

# Hospital Pollution Prevention (P-2) Strategies



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## CHAPTER I INTRODUCTION

This document was prepared in partial fulfillment of a pollution prevention (P-2) grant received by the Environmental Management Branch (EMB) within the California Department of Health Services from Region IX of the U.S. Environmental Protection Agency (U.S. EPA). EMB implemented the P-2 Project in six participating Bay Area hospitals to reduce their medical and solid waste streams and to eliminate mercury from their wastes. Additional hospitals have joined with EMB to implement P-2 program activities. The lessons learned from the participating hospitals have been used in developing this document.

EMB and the California Healthcare Association partnered in developing the *Self-Assessment Manual for Proper Management of Medical Waste* that was printed during 1998. As part of the P-2 Project, EMB published *A Guide to Mercury Assessment and Elimination in Healthcare Facilities* during 2000. Information from those two documents, as well as information from the solid and medical waste reports that were prepared for the participating facilities, have been used in creating this document.

A systems approach has been undertaken through the P-2 Project, as it is recognized that waste generation is an integral part of the healthcare system. Patients come into the hospital, services are provided, and wastes are generated in the process. To achieve desired outcomes the systems within a facility must be working harmoniously and not against each other. Although this sounds very straight forward, it is surprising how many systems are not aligned and actually are working against each other. The late quality guru W. Edwards Deming indicated that we must optimize the operations of the interdependent components within an organization to accomplish the aim of the system.<sup>1</sup> To ensure that wastes are handled, containerized, and stored properly, the environmental services staff within the hospital must work across professional boundaries with doctors, nurses, laboratory staff, and other generators. Unanticipated fiscal benefits were realized from the P-2 Project when systems were studied and improved. Systems improvement has become an area of focus within the P-2 process.

Additional benefits can accrue to the hospital when P-2 and systems improvement activities are implemented. Waste disposal costs can be lowered as waste volumes are reduced or eliminated. Income can be generated through some recycling efforts. The hospital can enhance its image through the following P-2 and systems improvement outcomes:

- Providing a safer workplace
  - Reducing workers' compensation claims

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<sup>1</sup> Deming, W. Edwards, *The New Economics For Industry, Government, Education*, Massachusetts Institute of Technology, 1993, page 98.

- Reducing lost time to injuries
- Improving worker satisfaction because the hospital has reduced causes of injuries
- Enhancing regulatory compliance
- Lessening adverse impacts on health and the environment
- Reducing the impact on overburdened waste sites
- Gaining recognition as a “good neighbor” to the community
- Gaining recognition as an industry leader in pollution prevention
- Increasing morale and pride as a member of an organization focused on P-2

These potential benefits should be sufficient to stimulate more hospital administrators to provide the leadership for their facilities to move into P-2 and systems improvement activities. This document provides the required information to institute a P-2 and systems improvement program in the hospital setting.

## **CHAPTER II**

### **P-2 PROGRAM PLANNING AND IMPLEMENTATION**

#### **PLANNING P-2 PROGRAMS**

If a P-2 program is to be successful within a hospital, top administrators within that facility must support it. The P-2 Project required written approval by the hospital administrator for the facility before that hospital could be a participant. The administrator also designated a staff member that would be the point person for the P-2 Project within the hospital. The approval form also indicated that staff would be given time to participate in P-2 activities. This process helped to ensure that the P-2 Project would be initiated within the facility.

The P-2 Project staff worked with the designated coordinators within each hospital facility. The P-2 coordinator was responsible for gaining project support from others throughout the hospital to join and become part of the P-2 team. It was found to be beneficial to create a P-2 team with representation from the various disciplines across the facility such as:

- Environmental Services/Housekeeping
- Infection Control Nursing
- Health and Safety/Hazardous Materials
- Risk Management
- Purchasing

Partnering with suppliers and regulators can also be beneficial and help ensure the success of the P-2 program. Suppliers can bring the latest technologies to the facility and can assist in developing cost-efficiencies in the products purchased by the hospital. Some suppliers can provide crucial services to the hospital to implement environmental improvements. For example, some suppliers will take mercury-containing sphygmomanometers from the hospital for recycling when mercury-free aneroid sphygmomanometers are purchased from them. In addition to selling products, suppliers often are able to provide essential training in the proper use of the equipment and supplies they sell.

