based on the Center of Disease Control's (CDC) Universal Precautions of body substance isolation. Presently, the VA-Cin Medical Center categorizes its wastes into five groups: general, chemotherapy, blood and body fluids, sharps, and radioactive. Determining which category a waste falls in also dictates its manner of disposal. Disposal methods include contracting with an infectious waste hauler, contracting with a toxic waste hauler, making use of the sewer system, sending wastes to an animal crematorium and autoclaving materials on-site prior to disposal offsite by a waste hauler. The completed checklist (Appendix B) identifies: the waste category of each waste, the ward generating each waste type, and the treatment/transport/disposal methods employed. Based on this information, Table 3 was generated. It provides a list of disposable medical supplies, the generating ward, and the disposal method in use.

The information from the sight of generation/disposal method checklist, the facility blueprint and the NJ/NY study, enabled the team to formulate a comprehensive operations summary.

TABLE 3. SITE OF GENERATION AND TREATMENT/DISPOSAL METHODS FOR MEDICAL SUPPLY WASTE STREAM

Disposal Method	Waste Category	Waste Type	Ward
	4	Broken glass (depends what it contained)	Patient care areas
	4	Broken glass (depends what it contained)	Lab service
	6.1	Sanitary napkins, tampons	Patient care areas
L	6.1	Bedding (respiratory isolation)	Patient care areas
L	6.2	Bedding (strict isolation)	Patient care areas
A	3	Blood components	Lab service
A	3	Blood derivatives	Lab service
A	3	Blood vials	Lab service
A	2	Body fluid specimen containers (full)	Lab service–inc.path
A	4	Broken glass beakers (soiled and used in lab)	Lab service
A	4	Broken glass flasks (soiled and used in lab)	Lab service
A	4	Broken glass test tubes (soiled and used in lab)	Lab service
A	4	Broken rigid plastic items (soiled and used in lab)	Lab service
A	4	Cover slips	Lab service
A	1	Culture dishes/devices to transfer, inoculate, mix cultures	Lab service
A	1	Culture media	Lab service
A	1	Cultures and stocks of medical and pathological labs	Lab service
A	4	Glass blood vials	Lab service
A	4	Glass culture dishes	Lab service
A	3	IV bags – containing blood	Lab service
A	4	Lancets	Lab service
A	4	Pasteur pipettes	Lab service
A	4	Slides	Lab service
A	6.1	Specimen containers (respiratory isolation)	Patient care areas
A	3	Test tubes	Lab service
C	3	IV bags – containing cytotoxics	OR
C	3	IV bags – containing cytotoxics	Patient care areas
C	4	Syringes (with or without attached needle) – cytotoxic	Patient care areas
C	4	Syringes (with or without attached needle) – cytotoxic	OR
C	4	Syringes (with or without attached needle) – cytotoxic	Pharmacy
G	2	Body fluid specimen containers (empty)	OR
G	2	Body fluid specimen containers (empty)	Lab service–inc.path
G	2	Body fluid specimen containers (empty)	Patient care areas
G	6.1	Bedpan (respiratory isolation)	Patient care areas
G	6.1	Urinal (respiratory isolation)	Patient care areas
G	6.1	Enema bags (respiratory isolation)	Patient care areas
G	6.1	Disposable diapers (respiratory isolation)	Patient care areas
G	6.1	Hot water bottle (respiratory isolation)	Patient care areas
G	6.1	Gowns, booties, cap (respiratory isolation)	Patient care areas
G	1	Clean up materials	Lab service
G	3	IV bags – other (non–blood, –cytotoxic)	Patient care areas
G	3	IV bags – other (non–blood, –cytotoxic)	OR
I	4	Hypodermic needles	Patient care areas
I	7	Hypodermic needles	Patient care areas
I	7	Hypodermic needles	Pharmacy
I	4	Hypodermic needles	Pharmacy
I	4	Hypodermic needles	OR
I	4	Instruments designed for cutting and puncturing – disposable	Patient care areas
I	4	Instruments designed for cutting and puncturing – disposable	Lab service–path.
I	4	Instruments designed for cutting and puncturing – disposable	OR

continued

TABLE 3. SITE OF GENERATION AND TREATMENT/DISPOSAL METHODS FOR MEDICAL SUPPLY WASTE STREAM (Continued)

Disposal Method	Waste Category	Waste Type	Ward
IH	3	Dressings *	OR
IH	3	Dressings *	SICU
IH	3	Dressings *	Patient care areas
IH	6.1	Drinking cups (respiratory isolation)	Patient care areas
IH	6.2	Drinking cups (strict isolation)	Patient care areas
IH	6.2	Enema bags (strict isolation)(disposable)	Patient care areas
IH	6.1	Gauze (in contact w/ oral/nasal secretions)(resp isolation)	Patient care areas
IH	6.2	Gauze (strict isolation)	Patient care areas
IH	3	Gauze *	Patient care areas
IH	3	Gauze *	PEA
IH	3	Gauze *	Clinic
IH	3	Gauze *	OR
IH	3	Gloves *	OR
IH	3	Gloves *	Patient care areas
IH	3	Gloves *	PEA
IH	3	Gloves *	Clinic
IH	3	Gowns *	Clinic
IH	3	Gowns *	Patient care areas
IH	3	Gowns *	OR
IH	3	Gowns *	PEA
IH	6.2	Gowns, booties, cap (strict isolation)	Patient care areas
IH	6.2	Hot water bottle (strict isolation)(disposable)	Patient care areas
IH	6.1	Masks (respiratory isolation)(worn by patient)	Patient care areas
IH	6.2	Masks (strict isolation)	Patient care areas
IH	3	Masks *	OR
IH	3	Masks *	PEA
IH	3	Masks *	Clinic
IH	3	Masks *	Patient care areas
IH	3	Paper towels *	Patient care areas
IH	3	Paper towels *	Lab service
IH	6.2	Sanitary napkins, tampons	Patient care areas
IH	6.2	Specimen containers (strict isolation)	Patient care areas
IH	3	Surgical sponges *	OR
IH	6.1	Thermometer covers (respiratory isolation)	Patient care areas
IH	6.2	Thermometer covers (strict isolation)	Patient care areas
IH	6.1	Tissue with nasal secretions (respiratory isolation)	Patient care areas
IH	6.2	Tissue with nasal secretions (strict isolation)	Patient care areas
IH	6.1	Toothbrushes (respiratory isolation)	Patient care areas
IH	6.2	Toothbrushes (strict isolation)	Patient care areas
IH	3	Underpads, disposable sheets *	Clinic
IH	3	Underpads, disposable sheets *	OR
IH	3	Underpads, disposable sheets *	Patient care areas
IH	3	Underpads, disposable sheets *	PEA
IH	6.2	Urinal (strict isolaiton)(disposable)	Patient care areas

TABLE 3. SITE OF GENERATION AND TREATMENT/DISPOSAL METHOD FOR MEDICAL SUPPLY WASTE STREAM (CONTINUED)

KEY:

- Waste Categories

1. Cultures and stocks of infectious agents and associated biologicals
2. Human pathological wastes
3. Liquid human blood, products of blood, items saturated and/or dripping with human blood or items that were saturated and/or dripping with human blood that are now caked with dried human blood
4. Sharps that have been used in animal or patient care or treatment or in medical, research or industrial laboratories
5. Contaminated animal carcasses, body parts, and bedding of animals that were known to have been exposed to infectious agents during research (not included in scope of study)
6. Biological waste and discarded materials contaminated with blood, excretion, exucated or secretions from humans who are isolated to protect others from certain highly communicable diseases, or isolated humans who are isolated to protect others from highly communicable diseases

    6.1 Involving Humans in Respiratory Isolation
    6.2 Involving Humans in Strict Isolation
    6.3 Involving Animals

7. Unused sharps

- Disposal Methods

G. General waste hauler

A. Autoclaved on station, then becomes general waste

I. Incinerated on station

H. Removed from station by liscensed infectious waste hauler

A. Removed from station by an animal crematorium and cremated (not included in scope of study)

C. Removed from station by licensed cytotoxic waste hauler.

An abbreviated checklist to guide case study team was developed prior to the site visit. The checklist consisted of general questions, such as:

1) The type of service provided and the number of patients or beds

2) Activity measures, such as the number of blood tests conducted

3) The rationale for the use of disposables versus reusables

4) The potential for substituting disposables with reusables (and the advantages and disadvantages of substitution)

5) Treatment/disposal methods used, and

6) General trends in the use of disposables and reusables.

Conducting the Site Visit

The site visit was conducted on August 16 and 17, 1989. The site visit agenda is presented in Table 4. Each ward/service was visited and questions were asked based on the checklist. VA officials were also afforded time to discuss other relevant issues beyond those raised as a result of the interview checklist.

On Day 1, the case study team initially met with Supply, Purchasing, and Distribution (SPD) and Acquisitions and Material Manifest (A&MM) to develop a better understanding of the supply and distribution system within the hospital, and to ensure that questions were targeted properly. SPD and A&MM professionals not only provided an overview of the hospitals supply and distribution systems, but also provided historical background of the general trends in materials management over the past 30 years.

Other areas visited on Day 1 included:

- Surgical Intensive Care Unit (SICU)
- Outpatient Clinic
- Medical Waste Storage Area
- Medical Intensive Care Unit (MICU), and
- Cardiac Care Unit (CCU)

Day 2 consisted of visits to the medical waste storage area, the incinerator, patient floors, the laboratory, hemodialysis, and research wards/departments.

Upon completion of the site visit, additional information requested from VA-Cin officials included the following:

1) Additional issue books and clarification of nomenclature in the issue books

2) The number, size, and originating ward of sharps boxes generated each week

TABLE 4. SITE VISIT AGENDA 8/16-17/89
- VA Medical Center - Cincinnati

Day 1:	Wednesday 8/16/89:		
	Department	Time	Contact
	Supply, Purchasing, and Distribution	9:30-10:30	Zephy Cross
	Acquisition and Materials Mgmt.	11:00-12:30	Paul Mang
	Surgery	12:30-1:30	Jeff Griffith, RN
	Surgical Intensive Care Unit	1:30-2:00	Martha Harrison, RN
	Outpatient Clinic	2:00-2:30	Barbara Bales, RN
	Basement Storage Area	2:30-3:00	Pat Barry
	Medical Intensive Care Unit and Cardiac Care Unit	3:00-3:30	Judy Monroe, RN
Day 2:	Thursday 8/17/89:		
	Basement Storage Area	8:30	Pat Barry
	Incinerator	8:30-9:00	Rich Crene
	Patient Floor	9:30-10:30	Maria Behan, RN
	Laboratory		
	Histopathology	10:45-11:00	Betty Williford
	Hematology	11:00-11:30	Pamela Dyer
	Clinical Chemistry	11:30-11:45	Ken Mescher
	Microbiology	11:45-12:00	Dr. Gilchrist
	Lab Supervisor	12:45-1:30	Dr. Copeland
	Hemodialysis	1:30-1:45	Freda Cassidy
	Research	1:45-2:30	Judy Harrison

3) The number of chemotherapy boxes generated by ward

4) The number of bags of blood and body fluid waste generated by ward, and

5) The number of Petri dishes, Vitex cards, and rapid RH panels ordered by the microbiology laboratory.