EMB's P-2 Project staff and the participating hospitals utilized a "safe harbor" arrangement that relieved anxiety of hospital staff that the regulatory agency might document violations while at their facility. EMB committed not to document violations at the facility while they were present conducting P-2 Project activities; these findings instead were discussed with the hospital staff and corrective actions implemented. The safe harbor did not apply during regular medical waste inspections or in response to complaints that untreated medical waste had been improperly handled and/or disposed. EMB first used the safe harbor concept when it developed the self-assessment manual.



**Figure 1** A soap dispenser supplier gives a presentation to hospital representatives. (Pollution Prevention Project Photograph)

Consultation and collaboration between the regulatory agency and the generator develops the best means for quickly solving problems. In its January 26, 1996 edition, the Los Angeles Daily Journal described this self-assessment project as the “Most promising new program for 1996.”<sup>2</sup>

## **UNDERSTANDING THE WASTE SYSTEMS WITHIN THE FACILITY**

To successfully reduce or minimize waste generation one must first understand why the wastes were created; where they arise; the special waste handling processes for worker and public safety; regulatory compliance governing the handling of the waste stream; and the varying costs of handling, treating, and disposing of these wastes. The following represent the six major waste streams generated within hospitals:

1. Liquid wastes
2. Solid wastes
3. Hazardous wastes
4. Radioactive wastes
5. Air emissions
6. Medical wastes

Each of these waste streams is governed by a specialized set of laws and regulations to ensure worker and public safety, as well as environmental protection. Some of these wastes may be found in different physical forms such as the liquid and solid states of medical wastes.

Wastes are unwanted items that are generated by the various systems and processes in operation within the hospital. The treatment technologies and disposal costs vary from one waste stream to another, making it fiscally prudent to handle the waste in the cheapest waste category legally allowed.

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<sup>2</sup> Hsiao, Peter, “Prize Policies-Evaluating Environmental Amnesty Programs,” *Los Angeles Daily Journal*, January 26, 1996.

## RECOGNIZING THE NEED TO REDUCE WASTES

The handling, storage, transportation, treatment, and disposal of wastes are a cost of doing business for the hospital. Improper management of the various regulated waste streams can result in additional expenditures for failing to comply with the laws and regulations governing these wastes. Segregation of the wastes requires employees to identify hazards associated with the various wastes. If employees are unable to recognize the various waste streams they not only increase the cost of disposal but also increase the likelihood of personal or public injury. Added to this situation is the unknown cost created by bad publicity and possible enforcement actions for failing to properly handle the waste stream.

Regulators classify mixed waste and specify the required manner of its disposal according to the most highly regulated component in the mix. Thus, solid waste mixed with medical waste is classified as medical waste and hospitals must dispose of it as such. This may increase the cost of disposal by at least 20 times over the cost if the waste streams had not been commingled.

Management and staff must be committed to waste minimization in order to successfully implement waste reduction within the hospital setting. Management must communicate the need for waste minimization in a manner that inspires staff to implement positive actions towards waste reduction. This can be achieved by publishing a “waste minimization strategy” to guide these efforts within the facility.



**Figure 2** Pollution prevention display at a hospital's "Earth Day" Fair. (Pollution Prevention Project Photograph)

The strategy should state the goal of the waste minimization program and identify new policies and directives for handling and discarding the various waste streams. Waste reduction comprises any practice that reduces the amount of waste generated. At the heart of waste minimization are activities that:

- Prevent waste generation,
- Reduce waste generation,
- Reuse waste that has been generated, and
- Recycle waste.

An additional component is purchasing recycled-content products or developing new products that utilize recycled materials. This assists in perpetuating the recycling process.

Technology is assisting hospitals in preventing the generation of some wastes. The change to electronic data storage for patient records is reducing the generation of paper wastes while speeding access to the records.

Kaiser hospitals use plastic totes for shipping supplies from their central warehouse to hospitals to reduce the need for cardboard containers. Supply trucks pick up the empty plastic totes from the back docks of the hospitals on a scheduled basis for return to the central warehouse for reuse.



Hospitals are composting yard and food wastes and using the resultant mulch as a soil amendment. Hospitals are also baling cardboard wastes for reuse.

The *Bio Elite Bag Company* in Southern California is manufacturing red bags for medical wastes, as well as laundry and solid waste bags, using at least 30 percent recycled plastics. These high-density bags also weigh less and are stronger than the traditional low-density bags that have been in use, thus offering additional savings in waste reduction and costly spill cleanups.

**Figure 3** The *Bio Elite* red bag contains 30 percent recycled plastics and weighs less than standard red bags. (Pollution Prevention Project Photograph)

## P-2 PROGRAM IMPLEMENTATION

To be successful, waste minimization efforts must begin with formulation of implementation strategies. The strategies should describe how the hospital's waste minimization goal would be achieved. Formal strategies contain the following elements:

- Goals to be achieved,
- Policies that guide or limit action regarding those goals, and
- Action sequences or programs that strive to accomplish the goals.<sup>3</sup>

The waste minimization strategy should be formally approved by top management within the hospital as a commitment to the program. Top management should next assign responsibility for the program to an individual, department head, team, or council. The individual or team responsible for implementing and coordinating the waste minimization program must be empowered by management to work across organizational boundaries in carrying out the program. When management announces the waste minimization strategy and assignment of responsibility they should include an expectation of cooperation from every operational unit and individual throughout the hospital.

Once management has announced the waste minimization strategy and assigned responsibility for implementation, the next task is to gather data as to the current waste streams being generated within the hospital. These data should include the quantities of waste being generated for each of the waste streams and the costs associated with handling and treatment of these wastes. This information can be utilized to help plan where to initiate waste minimization strategies, as well as to document the status of the wastes being generated at the start of the waste minimization project. These data will also provide the baseline from which to demonstrate the amount of change that has been achieved from implementation strategies. The ability to document success requires that accurate initial assessment data have been gathered.