This information was essential in compiling a complete list of medical supplies used at the facility and in identifying pollution prevention practices already in use at the facility.

SITE VISIT RESULTS

Summaries of site visit results are presented below by ward/department. The summaries are presented in the order that the wards/departments were visited by the case study team. Each site visit summary provides a list of the disposable medical supplies used in that ward or department as well as the waste handling, treatment, and disposal practices employed there. In addition, each summary includes an exhibit providing the number of disposable medical supplies ordered by that ward; the quantity of each item ordered in a six month period; and whether or not the Medical Center currently disposes the named disposable supplies as infectious waste.

SPD and A&MM

Supply, Purchasing and Distribution (SPD) and Acquisition and Materials Management (A&MM) were the first two departments visited by the case study team. Visiting these departments early in the process was essential to the success of the opportunity assessment because it allowed the case study team to understand more fully:

1) The degree to which the hospital made use of disposables;

2) The primary uses of disposables in the hospital;

3) The factors contributing to the extensive use of disposables in a hospital environment; and

4) The opportunities for converting from disposables to reusables.

In addition, SPD and A&MM staff were extremely helpful in explaining the supply, purchasing, and distribution system. Moreover, by gathering order sheets directly from SPD and A&MM, the case study team was able to make more efficient use of the time allotted for interviews with ward/department professional staff.

The following discussion summarizes results of meetings with SPD and A&MM staff. The four issues stated above were investigated.

To what extent does the hospital use disposables?

The majority of waste generated by a hospital consists of disposable products. According to SPD and A&MM, approximately 80% of the hospital's supplies are disposable (i.e., disposed after a single use). Supplies ordered from the central warehouse are termed "posted." Eighty percent of the hospital's supplies are posted, the remaining 20% of the hospital's orders are unposted (ordered directly from the supplier). Exhibits in each of the following subsections present the major disposable items ordered by

Laboratory Services, Surgery, SICU, MICU, 5 South (a patient floor), Hemodialysis, and the Outpatient Clinic. These exhibits were generated from each ward's "issue book." Issue books list the supply orders placed to the central warehouse by each ward/department.

The VA saw a change from reusables to disposables 10-15 years ago and an additional increase in the use of disposables in the last 2-3 years as a result of the spread of the AIDS virus. The most recent increase results from increased usage of existing disposable supplies (i.e. disposable gloves and masks), rather than from the use of newly developed disposable items.

Which wards/departments are the major purchasers of disposables?

The major purchasers of disposables at VA-Cin are in descending order:

- Supply, Purchasing, and Distribution
- Laboratory Services
- Surgery.

These three service areas together order approximately 85-90% of the hospital's disposables. SPD, unlike the lab and OR, is not a user of supplies. Rather, it serves as a central distribution point for all nursing services (inpatient floors and the outpatient clinic).

What factors explain the extensive use of disposables in the hospital environment?

According to VA officials, the use of disposables reduces the potential for health risks, and saves time, money, and man-hours by eliminating the need for re-sterilization and re-processing. The fact that the VA is not reimbursed for its health care services compels the Center's administrative staff to be extremely cost-conscious. VA officials are convinced that disposables are less expensive than reusables in many instances; consequently, cost is cited as the key reason for using disposables. In addition, hospital personnel stated that most reusables are no longer available as hospital supplies, although many reusable products remain available to the home health care market.

What opportunities for converting from disposables to reusables exist?

VA officials expressed their belief that it was unlikely that hospitals would convert back to the use of reusables on a wholesale basis. Concern over worker health and safety and a belief that disposable are more cost efficient are the major impediments to the return of reusables. Additionally, as mentioned above, hospital supply companies no longer market many reusables, making large quantities of reusables inaccessible to the hospital industry.

Still, pollution prevention is a reasonable objective in a hospital setting. The VA-Cin presently uses wovens as opposed to disposable gowns, greatly reducing waste volumes. Another method for reducing waste generation is through the reuse of disposables. While the VA-Cin employee training course specifies that, for health and safety reasons, reuse of disposables is ill-advised, such reuse occurs in the Medical Center, as well as other hospitals throughout the nation. In addition, recycling opportunities may exist for plastics and glassware. Further discussion of pollution prevention opportunities and limitations is provided in Section 3.

Which wards/departments are the major users of disposables?

Laboratory Services

The Laboratory Services Department performs analyses on specimens taken from patients throughout the Medical Center. In a nine month period, ending June 30, 1989, the laboratory conducted

41,097 venipunctures, 9,935 bacterial cultures, 4,730 blood cultures, 854 fungal cultures, and 815 tuberculosis cultures. The Laboratory consists of four separate areas: hematology, clinical chemistry, microbiology, and histopathology. These areas are located on the second floor (Appendix E) of the Medical Center.

The major items ordered from the hospital warehouse for use in the laboratories are presented in Table 5. Included on the list are blood collecting tubes, surgical drainage tubes, needles, surgical sponges, and gloves. Many items used in the laboratories are "unposted" (not supplied by the warehouse) and, therefore, are not represented in Table 5. Commonly ordered "unposted" products are discussed in the text. The hematology, clinical chemistry, and microbiology laboratories are major users of disposable medical supplies. Comparatively low volumes of disposable medical supplies are generated by the histopathology laboratory.

All of the VA's laboratory wastes are currently placed in orange biohazard bags, and autoclaved, thereby rendering the wastes non-infectious and suitable for general trash disposal.

Coffee cans lined with the biohazard bags are stationed at each technician's work area for use as waste receptacles. Disposable plastic sharps containers will soon replace the use of coffee cans and biohazard bags. This measure is being taken to reduce the risk of puncture injuries workers are exposed to during routine maintenance of the coffee can setup (i.e. removing and transporting biohazard bags to the autoclave room when they are full). The substitution will increase the volume of waste generated in the laboratory to ensure occupational safety. This change exemplifies the trade off that occurs between pollution prevention and safety in the health care arena (i.e. coffee cans will not be "recycled" for use as waste receptacles because they do not offer the same level of protection from puncture wounds, and associated risks of infection, as specially designed sharps containers).

Hematology Laboratory

The hematology laboratory draws and analyzes blood samples from 50-60 patients per day. The technicians visit the patient floors and the outpatient clinic to draw blood samples, returning to the hematology testing area to conduct the analyses.

Cloth gowns are currently worn by staff when blood is drawn, and are replaced with a second cloth gown for work in the laboratory. All gowns are laundered for reuse. To reduce the potential occurrence of infection during visits to the patient floors and outpatient clinic, the laboratory is considering requiring its technicians to use disposable gowns during floor visits. The paper gown would then be discarded, and the technicians would continue to use cloth gowns while in the laboratory.

Waste Generation--

Disposable products employed in the hematology laboratory include: test tubes (glass and plastic), glass slides, needles, VACUTAINER blood collection sets, gauze, gloves, chucks (placed under microscopes), pipettes (glass and plastic), plastic pipette tips, and other plastic testing items (e.g., cuvettes used to test blood coagulation).

The VA Medical Center generally disposes of infectious waste in three sizes of bags: 1 gallon (small), 5 gallon (medium), and 30 gallon (large). The hematology laboratory generates approximately 2 large bags of autoclaved waste per day consisting in part of approximately 15-20 small bags of waste collected from the work station coffee cans.

A blood bank, operated by an outside concern, is co-located with the hematology lab. The blood bank uses disposable glass pipettes, wooden applicators, and plastic blood bags. As a result of its activities, the blood bank generates no more than one large bag of autoclaved waste per week.

TABLE 5. LABORATORY SERVICES - PREVALENT "POSTED" DISPOSABLES ITEMS[a]

Purchase Item	Number of Items[b]	Number Ordered in a 6 month period	Disposed of as Blood and Body Fluid Waste
Blood Collecting Tubes (Glass)	2	33,500	No
Surgical Drainage Tubes	1	850	No
Urine Specimen Kit	1	4,500	No
Needles	2	25,100	No
Syringes	3	40	No
Gloves	6	4,496	No
Surgical Sponges	1	137,000	No
Dressing/Bandages/Gauze	1	1,900	No
Adhesive Tapes	1	688	No
Facial Tissues	1	33,500	No
Total number of items represented	19		

[a]This list was generated from the Laboratory Services, January 1989-June 1989 Issue Books for ordering supplies from the warehouse. Note that most of the laboratories' products are "unposted" (i.e., not supplied by the warehouse).

[b]Number of items represents the number of varying items within the same category (i.e., there are two different sizes of blood collecting tubes listed in the Issue Book. The table lists all sizes of the same type under one name.

[c]Sharps are autoclaved and incinerated on site. All other laboratory waste is autoclaved and disposed of as general trash.

[d]50% of the products ordered from the warehouse by Laboratory Services are listed in this Table. A total of 38 items are ordered by Laboratory services from the warehouse.

Handling/Treatment/Disposal--

Each of the 5-6 work stations in the hematology laboratory are equipped with coffee cans lined with small biohazard bags. Small disposable items, such as pipettes and pipette tips are placed in these receptacles. When the cans are full, the liner bags are removed and delivered to the adjacent autoclave room, and placed in the larger autoclavable bags. There is also a large bag in a trash canister located next to the CBC machine (blood analyzer). This receptacle is used for the disposal of gauze squares (used to remove test tube stoppers) and gloves that are worn during blood analysis. Approximately 1-2 gauze squares are used per sample. The receptacle is emptied periodically, and its contents are autoclaved. As mentioned earlier, autoclaved waste is rendered non-infectious and placed in the general trash. Used sharps, generated from drawing blood in patient or treatment rooms are placed in sharps boxes mounted in each patient room. The hematology laboratory professionals are not responsible for the disposal of these needles. The technician returns to the lab with only the samples and VACUTAINER blood collection sets. The blood collection sets are dropped in the sharps boxes located in the hematology lab. The sharps boxes are taken by housekeeping staff to the incinerator on the ninth floor for weekly incineration.

Clinical Chemistry Laboratory

The clinical chemistry laboratory is housed in the same room as the hematology laboratory. Professionals in this laboratory conduct blood serum and urine analyses. The samples analyzed in the chemistry lab are drawn by the hematology technicians.

Waste Generation--

The generation of disposable medical supplies in the clinical chemistry lab is essentially equal in volume to that which is generated by the hematology laboratory. Approximate waste generation rates of the principal disposables employed in the clinical chemistry lab are listed below:

- glass test tubes - 2,100 per week
- glass sample cups - 2,000 per week
- dry reagent slides - 21,000 per week

Waste generation rates of those disposables constituting a lesser volume of the total wastestream include:

- plastic cuvette rings - 25 per week
- urine sample containers - 280 per week
- pipette tips - 140 per week

All of the items used in the clinical chemistry laboratory are "unposted" items and thus, are not included in Table 5. Because many of this laboratory's supplies have short shelf-lives (e.g., reagent slides), they must be ordered directly from the suppliers.

The clinical chemistry lab generates 1.5 to 2 large bags of autoclaved waste per day.

Handling/Treatment/Disposal--

The waste from the hematology lab and the clinical chemistry lab are handled together and treated in the adjacent autoclave room. The waste is packaged in orange biohazard bags, autoclaved, and then placed in the general trash.