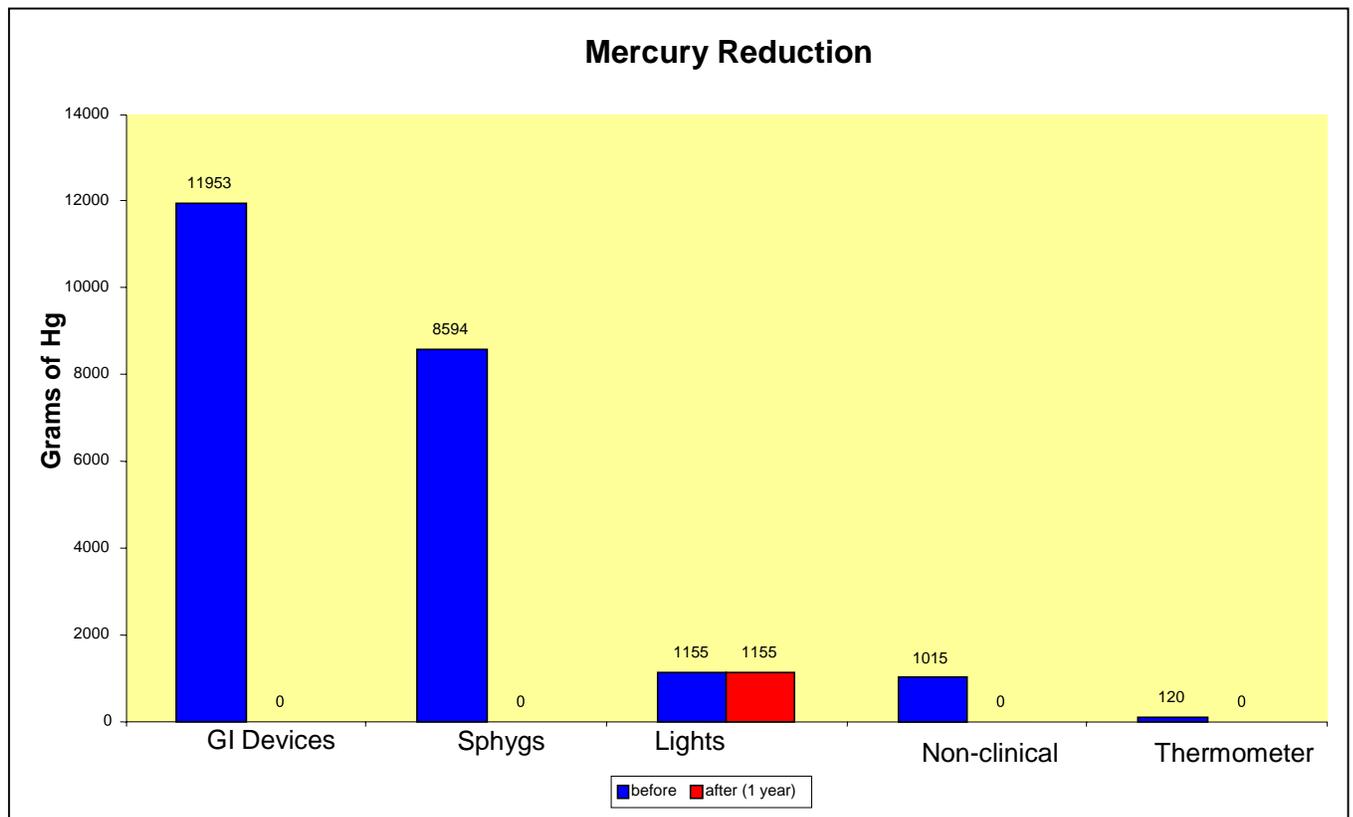
The status of waste minimization projects and results achieved from these activities should be communicated throughout the facility. Several hospitals have included information about their P-2 activities and achievements for waste minimization in staff and patient newsletters. Charts showing achievements should be prominently displayed throughout the hospital to encourage further actions in waste minimization. Success should be shared with the surrounding community to demonstrate that the hospital is a good environmental steward.

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<sup>3</sup> Dean, James W., Jr. and James R. Evans, *Total Quality Management, Organization, and Strategy*, West Publishing Company, 1994, page 260.



**Figure 4** Waste being weighed and the results entered into a computer for tracking to the point of generation. (Pollution Prevention Project Photograph)



**Figure 5** Chart showing “before” and “after” mercury assessment and removal results from a hospital. (Pollution Prevention Project Photograph)