The cuvette rings, used for testing blood coagulation, are often washed and reused 5-10 times before being disposed. These are the only disposable medical supply items that are reused in this laboratory. According to those interviewed, the high cost of the cuvette rings ($2.30 each) dictates their reuse prior to disposal.

Uncontaminated broken glass is placed in a cardboard box to prevent cuts or injuries. The cardboard box is disposed of as general trash. Blood contaminated glass is autoclaved and then placed in cardboard boxes for general waste disposal.

Microbiology Laboratory

This section of the laboratory generates the greatest amount of disposables by weight. The weight of the discarded supplies is due to the high volume of glass products disposed of in the microbiology lab.

Waste Generation--

According to the microbiology laboratory staff, disposable products comprise 98% of all their autoclaved waste. At least 3 large bags of autoclaved waste are generated in the microbiology lab each day. The principal disposable is glass Petri plates pre-prepared with agar, a culture media. Approximately 1500 are disposed of weekly. Other autoclaved disposables include: blood culture bottles, Vitek cards (used to identify bacteria - 225/week), contaminated slides, paper towels used to clean work areas (per Universal Precautions), disposable gowns and gloves (needed in tuberculosis isolation rooms), needles and syringes, and reagent strips (8/week).

Handling/Treatment/Disposal--

Contaminated wastes, such as Petri dishes, are disposed in trash barrels lined with large orange biohazard bags. Coffee cans, lined with small biohazard bags, are located at each work station for small objects such as Vitek cards. These wastes are autoclaved and then disposed of in the general trash.

Non-contaminated slides are placed in sharps containers and larger non-infected glass waste is placed in the covered cardboard box designated for discarded glassware. All other non-contaminated items are disposed of directly in the general trash.

Needles and syringes are autoclaved in sharps containers prior to incineration. Rh panels, used to test the Rh factor in blood, are the only lab items disposed of as blood and body fluid and consequently transported by a licensed infectious waste hauler. The lab uses approximately 6 Rh panels each week.

The microbiology lab does not reuse any disposable products. Petri dishes are not reused because: (1) they are difficult to clean properly, without sacrificing the integrity of the product, and (2) preparation of media is a labor intensive activity that can be achieved more cost effectively, and at a higher standard of quality, by an offsite manufacturer.

Histopathology Laboratory

The histopathology laboratory, located on the second floor (Appendix E), is responsible for analyzing tissue specimens and body parts from surgery and the morgue.

Waste Generation--

While this laboratory generates volumes of biopsy waste and body parts, it uses a limited number of disposable items. They include:

- physicians' gloves
- paper towels
- specimen bags (Ziploc bags), and
- specimen containers.

No more than one medium-sized, 5 gallon bag of autoclaved waste is generated per day.

Handling/Treatment/Disposal--

The disposable items listed above are autoclaved and rendered non-infectious, and disposed of in the general trash. Pathological wastes are incinerated onsite. Disposable specimen containers containing formaldehyde are autoclaved prior to incineration.

Surgery Department

The Surgery Department handles approximately 15 cases per day. According to VA officials, the VA hospital is one of the last hospitals in Cincinnati to use reusable woven gowns. Surgery staff attributed the use of wovens in the VA-Cin Medical Center to the relatively low number of daily cases.

Waste Generation--

According to Surgery personnel, the greatest volume of disposable medical supplies used and disposed of in Surgery are lap sponges. (Note, however, that Table 6 shows that exam gloves are ordered in greater quantities.) In the past, Surgery reused lap sponges prior to disposal. However, due to concerns of AIDS infection, Surgery currently uses single-use sponges. Other disposables from Surgery include procedure products that are found in operating room packs. These packs are generally used in full, although some items may never be used. Safety, quality assurance and product availability are three major concerns providing the impetus for disposable, operating room packs.

Table 6, compiled from Surgery's issue book, presents several of the major items ordered through the hospital warehouse. The primary items used are exam gloves, surgical sponges, surgical knife blades, syringes, needles, masks, and dressings/bandages.

The Medical Center's Surgery Department generates 1-2 large bags of blood and body fluid waste per case, or 15-30 bags per day. Approximately 1-1.5 bags per case is estimated to be paper waste (e.g., drapes) while, according to VA officials, other hospitals generate approximately 3 bags per case. The lower generation rate at the VA was attributed to their continued use of woven materials.

Handling/Treatment/Disposal --

The VA's Surgery Department is presently minimizing the generation of wastes through the extensive use of wovens. Surgery also carefully segregates wastes as they are generated. Waste to be disposed of as blood and body fluids waste must be "grossly contaminated" (i.e., soaked or dripping with blood). The VA Infection Control Practitioner explained that the facility is considering reducing the amount of segregation at the point of generation in Surgery to increase efficiency. As she explained, the surgeons and nurses should not be burdened with choosing the correct receptacle for each disposable during surgical procedures. The move toward reduced segregation may change the way waste is managed, but should have no effect on the overall rate of waste generation.

Sharps are segregated and placed in sharps containers which are clear-bagged, put in short-term storage and then taken to the onsite incinerator. Blood and body fluid waste from the operating room is brought to the storage room in the basement and then transported by the infectious waste hauler to the final treatment and disposal site. All other waste is disposed of as general trash.

Surgical Intensive Care Unit (SICU)

The SICU has 8 beds on the ward, 7-8 of which are occupied on a regular basis. Cloth gowns are worn by patients and hospital staff and laundered for reuse. Some sterile gowns are required in the SICU. These are sterilized by SPD after being laundered. Procedure trays (e.g., tracheotomy trays) are also sent to SPD for sterilization and returned to SICU for reuse. SICU staff expressed an interest in switching to the use of disposable trays (increasing waste generation volume), because prepared trays would be more convenient to the nursing staff.

TABLE 6. SURGERY - SELECTED DISPOSABLE PURCHASE ITEMS[a]

Purchase Item	Number of Items[b]	Number Ordered in a 6 month period	Disposed of as Blood and Body Fluid Waste
Surgical Sponges	1	16,000	Yes (if blood-soaked)
Exam Gloves	5	20,900	Yes
Surgical Knife Blades	2	3,900	No
Needles	4	1,200	No
Syringes	9	2,435	No
Surgical Mask	1	1,350	No
Paper Aprons	1	0	Yes (if blood-soaked)
Dressings/Bandages	12	1,612	Yes
Catheters/Tubing	8	834	Usually
Disposable Surgical Pack	1	0	Yes
Specimen Bottle (plastic, disposable)	1	24	Sent to laboratory
Total number of items represented[c]	45		

[a]This list was generated from Surgery's January 1989 1989 Issue Books for ordering supplies from the warehouse.

[b]Number of items represents the number of varying items within the same category (i.e. there are two different sizes of blood collected tubes listed in the issue book. The table lists all sizes of the same type under one name.

[c]72.6% of the products ordered from the warehouse by Surgery are represented in this Table. A total of 62 items are ordered by Surgery from the warehouse.

TABLE 7. SURGICAL INTENSIVE CARE UNIT - SELECTED DISPOSABLE PURCHASE ITEMS[a]

Purchase Item	Number of Items[b]	Number Ordered in a 6 month period	Disposed of as Blood and Body Fluid[c] Waste
Tubes/Catheters	24	3,061	Yes
Suction Equipment	2	2,634	Yes
IV Sets	2	277	No
Needles	7	9,309	No
Syringes	2	1,882	No
Total Number of Items[d]	37		

[a] SICU is supplied through SPD. This list was generated from SPD's supply distribution lists. Items selected were those listed as major disposables by the SICU RN during the site visit.

[b] Number of items represents the number of varying items within the same category (i.e. there are two different sizes of blood collecting tubes listed in the Issue Book. The table lists all sizes of the same type under one name.

[c] Note that waste not usually treated as blood and body fluids waste will be treated as such from when it is derived from strict isolation patients and from some respiratory isolation patients.

[d] 24.3% of the products ordered from the warehouse by SICU are represented in this Table. A total of 152 items are ordered by SICU from the warehouse.

Waste Generation--

SICU orders its supplies through Nursing Services which, in turn, receives supplies from SPD. The principal items ordered through SPD are listed in Table 7. While over 152 separate items are ordered by SICU, the 37 items listed represent a sizeable proportion of the total number of supplies ordered. The 37 items include 24 different types of tubes/catheters, suction equipment, IV sets, needles and syringes.

Blood and body fluid waste generated in the SICU consists mainly of suction liners and tubes. Foley bags and chest tubes are flushed of their fluids and disposed of in the general trash. IV bags are placed directly in the general trash receptacle. SICU also generates needles and syringes. These are disposed of in sharps boxes and are incinerated onsite.

Blood and body fluid wastes are strictly segregated into 1-2 large bags per day. The SICU RN estimated that one medium-sized sharps box is generated per bedside per day. The waste generation rate can greatly increase with isolation patients. For example, the SICU may generate 10 medium sized bags of medical waste for one isolation patient in one day. The number of isolation patients varies greatly over time.

Handling/Treatment/Disposal--

Waste generated in patient rooms is segregated into three categories: (1) sharps, (2) blood and body fluids, and (3) general trash. Per general hospital practice, the blood and body fluid waste is taken to the basement storage area to be transported by the infectious waste hauler.

Sharps boxes are removed from the rooms when they are approximately three-quarters full. The sharps containers are then taken to the incinerator.

Patient Floors

The surgical patient floor visited (located on the fifth floor, south side, otherwise known as 5 South) has 36 authorized beds, only 32 of which are in operating service due to staffing shortages. The RN estimated that 29-32 beds are occupied at any given time. This ward provides pre- and post-operative nursing care to inpatients. Such care includes administering medication and changing dressings. The other patient floors (i.e., medical patient floors) provide similar care to non-surgery patients. Each head nurse is responsible for all activities within his/her own ward, including ordering supplies and overseeing waste segregation activities. In total, the medical and surgical patient floors have 106 operating beds with approximately 78 occupied at any given time (Table 1).

Waste Generation--

Wastes generated in patient rooms are segregated into three categories: (1) sharps, (2) blood and body fluids, and (3) general trash. Products disposed as blood and body fluid waste include wall suctioning bags, tubing, and blood transfusion waste.

Table 8 lists the principal items ordered through SPD by 5 South. Dressing supplies are ordered most frequently followed by disposable linen protectors (chucks), tubes/catheters, and wall suctioning equipment. The head nurse of 5 South estimated that 85-90% of their supplies are disposable.

The head nurse also estimated that 5 South generates 1-2 large bags of blood and body fluid waste per day. Other patient floors may vary slightly in their waste generation rates, depending on the type of care administered.

Handling/Treatment/Disposal--

Sharps containers are mounted in each room and on the nurses' medication carts. There is a receptacle for general trash in each patient room, and the blood and body fluid waste container is

TABLE 8. SURGICAL PATIENT FLOOR (5 SOUTH) - SELECTED DISPOSABLE PURCHASE ITEMS[a]

Purchase Item	Number of Items[b]	Number Ordered in a 6 month period	Disposed of as Blood and Body Fluid[c] Waste
Tubes/Catheters	16	3,388	Yes
Dressing Supplies	10	22,418	No
Wall Suctioning (bags/trays)	3	881	Yes
Linen Protectors (chucks)	1	5,877	No
Total Number of Items[d]	30		

[a] Patient floors are supplied through SPD. This list was generated from SPD's supply distribution lists. The items selected for this table were listed as major disposables by the RN during the site visit.

[b] Number of items represents the number of varying items within the same category (i.e. there are two different sizes of blood collecting tubes listed in the Issue Book. The table lists all sizes of the same type under one name.

[c] Note that waste not usually treated as blood and body fluids waste will be treated as such when it is derived from strict isolation patients and from some respiratory isolation patients

[d] 21% of the products ordered from the warehouse by 5 South are represented in this table. A total of 143 items are ordered by 5 South from the warehouse.

FIGURE 1. WASTE HANDLING PROCEDURES POSTED IN SOILED UTILITY ROOM

Blood & Body Fluid Can	Regular Trash	Drain (wear a gown and gloves
Suction canisters	Suction catheters	Urine
Hemovacs	IV TBG	Stool - liquid
Jackson-Pratt drains	Suction TBG	Turp urine
Blood admin. TBG	ETT's	Gomco contents
Full rectal drainage bags	Chucks with blood	Melena stool
Dressings soiled	Bedpans	
Anything with a volume of body fluid contained	Urinals	

Only the above can be in the blood & body fluid can - it is paid for by the pound.

Use plastic covers on every PT on the bedscale.

Use plastic lab specimen bags.

Only use Staphene on things that do not come in contact with a patient.

located in the soiled utility room. Figure 1, posted to provide instructions on appropriate waste handling procedures, appeared in a soiled utility room on the 5th Floor. It lists those items to be disposed of as blood and body fluids waste, regular trash, and those that should be disposed of down the drain. In practice, as a matter of convenience, the nurses often dispose of non-blood and body fluid waste in the blood and body fluid waste container.

IV bags are to be disposed of in the general trash per hospital guidelines, although they are often found discarded in the blood and body fluid waste container. Cloth gowns are generally worn on the floors; when cloth gowns are unavailable, disposable gowns are used by the staff. Disposable gowns contaminated with blood should be disposed of in the blood and body fluid canister. However, used gowns are sometimes placed in the general trash cans in the patient rooms.

Medical Intensive Care Unit/Cardiac Care Unit (MICU/CCU)

The MICU/CCU has 8 authorized beds, and normally operates at 100% occupancy. This ward provides nursing services for patients requiring close medical attention.

Waste Generation--

Disposable products employed in the MICU/CCU include, but are not limited to: blood and suction canisters, needles, syringes, paper masks, and chucks. The numbers of items ordered appear in Table 9.

The two reusable items employed in the MICU/CCU are cotton gowns and pressure bags. The former is laundered and reused and the latter, a bag often used to introduce blood into a patient, is washed out and reused. The RN interviewed during the site assessment observed that not much further opportunity for switching to reusables exists.

The MICU/CCU generates approximately one large bag of blood and body fluid waste per week.

Handling/Treatment/Disposal--

Wastes are segregated into the same three categories as in the other wards: (1) sharps, (2) blood and body fluids, and (3) general trash. Sharps are disposed of in sharps boxes and incinerated onsite. All remaining waste generated in the MICU/CCU is placed in the general trash per hospital procedures. However, the assessment team observed that, as mentioned above, waste not meeting the definition of blood and body fluid wastes is discarded in the blood and body fluids containers. For example, empty, disposable urinals were seen in the blood and body fluid containers.

Hemodialysis

The hemodialysis unit has 9 treatment stations. Treatment is not continuous but occurs in shifts. The treatment schedule is presented below:

- Monday, Wednesday, Friday - AM shift - 8 patients
  - PM shift - 8 patients
- Tuesday, Thursday - AM shift - 7 patients.

Each treatment takes approximately 5 hours.

Waste Generation--

Nearly all products used in the hemodialysis unit are disposable. Each treatment involves at least: 2 IV bags, 2 tubes, 2 needles, one pair of gloves, and significant amounts of adhesive tape. The hemodialysis unit uses disposable aprons and masks as well. A list of disposable supplies used in the

TABLE 9. MEDICAL INTENSIVE CARE UNIT - SELECTED DISPOSABLE PURCHASE ITEMS[a]

Purchase Item	Number of Items[b]	Number Ordered in a 6 month period	Disposed of as Blood and Body Fluid[c] Waste
Tubes/Catheters	37	8,222	Yes
Suction/Collection Bags	15	4,760	Yes
Needles	8	9,059	No
Syringes	5	2,316	No
Linen Protectors (chucks)	1	7,999	No
Face Masks	1	40	No
Total Number of Items[d]	67		

[a]This list was generated from SPD's supply and distribution lists. The items selected were listed by the RN during the site visit as major wastes generated.

[b]Number of items represents the number of varying items within the same category (i.e. there are two different sizes of blood collecting tubes listed in the Issue Book. The table lists all sizes of the same type under one name.

[c]Note that waste not usually treated as blood and body fluids will be treated as such when it is derived from when it is derived strict isolation patients and from some respiratory isolation patients.

[d]30.6% of the products ordered from the warehouse by MICU are represented in this Table. A total of 219 items are ordered by MICU from the warehouse.

TABLE 10. HEMODIALYSIS - SELECTED DISPOSABLE PURCHASE ITEMS[a]

Purchase Item	Number of Items[b]	Number Ordered in a 6 month period	Disposed of as Blood and Body Fluid Waste
Gloves	5	13,112	Yes
Needles	4	8,900	No
Blood Collecting Tubes	2	1,400	Yes
Adhesive Tape	2	672	Yes
Masks	1	1,900	Yes
Plastic Disposable Lab Apron	1	5	Yes
Total Number of Items[c]	15		

[a]This list was generated from the Hemodialysis Issue Books (January 1989-June 1989).

[b]Number of items represents the number of varying items within the same category (i.e. there are two different sizes of blood collecting tubes listed in the Issue Book. The table lists all sizes of the same type under one name.

[c]28.8% of the products ordered from the warehouse by Hemodialysis are represented in this Table. A total of 52 items are ordered by Hemodialysis from the warehouse.

hemodialysis unit can be found in Table 10.

The unit makes use of disposable dialyzers. However, as is common in many hospitals, the dialyzers are sterilized and reused. In this hospital, staff estimated that dialyzers were used 20 times before disposal. The reuse of dialyzers reduces the volume of waste generated, and thus, provides a means of minimizing waste. The practice of reusing disposables is a controversial issue in the health care industry and is discussed further in Section 3. At least 4 large bags of blood and body fluid are generated per day in the hemodialysis ward.

Handling/Treatment/Disposal--

Most of the disposable items mentioned above and those that are listed in Table 10 are discarded in the blood and body fluids receptacle located in a soiled utility room in the unit. Needles are placed in sharps containers for onsite incineration.

Outpatient Clinic

The outpatient clinic, located on the first floor (see Appendix E), provides services to approximately 500 patients per day. The services provided at the clinic include: surgical procedures, medical exams, chemotherapy, dermatology, urology, plastic surgery, orthopedics and ear, nose, and throat (ENT).

Waste Generation--

Ninety percent of the supplies used in the outpatient clinic are disposable. The major disposable items used are dressing materials and suction liners. However, as identified in Table 11, the outpatient clinic orders over 800 different disposable items from SPD. Most of the clinic's "unposted" supplies comprise reusable instruments that are sent to SPD for sterilization prior to reuse.

Plastic-coated paper gowns are used by staff members administering chemotherapy treatment. According to the RN, they are also worn for all other outpatient treatments and procedures. Although the RN related that the paper gowns were being used for all or most outpatient treatments (rather than just for chemotherapy treatments), this usage is not reflected in the number of paper gowns ordered in a 6 month period (Table 11). Paper gowns used during chemotherapy treatments are disposed of with the cytotoxic wastes, and the gowns worn while administering general treatments are disposed of with the blood and body fluids, if they are considered contaminated. The RN interviewed believed disposables are being employed in the clinic for greater ease and reduced risk of injury/infection to the Medical Center staff.

Reusable wovens that are commonly used include sheets, pillow cases, towels, and blankets. Although wovens should always be laundered and reused, the RN reported that the staff frequently discards very soiled linens.

Gomco suction apparatus, suture removal sets, and scalpels are all reused. Although general suction equipment and rubber tubings were reused in the past, disposable suction liners are now employed.

One large bag blood and body fluid waste is generated by the clinic per day.

Handling/Treatment/Disposal--

Each procedure room has a mounted sharps box and a small waste container for general trash. Blood and body fluid waste bags are kept in the clinic's soiled utility room. The clinic's head nurse is considering putting blood and body fluid bags in each procedure room per OSHA's recommendation.

Chemotherapy wastes are packaged in white plastic containers, stored in the same basement storage areas where blood and body fluid waste is stored prior to pick-up, and transported for disposal by a licensed cytotoxic waste hauler.

TABLE 11. OUTPATIENT CLINIC - SELECTED DISPOSAL PURCHASE ITEMS[a]

Purchase Item	Number of Items[b]	Number Ordered in a 6 month period	Disposed of as Blood and Body Fluid Waste
Dressing/Bandage/Gauze	74	17,608	Yes (if blood soaked)
Suction Liners	10	696	Yes
Surgical Masks	4		No
Plastic-Coated Paper Gowns (Chemotherapy Gowns)	2	76	No (Chemotherapy)
Total Number of Items[c]	90		

[a]This list was generated from SPD's supply and distribution and represents the sum of the products ordered for each area of the clinic.

[b]See Exhibit 2-6.

[c]10.7% of the products ordered from the warehouse by the Outpatient Clinic are represented in this Table. A total of 840 items are ordered by the Outpatient Clinic from the warehouse.

Incinerator

The Medical Center's incinerator is located on the ninth floor. Sharps, pathological wastes, and expired pharmacy drugs are incinerated every Friday. The capacity of the incinerator is not great enough to accommodate any additional waste, and, consequently the hospital is expecting to build a new incinerator within one year with increased capacity to accommodate all of the hospital's medical waste, thus eliminating the need to contract with waste haulers.

Sharps Generation--

The pollution prevention case study team counted 14 medium-sized sharp boxes, containing mostly needles and syringes, and 3 large boxes containing blood transfusion waste stored in the ninth floor storage room. The sharp containers were enclosed in clear plastic bags. According to VA officials, the number of sharps boxes burned in a typical week is fairly consistent. The numbers of boxes incinerated over two previous weeks are shown below:

Sharps Container Size	Number of Containers Incinerated for the Week Ending 6/30/89	Number of Containers Incinerated for the Week Ending 7/21/89
small	3	2
medium	35	45
large	8	7

According to VA officials, on average, small sharps containers weigh 1.5 pounds, medium sharps containers weigh 4 pounds and large sharps containers weigh 10.5 pounds. Using the figures from the weeks ending 6/30/89 and 7/21/89 the average weight of used sharps incinerated each week was calculated to be 242.5 pounds.

Storage Area

The storage room for blood and body fluid waste and cytotoxic wastes is located in the basement, adjacent to the general trash loading dock. The blood and body fluid waste, generally packaged in large brown plastic garbage bags, is transported by housekeeping from the soiled utility rooms to the basement storage area. The brown bags are then placed in cardboard boxes which are lined with red biohazard bags. These packaging materials are supplied by the contracted transporter. The blood and body fluid waste is picked up every Thursday and transported offsite to be incinerated at a commercial treatment/disposal facility. The hospital is charged $.30 per pound of blood and body fluid waste transported for disposal.