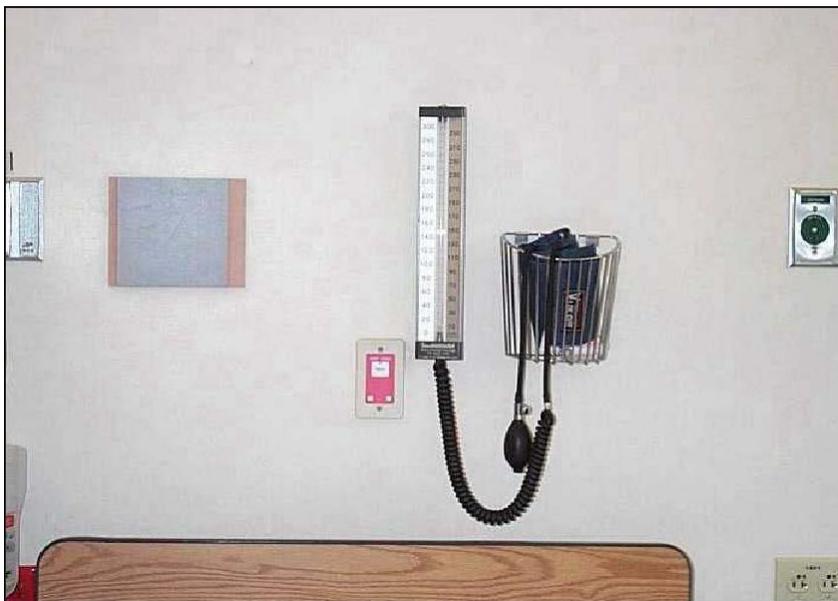
## CHAPTER III HAZARDOUS WASTE MINIMIZATION

### HOSPITAL EQUIPMENT AND DEVICES CONTAINING MERCURY

#### Sphygmomanometers

The sphygmomanometer that traditionally has been used in hospitals to monitor blood pressure contains mercury. Until recently, this was the only accurate sphygmomanometer on the market. Although technical developments have given the mercury-free aneroid sphygmomanometers an accuracy rating similar to the mercury units, it is often difficult to convince some practitioners to change. Arguments are made that aneroid sphygmomanometers add to the burden of hospital maintenance staff because of the need for periodic calibration. However, mercury sphygmomanometers also need periodic maintenance. The expense and time of managing maintenance, spills, and disposal of mercury sphygmomanometers can outweigh the time needed for calibrating the aneroid units.

Many hospitals are replacing mercury sphygmomanometers and have found that companies that manufacture aneroid sphygmomanometers have policies that make replacement more economically feasible. These companies may take back and recycle mercury units on a one-for-one basis when their aneroid units are purchased. The purchasing department of a hospital can negotiate with these companies to get the best price for the number of mercury sphygmomanometers they want to replace and not to be burdened with additional mercury disposal costs.



**Figure 6** Bedside mercury sphygmomanometer commonly found in hospitals. (Pollution Prevention Project Photograph)



**Figure 7** The bedside mercury sphygmomanometer has been replaced with an aneroid unit. (Pollution Prevention Project Photograph)

### **Baumanometer→ Safety Devices**

By far the most commonly used sphygmomanometer found in hospitals is the Baum brand wall-mounted sphygmomanometer. Manufactured in New York since 1916, the Baum sphygmomanometer was a technological breakthrough at that time. Since then, it has undergone many modifications and improvements and is considered by some a standard for blood pressure measurement.

Indeed, a testament to the quality of this instrument is the fact that many in use are up to 30 years old. However, this is also one of the problems with the “Baumanometers.” The majority of instruments in use in the hospitals visited by California pollution prevention staff were manufactured before Baum began including safety features that greatly diminish the chance of a mercury spill.

Baumanometers are found in many uncharacteristic places. In fact, many patient areas that have been turned into offices may still be found with the Baumanometers mounted on the walls next to desks. Additionally, alternative types of sphygmomanometers may be found, but the Baumanometers are not removed from the walls. These wall-mounted sphygmomanometers are seen in many emergency rooms, treatment rooms, and doctors’ offices.

The safety issues with these older model sphygmomanometers include two items that are inexpensive and easy to fix. One is replacement of the glass mercury tube with a mylar-coated tube. The other is the insertion of a small “L” shaped metal “lever lock” that prevents accidental release of the mercury from the tube. Both are included on new Baumanometers.

Older models of the Baum sphygmomanometers used a clear glass tube. Although it is somewhat recessed in the instrument’s face, it has always been a potential source of a spill if the tube were broken. Now, hospital personnel can replace the

glass tube with one coated with mylar. If the tube breaks, the mylar coating will prevent shattering and maintain the integrity of the tube. The mylar sheath ends close to the tube's top end, and a fingernail can detect the change in the tube's outer diameter. This check can be used to see if existing tubes are mylar coated. The mylar coated tubes can be purchased from Baum and replacement is not difficult. They are available for all models of Baum brand sphygmomanometers.

The second safety device is provided free of charge from Baum. On the wall mounted Baumanometer, the mercury-containing tube is held in place by a lever on top of the device. The lever is only supposed to be moved when the sphygmomanometer is removed from the wall and lying on its right side. If this lever is inadvertently flipped back while the instrument is upright on the wall, the tube is released and the mercury spills out of the bottom of the tube.