Waste Generation--

According to previously conducted studies, hospitals generate between 13 and 15 pounds of solid waste per patient per day, with infectious waste comprising between 5 and 15 percent of the volume. Infectious waste generation estimates from various studies indicate generation rates between 0.5 and 4 lbs. per occupied bed/day.[1] The VA-Cin facility generates approximately 2,300 lbs/month of blood and body fluids and sharps, or approximately .60 lbs/occupied bed/day. Of the 2,300 lbs/month estimate,

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[1]Results from the earlier referenced NY/NJ report estimated "average" generation rate of from 1.5 to 3 lbs/occupied bed/day. A New York Department of Health Study (Infectious Waste: A Statewide Plan for Treatment and Disposal, 1988) estimated generation rates at 4 lbs/occupied bed/day. A 1983 study of North Carolina's hospitals estimated a generation rate of 0.5 to 1.09 lbs/bed/day (Rutala and Sarrubi, "Management of Infectious Waste from Hospitals", Infection Control, 1983).

roughly 1,300 lbs consists of blood and body fluids waste and the remaining 1,000 lbs. consists of sharps (and sharps containers). Thus, at a rate of roughly .60 lbs/day for each occupied bed, the VA-Cin facility has a lower infectious waste generation rate than reported in many of the above mentioned studies. However, this is not necessarily indicative of the hospital's success in pollution prevention.

The numbers are probably not comparable due to inconsistencies in how hospitals define what constitutes infectious waste. These inconsistencies are most apparent in that most hospitals consider the laboratory the greatest single source (approximately 30-31% of total medical waste according to the NY/NJ study) of infectious waste, whereas, the VA-Cin classifies the majority of its laboratory's waste as general trash upon autoclaving.[2] On the other hand, the Medical Center's extensive use of woven products is at least partly responsible for the relatively low infectious waste generation rate.

[2]Inflating the VA-Cin's quantity of medical waste to reflect the absence of lab waste in the count would yield approximately 0.87 lbs/occupied bed/day. This figure remains low compared to waste volume generation rates experienced by other hospitals.

SECTION 3

POLLUTION PREVENTION OPPORTUNITIES AT HOSPITALS

INTRODUCTION

The purpose of this section is to identify, discuss and evaluate the feasibility of and opportunities for minimizing waste in a hospital setting. Through a review of available literature, the VA hospital site visit, and an understanding of the limitations facing waste reduction in a hospital setting, recommendations for realizing pollution prevention opportunities are made with regard to product substitution, the reuse of disposables, and recycling.

INCREASE IN THE USE OF DISPOSABLES

The use of disposables in health care facilities has increased steadily over the last thirty years (see Table 12). Since the 1950's, hospitals have been replacing items and devices originally made out of glass, metal, rubber and woven textiles with plastic and paper, single-use, disposable products. The application of a cost-plus basis for health care institution reimbursement in the 1960's and 1970's, an increase in inpatient care services and the advent of the plastics revolution all factored in ushering in disposables.

Reimbursement of hospitals on a cost-plus basis provided an incentive to introduce new products and services that improved diagnostic, surgical and/or therapeutic capabilities. At the same time, because little money was invested to streamline operational efficiency or increase productivity, no active incentive existed to upgrade basic services. One operation which suffered from this lack of funds was the hospital laundry. Inpatient services increased during this period, creating new demands for all linen products. Antiquated laundry operations were unable to keep pace with the expanding burden, and, consequently, the facilities were often unable to efficiently process and sterilize the soiled linens. Disposables provided health care institutions with a convenient solution. Replacing linens with disposables ensured an adequate supply of required products and simultaneously relieved an overburdened laundry operation.[1]

As a result of the rapidly expanding plastics industry, many hospital devices including syringes, gloves, tubing and catheters could be made cheaply and sold prepackaged and presterilized. Although the per item cost for disposable products was high, the cost based reimbursement policy encouraged the use of disposables. Guaranteed availability and decreased labor costs resulted in disposables largely replacing reusables in health care facilities. As technology advanced, more intricate instruments were able to be mass-produced and sold as single-use items. The critical function of these high-tech devices required that they be unquestionably sterile and reliable. The availability of prepackaged and presterilized devices solved the quality assurance problem hospitals were facing and the single-use items quickly replaced their reusable counterparts.

INCENTIVES FOR REDUCING COSTS

Rapidly rising health care costs over the past decade, paralleled by the increasing costs associated with single-use items, have led to a call for cost containment and consequently, a reassessment of the reusable versus disposable products issue. Hospitals have been forced to consider every alternative for saving money without sacrificing the quality and integrity of their medical services. Operational

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[1] "Reusable Linens: An Economical Alternative to Disposables," Hospital Material Management Quarterly, February 1984, pp. 7-26.

TABLE 12. HISTORICAL SHIFT TO DISPOSABLE ITEMS[2]

Year	Generation Rate (lbs/day/bed)	Source
1958	7.0	Clarisse, 1958
1968	12.0	Davis, 1968
1983	13.0	North Carolina Hospitals
1988	20.0	NYSDOH

inefficiencies are now being evaluated and remedied, triggering the development of new procedures and programs to increase productivity and lower material and labor cost. As the cost of solid waste disposal (including incineration) goes up, particularly the disposal costs for medical waste, the reintroduction of reusables may be warranted. The cost of medical waste disposal can be as high as $.90 per pound ($.30 at the VA-Cin facility).

Hospital automation, specifically in the processing and sterilization of soiled linens, over the past few years is enabling many institutions to reconsider the use of reusable surgical linens as a cost-effective option to the disposal of paper products.

Hospitals and other health care facilities have also attempted to reduce costs by reprocessing disposable, "single-use" devices. Figure 2 provides a list of the most commonly reused, single-use devices and reveals the prevalence of this practice in hospitals today. The reuse of single-use items is a much studied issue and is given considerable attention in the field of medicine. Committees such as the Association for the Advancement of Medical Instrumentation (AAMI) that develop standards, recommend practices, and prepare technical information reports on medical devices also develop operating practices for reuse. Documents regarding the reuse of disposables are available for many specific devices (such as AAMI's "Reuse of Hemodialyzers,") and reviews of the issue are common in medical journals.

Although the issue of reusing disposable devices is highly debated, health care professionals agree that if a product is to be reused, the reprocessed product must be as functional, sterile and safe as it was when it was new. The factors which must be considered when making the decision to reuse a single-use product include possible contamination, increased liability, decreased functional reliability, compromised patient safety and the associated costs. A health care facility must also determine if their quality assurance program is compatible with reprocessing disposable items, and if not, evaluate the economic feasibility to make it so.

In general, the less critical an item, the greater the chance that it will be considered for reuse. The reprocessing of equipment that has been removed from a pack but has not been used will generate little anxiety while the reuse of a cardiac catheter is more disturbing. The line graph presented in

[2] Taken from "A Review of Reusable vs. Recyclable Medical Waste Generated by Medical Facilities," New York City Department of Health, Environmental Health Services, April 1989.

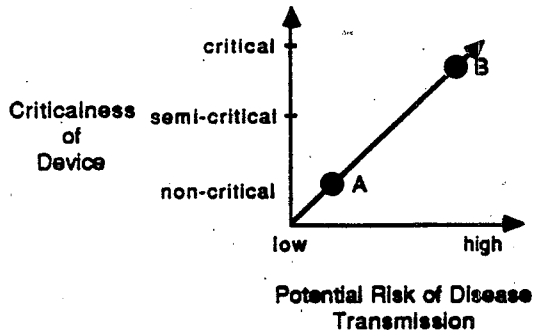
FIGURE 2. DISPOSABLE MEDICAL DEVICES REPORTED TO BE REUSED IN DESCENDING ORDER OF FREQUENCY[3]

Hemodialyzers	(46%)
Cardiovascular catheters and guidewires	(31%)
Respiratory therapy breathing circuits	(18%)
Biopsy needles	(17%)
Cautery devices	(16%)
Anesthesia breathing circuits	(14%)
Endotracheal tubes	(10%)
Suture staple removers	(9%)
Syringes	(9%)
Orthopedic appliances	(7%)
Suction canisters	(7%)
Tracheal tubes	(6%)
Bovie cords	(5%)
Esophageal thermometers	(4%)
External pacemaker electrodes	(4%)
Arterial catheter needles	(2%)
Aseptic irrigating syringes	(2%)
Shunt connectors	(2%)
Sterile skin scribes	(2%)
Cholangiographic catheters	(1%)
Esophageal stethoscopes	(1%)
Pacemakers	(1%)
Pulmonary nebulizers	(1%)
Skin staplers	(1%)
Urinary catheter plugs	(1%)
Allen needles	(<1%)
Arterial embolectomy catheters	(<1%)
Condensing bottles	(<1%)
Operating room clamps	(<1%)
Ear syringes	(<1%)
Face tents	(<1%)
Gastric pH monitors	(<1%)
Hypodermic needles	(<1%)
Javid tubes	(<1%)
Oxygen masks	(<1%)
Microscalpels	(<1%)
Stone baskets	(<1%)
Surgical gloves	(<1%)
Triadaptors	(<1%)
Tracheostomy tubes	(<1%)
Urethral stents	(<1%)
Urinary bags	(<1%)

[3] "Reuse of Disposable Medical Devices in the 1980's," Proceedings of the International Conference. Institute for Health Policy Analysis, Georgetown University Medical Center, 1984, Appendix B.

Figure 3 illustrates this concept. As the criticalness[1] of an item increases and the potential for infection increases, the likelihood that an item will be reused decreases. For example, point A represents a bedpan. Because the item is considered non-critical by CDC definition and the risk for disease transmission is minimal, reuse would be considered. An arterial embolectomy catheter, alternatively, would be considered critical and the potential for exposure to infection great. Therefore, generally this item would not be considered for reuse. In the end, safety takes precedence economics and pollution prevention in a health care environment. A hospital should consider each item separately to determine the effects of reprocessing on the integrity of the product before making a decision about reuse.

Figure 3 General Guideline for Reuse



Key:
A = bedpan
B = arterial embolectomy catheter
$\overline{AB}$ = decreasing likelihood of reuse

BARRIERS TO REDUCING RELIANCE ON DISPOSABLES

When considering reusables and the reuse of disposables as a means for reducing the amount of waste generated in the hospital infection control represents a limiting factor. The threat of AIDS, hepatitis B and other infectious diseases associated with blood borne pathogens, has made necessary the implementation of guidelines in the health care arena which minimize the possibility of transmission. The Center for Disease Control's (CDC) Universal Precautions state that all visible blood and body substances must be treated as potentially infectious. Since the status of all patients' blood cannot be known, precautionary measures should be taken at all times. The CDC's Universal Precautions reduce the risk of infection by the consistent use of barriers. The recommendations followed by most hospitals include the use of gloves, protective clothing, masks and eye protection when there is a possibility of coming into contact with body substances.

Further, the Occupational Safety and Health Administration (OSHA) has proposed a rule regarding occupational exposure to blood borne pathogens. The proposed standard, published in the Federal Register on May 30, 1989, follows closely the guidelines issued by CDC on Universal Precautions. The rule states that personal protective equipment (PPE) must be worn if there is a potential for soiling; fluid resistant PPE must be worn if there is a potential for splashing/spraying; and fluid proof PPE must be worn if there is a potential for soaking. PPE includes gloves, gowns, masks, eye protection, faceshields, foot coverings, and respiratory equipment. The proposed rule further recognizes that the regulations will increase the amount of waste entering the general waste stream "due to the increase in the use of disposable PPE" (54 FR 23108).

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[1]According to the Center for Disease Control, a critical item is one that will enter the vasular system or any sterile area of the body. An item is semi-critical if it comes into contact with only intact mucous membranes. A non-critical item is one that comes into contact only with intact skin.

When considering the increasing frequency of AIDS and the seriousness of all infectious diseases, health care facilities must be careful, when trying to reduce their generation of waste, to avoid conditions where the sterile nature of an item may be compromised.

A second barrier to converting to reusable devices is that reusable products may not be readily available. In many cases, the development of disposable substitutes has completely eliminated the market for reusable products, and consequently, the reusable form is either no longer manufactured or only available through special-order medical supply companies. It was suggested during the site visit interviews that this may be the case for many items such as steel bedpans. In addition, special-order supply companies may not be able to guarantee the availability of a product over time or may not be able to supply large quantities of any individual item. Furthermore, the costs associated with special-order items may exceed budget limitations.

REUSABLE VERSUS DISPOSABLE PRODUCTS

The many reasons disposables continue to be used in hospitals, despite increased disposal costs for infectious wastes include:

- the necessity of maintaining unquestionably sterile items for infection control
- increased barrier protection for patients and employees
- safety risks related to the reuse of glass or other breakable supplies
- lack of adequate space, equipment and personnel to reprocess reusables
- better inventory control
- liability concerns when using non-sterile items and
- cost-effectiveness and other financial issues[2].

Table 13 reviews the reasons for choosing the disposable alternative for a select set of supplies available in both disposable and reusable form and provides a cost comparison of these items. It should be noted that the cost figures presented represent only the initial cost of the item and do not incorporate disposal or reprocessing costs.

Wovens versus Nonwovens: General Issues

Many of the issues outlined above are raised in examining a hospital's decision to use wovens or paper products. The use of wovens would decrease the volume and weight of hospital waste significantly. Therefore, employing wovens throughout the hospital should be given serious consideration, and each of the reasons for choosing disposables re-evaluated.

Health care personnel often choose paper products to ensure the sterility of an item even though wovens, when laundered at sufficiently high temperatures and sterilized, presents an equally sanitary product. Additionally, hospital employees generally view paper products as offering a more reliable barrier against blood and body fluid penetration as well as better protection against microbes.

Although concerns about contamination are valid, the commonly held belief that disposables offer superior infection protection may not be justified. Reusable fabric can be treated and made water repellent, thereby resisting blood and body fluid penetration, and testing has shown that the density of such treated fabric provides an effective barrier to bacteria. Antimicrobial fabrics such as BioGuard (Burlington Industries, South Carolina) are available and should be investigated. A recent study on

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2 "A Review of Reusable vs. Recyclable Medical Waste Generated by Medical Facilities," NYC Department of Health, Environmental Health Services, April 1989.

TABLE 13. COMPARISON OF SUPPLIES AVAILABLE IN DISPOSABLE AND REUSABLE FORM

Supply	Reason for disposal	Disposable cost	Initial reusable cost
Syringes (10 ml)	Labor savings Space savings Cost savings Sterility	$0.25	$30.00
Petri dishes	Labor savings Space savings Cost savings Sterility	$0.20 (sterile)	$2.80
Needles (1"-25" gauge)	Labor savings Better quality Sterility	$0.10 (sterile)	$2.50
Pipettes (1 ml Serological)	Convenience Labor savings Sterility	$0.17 (sterile)	$6.63
Lab coats	Safety	$4.00	$35.00

nosocomial infections at the University of Connecticut Medical Center determined that patient safety is not compromised through the use of woven products. Researchers found that "disposable gowns hold no advantage over reusables in preventing surgical wound contamination and infection."[3]

Moreover, the Association of Operating Room Nurses (AORN) recommends that surgical gown material should be comfortable, durable, drapable and aseptic.[4] The advantages of woven material include that it is nonabrasive and allows for freedom of movement; it is more puncture resistant than paper; and it conforms to the patient's body, allowing for ease of maneuverability and examination. And, as mentioned above, wovens are equal in asepticity to paper satisfying the fourth recommendation of AORN.

The use of wovens, when all costs are integrated, may also represent a better use of hospital resources. A cost comparison of a reusable versus a disposable surgeon's gown pack and the cost computing figures used to obtain these figures is presented in Figure 4. The discrepancy between the

[3] "Nonwoven Barrier Material Equal to Cotton," Hospital Infection Control, July 1985, p. 85.

[4] "Recommended Practices for Aseptic Barrier Materials for Surgical Gowns," AORN Journal, 1983, Vol. 37, no. 2, pp. 249-58.

FIGURE 4. COST COMPARISON OF REUSABLE VERSUS DISPOSABLE SURGEON'S PACK[5]

Per-use cost ($)

Pack	Materials and laundering	Inspection and preparation	Sterilization cost ($)	Per-pack cost ($)
Disposable				3.50
Reusable				
Gown	0.37			
Towel	0.07			
Wrapper (Premier)	0.14			
Wrapper (Steri)	0.15			
Total	0.73	1.19	.027	2.19

Cost Computing Formulas

Laundering and product cost-per-use calculations

Item	Original Purchase price ($)	Item weight (pounds)	Laundry cost (per pound)*	Life Expectancy (washing)	Total Cost per use
Surgeon's gown	11.57 +	(0.88 / 75)	x $.25	x 75)	0.37
Absorbent towel	1.11 +	(0.19 / 50)	x $.25	x 50)	0.07
Wrappers (Premier)	3.13 +	(0.43 / 100)	x $.25	x 100)	0.14
Wrappers (Steri)	4.32 +	(0.38 / 75)	x $.25	x 75)	0.15
Total Cost Per Use					$0.73

*National average laundering cost per pound

[5] Taken from "Reusable Linens: An Economical Alternative to Disposables," Hospital Materials Management Quarterly, Feb. 1988, pp. 17-26.

FIGURE 4. COST COMPARISON OF REUSABLE VERSUS DISPOSABLE SURGEON'S PACK
(Continued)

Inspection, Folding, Preparation and Delivery Costs

Time required for one gown pack	.17 hour (10 minutes)
Hourly wage, including fringe benefits	$7.00/hr
Total cost per use: .17 x $7.00 = $1.19	

Sterilization costs

Cost per load	$5.39
Percentage of load space gown pack occupies	.05%
Total cost per use: .05 x $5.39 = $0.27	

costs for the disposable pack and the reusable pack becomes even greater if disposal costs are included.

Although, in some cases, paper products will offer a superior basis for use in administering the best and safest medical care, the universal use of paper products in any health care facility should be avoided. To achieve waste reduction, a health care facility must evaluate each case in which paper products are employed to determine if wovens could be employed as an equivalent substitute. Intended use, risk of infection, and other task-specific factors should be considered in determining which alternative, wovens or paper, best suits a particular application. Once a hospital-wide evaluation has been conducted, paper products should be replaced with woven products wherever possible to achieve maximum pollution prevention.

Wovens versus Nonwovens: Pollution Prevention Opportunities at the VA Hospital

The VA Medical Center in Cincinnati currently uses woven gowns for both patients and staff in most areas of the hospital including the laboratories, Surgery, Surgical Intensive Care Unit, patient floors, and the Medical Intensive Care Unit/Cardiac Care Unit. Although cloth gowns are presently worn by hematology technicians for both patient floor visits and lab work, the laboratory is considering switching to disposable gowns for use during patient floor visits. The change will be made to reduce the risk of infection. Newer fabrics and fabric treatments may make a reusable gown a viable option.

Disposable gowns are also worn by staff for tuberculosis isolation room visits, and plastic coated disposable gowns are worn by staff while administering chemotherapy treatments in the Outpatient Clinic. More recently these plastic coated gowns have been worn increasingly by staff attending to other outpatient treatments. This situation should be examined to determine the sudden interest in disposable gowns. If the outpatient treatments have either low or no relative risk of disease transmission, the staff should consider the use of cloth gowns whenever they are available.

Hemodialysis staff wear aprons during all patient treatments. This practice is necessitated by the inevitable exposure to blood during such treatments, and consequently the need for a high level of staff precaution and protection. Currently disposable aprons are used. The availability of an appropriate reusable item should be investigated.

Other woven products being employed by the VA include sheets, drapes and cloth instrument wraps. The instrument wraps are used in the operating room and laundered for reuse. All masks used by staff during patient care in strict isolation rooms, the medical intensive care unit, hemodialysis and during surgery are paper. Because paper masks are relatively inexpensive, it would be an economic burden for the hospital to return to woven masks. In addition, hospital staff may also be unwilling to use cloth masks because of the perceived health risks associated with reusing face masks. Furthermore, the residual chemicals which may remain from the laundering and sterilization process may be irritating, as well as noxious.

In addition, chucks used throughout the hospital are made of paper and disposable. Chucks act as linen and surface protectors, absorbing body fluids and blood so that the linens that will be reused do not become grossly soiled and so that surfaces are easier and safer to clean. The hospital may want to review the use of chucks throughout hospital and assess whether the availability of the product has led to its use even where it is not necessary.

Recently, a decision was made by the VA's Commodity Standardization Committee to purchase, stock and issue plastic bed pillow covers (Minutes, Commodity Standardization Committee, February 2, 1989). Prior to this decision, woven pillow covers were the only type supplied. The arguments to initiate the use of plastic covers included: a decreased risk of infection due to the increased prevention of soil and moisture absorption; and decreased replacement costs for pillows through an extended life due to the use of plastic covers. However, the decision to use plastic pillow covers will increase the

waste generated by the hospital. As a pollution prevention alternative, the VA should consider that vinyl/nylon laminate covers be purchased for pillows. Such a purchasing decision would extend the life of the pillow, decrease the risk of infection in the same way the plastic covers would, and reduce waste by continuing the use of woven pillow covers. In addition, the comfort of the patient would be preserved.

Although no decision to use or not use a particular product should be based solely upon its effect on waste generation, the Commodity Standardization Committee should consider requiring that the effect on the generation of waste be included in the consideration of purchasing new products. Second, the Committee may request that Committee members look to identify pollution prevention opportunities which exist so that any product substitutions, fostering the reduction of waste, can be made.

The decision to delete plastic bed mattress covers from the SPD stock is an example of implementing pollution prevention (Minutes, Commodity Standardization Committee, February 2, 1989). Because the mattresses currently being used have a vinyl/nylon laminate cover that can be wiped clean, the plastic mattress covers are not needed. Although the deletion of this product from SPD stock is clearly a step toward pollution prevention, it is not identified as such. By identifying this decision as one that reduces hospital waste, the concept and goal of pollution prevention is emphasized. Staff awareness and understanding of a hospital's goal to minimize waste generation is a crucial element in attaining this goal. Incorporating pollution prevention assessments into the Commodity Standardization Committees procedures will greatly increase the dissemination of pollution prevention goals.

The current use of wovens over disposables by the VA Hospital greatly reduces the volume of waste generated. Additional opportunity for product substitution with respect to replacing paper products with cloth products is limited due to the stringency of CDC and other infection control guidelines, as well as perceptual and cost considerations. The VA's use of wovens serves as an excellent example for other hospitals implementing pollution prevention but who currently employ disposables.

Disposable versus Reusable Procedural Equipment: General Issues

A variety of disposable devices ranging from syringes and hemodialyzers, to Petri dishes and bedpans further contribute to the growing waste streams generated by health care facilities. In the past, many of these items were made from glass, steel, and rubber and were reused. With the issues raised by the AIDS virus and a growing understanding of infectious diseases, concerns of transmission have led many organizations such as CDC and OSHA to develop strict precautionary guidelines. The essentiality of infection control in contemporary medicine often eliminates the opportunity to replace many single-use items with reusables.

Still, opportunities for substitution do exist. To successfully reduce waste, it is important that a hospital carefully revisit each site where the decision to use a single-use device has been made and re-evaluate that determination. If a reusable product provides comparable function, sterility and safety, the use of the disposable device should be reconsidered. For many of these products a decision may also be made with respect to reusing a single-use device.

Disposable versus Reusable Procedural Equipment: Pollution Prevention Opportunities at the VA Hospital

Because of the diversity of items included in this subsection it will be expedient to discuss opportunities for pollution prevention by ward in the following discussion. The major disposable items in each ward will be reviewed.

Laboratories--

Laboratory Services use essentially all disposable items. Many of these items are glass products

and include test tubes, sample cups, Petri dishes, slides, pipettes and pipette tips. Although glass can be washed, autoclaved and reused, all glass used in the VA Hospital's laboratories is autoclaved and disposed of after a single-use. This practice is employed by the hospital as a general safety practice to reduce the risk of injury and exposure to infection. By immediately disposing of glass and other breakable items, handling time is decreased, lessening the chance of exposure to infection through spills and breakage.

Glass products used in the Hematology and Clinical Chemistry laboratories are contaminated with blood and body fluids, and therefore are to be considered potentially infectious per Universal Precautions. The reprocessing of blood or body fluid contaminated items would increase worker exposure to bloodborne pathogens. Although it would be possible to reprocess and reuse some glassware (e.g. slides), a proposed OSHA rule will require "glassware and hand instruments...to be decontaminated prior to washing and/or reprocessing" (54 FR 23121). Such requirements will increase labor and reprocessing costs to the point where reusing glassware may not be economically feasible.

The Microbiology Lab disposes of approximately 1500 glass Petri plates each week. Because they are glass there is an opportunity to reprocess the dishes and reprepare them with media. Although this would minimize waste to a large extent, Petri dishes are not reprocessed because they are difficult to clean and reprocessing may sacrifice the integrity of the product. Furthermore, preparation of the agar is labor intensive. Still, it is important that the hospital consider reusing glass Petri dishes. The Medical Center should investigate the opportunity to have glass Petri dishes reprocessed off-site. Such an alternative would allow the laboratory to continue operating efficiently, without the disruption of implementing in-house reprocessing practices, and decrease significantly the amount of waste generated by the laboratory.

Plastic and other synthetic material products constitute a large part of the remaining disposables found in the laboratories. The principal disposables include pipettes, pipette tips, test tubes, testing items, specimen bags and containers, urine specimen kits, and gloves. All of these items are autoclaved and disposed of after a single-use. Pipettes, test tubes and specimen containers are all available in glass, but as the hospital's policy now stands and due to the limitations mentioned above with respect to infection control, such a substitution would provide little benefit and only increase waste disposal costs due to an increase in the weight of the disposed products. The urine specimen kits are used for convenience and provide all needed materials presterilized and prepackaged. Assured availability and decreased labor costs associated with these packs has encouraged their use. Because of the convenience of such kits, reusables are unlikely candidates for substitution. Over time, however, as land filling and incineration costs are expected to spiral in the future, reprocessing of glassware may prove an economical alternative to plastic disposables.

Plastic testing items include Vitek cards, cuvette rings and RH panels. These disposable items were developed for their convenience. Reverting to reusables would drastically increase time, labor, and associated costs. Reprocessing and reuse of disposable items, although generally practiced to keep costs down, would present an alternative way to minimize wastes. The cuvette rings, disposable devices used to test blood coagulation, are reused five to ten times before they are discarded. Although they are single-use items, they are reused because of their high cost. As previously discussed in this Section, the decision to reuse must be made on a product by product basis. For instance, the reuse of bedpans (a non-critical item) would be generally accepted and would reduce a hospital's waste generation rate.

Gloves contribute to the laboratory waste stream. Universal Precautions recommend that gloves should be worn when it is likely that hands will be in contact with body substances. In addition, in accordance with CDC recommendations, the proposed OSHA rule mandates that disposable gloves will not be washed or disinfected for reuse. CDC states in "Update: Universal Precautions for Prevention of Transmission of Human Immunodeficiency Virus, Hepatitis B Virus, and Other Bloodborne Pathogens in Health care Settings," (June 24, 1988) that disinfecting agents may cause deterioration of the glove

material while washing with surfactants could result in enhanced penetration of liquids via undetected holes.

The remaining waste consists of syringes, needles, VACUTAINER blood collection sets, dressings, bandages, gauze, adhesive tapes, facial tissues and paper towels. These constitute wastes which are inevitably generated by any health care facility. Due to the high potential for disease transmission from these items, they are currently disposed and there is no immediate prospect for product substitution. Moreover, any contaminated paper product is likely to raise concerns of recyclers.

Surgery--

Exam gloves and surgical sponges contribute the greatest number and volume of disposables to the hospital's waste from Surgery. [It should be noted that in most hospitals paper gowns, drapes, and instrument wraps constitute the greatest percentage of waste generated in the operating room.] The VA's use of linens, although atypical, provides for an enormous reduction of waste. As previously discussed, it is imperative that gloves are used only one time and immediately discarded to maintain a high level of infection control. Surgical sponges are used during all operating procedures to soak up blood and body fluids. Consequently, used sponges must be considered soiled by potentially infectious fluids. Their immediate disposal reduces worker exposure to potential pathogens. Furthermore, the absorbent quality of sponges makes reprocessing an unlikely option. Although sponges are essential items, and there may be no viable substitute, hospital practices should be examined to discover if sponges are being used in greater quantities than necessary or for activities which could alternatively use absorbent, reusable towels (e.g., cleanup activities).

Surgical knife blades, syringes and needles are disposed of as sharps and incinerated at the hospital. Because of the high risk of worker injury and disease transmission through cuts and puncture wounds associated with these items, CDC recommends the disposal of these items over reprocessing.

Because of the nature of surgical procedures and the absolute necessity of available and sterile devices, operating room packs are often used. Operating room packs are disposable and contain the instruments and other materials needed for a given procedure. One of the reasons for using these packs in lieu of assembling the required reusable materials prior to each operation is a decrease in the labor resources which must be devoted to both assembling new trays and reprocessing soiled procedure items. The costs of presterilized, disposable trays are significantly lower than those associated with collecting, cleaning, sharpening, lubricating, inspecting, packaging and sterilizing the many items needed for a given procedure. Although convenience is an important factor, assured availability and increased safety suggest that the return to reusable procedure materials is unrealistic for contemporary medical practices. In the past, the use of prepackaged procedure trays often resulted in needless waste, i.e., the disposal of unused materials. Today, most surgical packs are very specialized so that all contents are generally employed during a given procedure. Although it is not often the case that components of the packs or trays are not used, the VA Medical Center repackages any unused devices for reuse. This achieves some level of waste reduction without having to alter contemporary medical practices.

The most significant waste reduction in the operating room will be achieved through general housekeeping practices as discussed below.

Surgical Intensive Care Unit (SICU)/Medical Intensive Care Unit (MICU)[6]--

The major disposable products used in the SICU and MICU include catheters, tubing, suctioning equipment, IV bags, needles, and syringes. Catheters, tubing, and suctioning equipment all come in contact with body fluids during usage. Per Universal Precautions, these items when soiled are associated

[6] Because the principal disposables used in the SICU and the MICU overlap to a great degree, they are discussed together.

with a relatively high risk of disease transmission. The use of disposables limits worker exposure to potential pathogens. In addition, the shapes of these devices make them difficult to clean. Patient safety may be compromised if the integrity and sterility of such items are not assured. IV bags on the other hand never come in direct contact with any body fluids and thus are not contaminated during use. Plastic IV bottles, reusable for a single patient, should be considered as a substitute. Glass IV bottles are also available but the safety and ease of handling of the plastic bags make staff reluctant to consider this option.

Patient Floors--

The disposable products regularly used on the patient floors include suctioning equipment, tubing, catheters, blood transfusion equipment, and dressing supplies. Suctioning equipment, tubing, and catheters are employed in the same way as in the SICU and MICU and thus have the same pollution prevention opportunities discussed in the corresponding section.

Those items associated with the transfusion of blood must be handled and disposed of with increased precautions due to their inherent contact with blood. Per Universal Precautions, a high risk of disease transmission must be assumed. Consequently, neither the reuse of this equipment nor the use of reusable equipment is recommended.

Considerations of infection control again limit the use of reusables as a means to pollution prevention in isolation cases. Wastes from strict and respiratory isolation rooms are contaminated with diagnosed, transmittable pathogens. Because the consequences of transmission can be fatal, risk of exposure to such viral agents must be minimized. Almost all disposable products are used and the circumstances disallow reuse of single-use items. The use of reusables is also extremely restricted in isolation cases to limit the number of and risk to employees who must handle the contaminated items.

Hemodialysis

Disposable products used in this ward include IV bags, tubing, needles, gloves and dialyzers. As has been consistently found throughout this review, little opportunity exists for pollution prevention by way of reuse or product substitution of IV bags, tubing, needles and gloves. Dialyzers, though single-use items, are reused by the VA approximately 20 times before their disposal.

The reuse of hemodialyzers has been found to be a common practice in health care institutions today. In an informal survey conducted at the 1984 Georgetown University International Conference on the reuse of disposables, 46% of the respondents reported that hemodialyzers were being reused in their institution.[7] Such reuse reduces the waste generated during hemodialysis treatments.

It should be recognized, however, that an evaluation must be made for each disposable which is being considered for reuse. With respect to high-tech items, it is generally believed that hemodialyzers are the only device that has been studied sufficiently to show that its function is not impaired by reprocessing.[8] Such research determinations may encourage the reuse of hemodialyzers as a means of achieving waste reduction. Still reuse of single-use devices in any health care facility will be dependent upon that facility's policy regarding reuse. Because other issues such as safety, ethics and even legality are involved, it is important that these decisions are made according to hospital policy and not individual staff member discretion.

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[7] "Reuse of Disposable Medical Devices in the 1980's," Proceedings of the International Conference. Institute for Health Policy Analysis, Georgetown University Medical Center, 1984, Appendix B.

[8] "Single Use or Reuse: What's the Answer?" OR Manager, Oct. 1985, p. 6.

Outpatient Clinic

Each of the disposable items employed in the Outpatient Clinic have been discussed individually above. Principal disposables include dressing supplies and suction equipment.

OTHER OPPORTUNITIES FOR POLLUTION PREVENTION

The VA Hospital in Cincinnati has realized many of the opportunities for waste reduction that exist through product substitution. The hospital's standard use of wovens has lead to a significant decrease in the amount of waste it generates. This reduction of waste is exemplified by the comparatively low number of bags of medical waste generated per case in the VA Hospital Surgery Department. Only one to two bags of medical waste are generated per case at the VA as compared to the two to three bags of medical waste generated per case by hospitals that employ most or all paper products in the operating room.[9] In addition, the reuse of some disposable devices, where functional integrity, sterility and patient safety are not compromised, has further reduced the hospital's waste output. The reprocessing of glass materials in the laboratories would reduce significantly the hospital's rate of waste generation if such reprocessing was deemed feasible. Although further waste reduction through product substitution is greatly limited by infection control guidelines, each disposable product employed by a health care facility should be re-evaluated for pollution prevention opportunities. In the end, each hospital must decide on its proper mix of disposables, durables, and reuse of disposables, depending on its size, its reprocessing capability and its in-house quality assurance program.

The suggestions below focus on achieving pollution prevention through recycling and good housekeeping, are applicable to all health care facilities, and are equally crucial to any successful pollution prevention program as product substitution.

Recycling

Although options for recycling are limited, some glassware generated in the laboratories may potentially be recycled. The recycling of glassware made from sodalime (e.g. pasteur pipettes) may greatly reduce the volume and weight of a hospital's current wastes. Unfortunately, a large percentage of the glassware employed in the laboratory is made of pyrex (borosilicate) and can not be recycled with other consumer glass wastes. Furthermore, although the autoclaving process completely disinfects, the stigma which has been ascribed to medical waste may restrict or eliminate recycling as a means of waste reduction. Nevertheless, this alternative to disposal should be investigated. Community, county, and commercial recycling centers should be consulted about their policies regarding the acceptance of glass used in health care facilities.

Good Housekeeping

Efficient and controlled management of materials is an essential element in the pollution prevention effort. It is important that accurate inventories are kept of stocked materials as well as accurate numbers of noninventoried items that are requisitioned. By closely monitoring purchasing and distribution operations, a hospital will be able to avoid both over-ordering and stocking materials no longer used. Tracking materials from purchase through distribution also mitigates the problem of supplies ending up in wards that do not use them. In addition, if a given product is overstocked in a ward, materials tend to be used less conservatively and are often wasted.

Reusables should be employed whenever the option is available. For example, in the Outpatient Clinic both woven and plastic-coated paper gowns are available. For most treatments, the cloth gown

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[9] Jeff Griffith, Per site visit interview, August 16, 1989

provides a sufficient barrier against infection, and therefore should be the primary gown worn by outpatient staff. The use of paper gowns should be limited to those treatments, such as chemotherapy, which require more stringent infection control and increased barrier protection. Policy regarding the primary use of reusables should be defined and communicated to all staff.

Moreover, pollution prevention should be considered when making purchasing decisions. Incorporating pollution prevention assessments into the decision-making process for purchasing supplies would greatly foster the waste reduction goal through the ultimate purchase of a greater number of reusables. The incorporation of such assessments into the Commodity Standardization Committee meetings will also encourage staff awareness of the hospital's goal to minimize wastes. Employee involvement will be critical in the operation of any pollution prevention program and will be further discussed below.

ELEMENTS OF A SUCCESSFUL POLLUTION PREVENTION PROGRAM

A successful pollution prevention program must begin with support from top management. This support should be clearly affirmed in a written statement and circulated among hospital staff. A program must also be developed and clearly defined in a document explicitly identifying the program goals and objectives. A commitment to evaluate and implement waste reduction opportunities should be expressed.

Personnel training should be modified to include an orientation of the pollution prevention program. To ensure policy consistency, it is important that such training be standard and used throughout the hospital regardless of the ward an employee will be servicing. The significance of the pollution prevention program will be best impressed on staff through an initial orientation and the periodic distribution of materials highlighting the hospital's pollution prevention achievements. The use of rewards and incentives to encourage employee involvement should also be considered.

Changes over time in the amount of waste generated should be carefully tracked. This will allow the hospital to identify new or changing opportunities for waste reduction and inform staff of the success of the program. Periodically, a review of the program should be conducted to revise and update the program to reflect changing conditions. Additionally, the exchange of pollution prevention information both within a health care facility and between outside health care facilities should be encouraged.

A successful pollution prevention program will be founded upon these elements. They offer a starting point for any waste reduction program, the ultimate success of which will depend upon a facility's creativity and dedication to minimizing the amount of waste being generated.

Research and Development Opportunities

Although pollution prevention opportunities may appear limited at first, the implementation of alternatives whenever possible will, in sum, achieve significant waste reduction. In addition, greater opportunities may be unveiled with further research. Identifying research needs to enhance pollution prevention in the health care industry is an important step in accomplishing waste reduction goals. Suggestions for research and development possibilities in the health care industry are presented below:

- Costing: The literature suggests there is some confusion as to the relative costs of reusables and disposables. As noted earlier, the unit costs of a product do not necessarily represent the entire cost realized by health care facilities. For disposables, one must also consider associated disposal costs. Disposal costs can be expected to increase in the future as landfill and incineration rules grow increasingly more stringent. Similarly, in considering reusable costs, one must account for reprocessing and storage costs. EPA may want to conduct cost studies for certain health care products in cooperation with other Federal agencies, such as Veterans

Affairs and Health and Human Services.

• Quality Assurance: As noted earlier, the literature review conducted for this study indicated that many health care institutions are reusing disposables upon sterilization. However, there are considerable legal and ethical issues associated with the decision to reuse disposables. Among these are the manufacturer's admonishments against reuse. There is agreement that, in general, manufacturers can offer a higher surety of sterility than can the individual health care facility. In addition, the products were not designed for reuse and may face some deterioration over time from use to use. EPA may want to consider working with trade associations, and other Federal agencies, such as the Food and Drug Administration, in reviewing techincal, legal, and policy impacts of reusing disposables. The ultimate goal would be a protocol for reuse.

• Development of Reprocessing Capacity: As stated earlier, many hospitals have lost their reprocessing capabilities as a result of the disposable revolution. Space and labor constraints appear to be the major impediments to returning to reprocessing, along with a general preference for the convenience of disposables. As health care cost containment gains ever increasing attention, reprocessing may once again receive a cost-competitive edge. EPA could explore, along with trade associations and other Federal agencies, the potential for re-establishing the viability of reprocessing, perhaps by stimulating the development of cooperative reprocessing service centers in areas with a high density of health care facilities.

• Developing Reusable Market: Certain bills in Congress amending the Resource Conservation and Recovery Act (RCRA) will require that Federal agencies meet certain objectives for use of recyclable products. The EPA and VA may want to work together in developing procurement guidelines for the VA which will stimulate the production and distribution of reusables and recyclables. This could lead to waste minimization technology transfer opportunities throughout the health care community.

APPENDIX A

The term medical waste has been defined by EPA in the course of a recent rulemaking. In promulgating standards for the Tracking and Management of Medical Waste (54 Federal Register 12371), EPA differentiated between medical waste and **regulated** medical waste. The term "regulated medical waste" is currently applicable in states (termed "covered states") in which the Medical Waste Tracking Act (MWTA) is operable. These States include Connecticut (CT), New Jersey (NJ), New York (NY), Rhode Island (RI), and the Commonwealth of Puerto Rico (PR).

As defined in the MWTA, the term regulated medical waste includes those wastes listed below. It is apparent from this list that regulated medical waste (as defined by the MWTA) is comprised of contaminated medical supplies, blood, other body fluids, body parts, and unused sharps. However, Ohio is not a "covered state", and since the VA-Cin hospital is not subject to the MWTA rules, the MWTA definition of regulated medical waste was not used in this study to guide the evaluation of the volumes of medical waste generated.

DEFINITION OF REGULATED MEDICAL WASTE

- 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; wastes from the production of biologicals; discarded live and attenuated vaccines; and culture dishes and devices used to transfer, inoculate, and mix cultures.

- Human pathological wastes including tissues, organs, body parts, and body fluids that are removed during surgery or autopsy, or other medical procedures, and specimens of body fluids and their containers.

- Human blood and blood products including (1) liquid waste human blood; (2) products of blood; (3) items saturated and/or dripping with human blood; or (4) items that were saturated and/or dripping with human blood that are now caked with dried human blood; including 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 in this category.

- 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 or without the attached needle), pasteur pipettes, scalpel blades, blood vials, test tubes, needles with attached tubing, and culture dishes (regardless of 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.

- 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 highly communicable diseases, or isolated animals known to be infected with highly communicable diseases.

- Unused sharps: hypodermic needles, suture needles, syringes, and scalpel blades.

APPENDIX B

CALCULATION OF HEMODIALYSIS OCCUPIED BEDS

Since hemodialysis beds are the only beds in this table that are not set up for overnight use, the following calculation was done to equate the use of hemodialysis beds with the use of overnight beds, (i.e., the number of occupied beds presented in this table):

Potential Use:

(9 operating beds) x (2 treatments/day) x (5 days/week) = 90 treatments/wk

Actual Use:

(8 used beds) x (2 treatments/day) x (3 days) = 48
(7 used beds) x (1 treatment/day) x (2 days) = 14
62 treatments/wk

Percent Usage:

62 treatments/wk
90 treatments/wk = 68.9%

Hemodialysis Occupied Bed Equivalent:

(9 operating beds) x (0.689) = 6.2 "occupied beds"

APPENDIX C. MAJOR GENERATING WARDS IN NEW YORK AND NEW JERSEY[1]

Ward	Rank Ordering				
	Largest Source	2nd Largest Source	3rd Largest Source	4th Largest Source	5th Largest Source
Lab (including pathological)	15	9	6	0	0
Operating Room	11	12	4	1	1
Medical/Surgical	2	2	3	2	2
Dialysis	3	1	0	1	0
Emergency Room	0	5	5	5	8
Labor & Delivery	2	0	4	0	1
ICUs/CCU	1	1	4	8	4
Nursing Unit	1	1	0	1	1
OB/GYN	1	1	1	2	4
Patient Floor/Room	0	0	1	3	1
Oncology	0	1	1	1	0
Pharmacy	0	1	0	1	0
Ambulatory	0	0	1	0	0
Endoscopy	0	0	0	1	1
Isolation Rooms	0	0	0	0	1
Shock Treatment	0	1	0	0	0
Long Term Care	0	1	0	0	0
TOTAL RESPONSES	36	36	30	26	24

Note: Sample size = 54

[1] Taken from Characterization of Medical Waste Generation and Treatment and Disposal Practices in New York and New Jersey, January 30, 1989.

GLOSSARY

Chuck - Disposable linen protector.

Culture - A growth of microorganisms or other living cells in special media.

Cuvette - A glass container used for examination of materials in the ultraviolet or visible region of the spectrum.

Dialyzer - An apparatus for drawing different components of a body fluid.

Petri dish - a shallow vessel of glass or other material for making bacterial cultures.

Pipettes - A glass or transparent plastic tube used in measuring or transferring small quantities of liquid.

Posted - Supplies available from the Medical Center's central supply warehouse.

Sharps - These include hypodermic needles, syringes, pipettes, scalpel blades, and needles.

Sharps containers - A container in which sharps are disposed.

Unposted - Supplies not available through SPD that must be ordered directly from a medical supply distributor.

VACUTAINER - Blood collection sets.