The "L" shaped lever lock is a simple strip of angled metal that is easily slipped behind the lever to immobilize it. The lock can be removed with no problem using a screwdriver, but spills are prevented because patients cannot remove the lever lock without some effort. The lock eliminates the potential to idly flip the lever, which bored and/or curious patients may do. Vigorous cleaning of the sphygmomanometer can also allow inadvertent flipping of the lever.



**Figure 8** Unless recycled, the 90 sphygmomanometers, along with thermometers and bougies (not pictured), would have to be managed as hazardous waste at great expense. There are programs to exchange both bougies and sphygmomanometers. (Pollution Prevention Project Photograph)

Another benefit of inserting these lever locks is that one person in the facility can make a detailed accounting of where and how many Baumanometers are in the hospital, and can make a quick visual maintenance check as well.

## Sphygmomanometer Service Kit

One significant source of mercury that must not be overlooked when conducting a mercury audit of a hospital is contained in the sphygmomanometer service kit. Typically, along with spare parts and fittings, such a repair kit will come with one or more one-pound bottles of triple-distilled mercury. If the service kit has been used, there may well be another bottle of waste mercury. The service kit may be all that remains at a facility that has changed out all its mercury sphygmomanometers. Extra bottles of mercury have also been discovered separate from the kit. One pound of mercury is about 33 milliliters, or about the volume of a nasal or ophthalmic solution bottle. The engineering department of a large hospital could easily overlook such a small container.



**Figure 9** This style sphygmomanometer service kit is provided for the Baum sphygmomanometer. The mercury from this kit may be consolidated with that from other sources to be recycled. Sphygmomanometer exchange programs may agree to accept this source of mercury. (Pollution Prevention Project Photograph)



**Figure 10** The bottle of "new" mercury (left) weighs 500 grams (454 grams is a pound). The waste mercury (right) was estimated at 0.3 pound. (Pollution Prevention Project Photograph)

## Esophageal Dilators (Bougies) and Feeding Tubes

Esophageal dilators, feeding tubes, and other devices may use mercury as a weight. Non-mercury replacements are available for all the mercury-containing devices that have historically been used in hospital endoscopy departments. The most common of these is the esophageal dilator or bougie. This device is a long, flexible tube containing mercury. It is passed down the patient's esophagus and used to dilate this structure if there are constrictions from various disease processes. Patients may return periodically to the hospital for this procedure if they have a chronic problem. A mercury-free alternative is available, containing tungsten gel for weight instead of the mercury. Additionally, the outside surface is silicone, which is non-slip when dry, and slippery when wet, making handling easier. The mercury-containing bougies are made of rubber.



**Figure 11** A complete set of tungsten gel-weighted bougies, stored in the leather zippered case that formerly held the mercury ones. (Pollution Prevention Project Photograph)

The silicone tungsten gel bougies are green, easily differentiating them from the orange rubber mercury bougies. At least one company has a trade-in policy that gives a ten percent rebate toward purchase of a new mercury-free bougie and also includes free recycling of the old one.

## Gastro/Esophageal Tubes Containing Mercury

Miller Abbott tubes are passed down a patient's esophagus, through the stomach, and into the small intestine to help unblock intestinal obstructions. Historically, these tubes had a balloon containing mercury to guide the tube into place through gravity. The mercury balloon can be replaced with a water-filled balloon, or a different procedure used. Most practitioners have stopped using the Miller Abbott tubes in favor of a combination of drugs and surgery for obstructions.

The Blakemore tube (Sengstaken-Blakemore tube) (shown below) is a device used to stop the bleeding of esophageal varices (dilated veins in the esophagus). The tube consists of two balloons; one inflated in the stomach to hold the device in place, the other inflated inside the esophagus to compress the bleeding vessels. The

Blakemore tube is an absolute necessity in the emergency room. Older Blakemore devices have a mercury-weighted tube allowing them to be placed in a similar fashion as the Miller Abbot tube. A solid rubber weight replaces the mercury in the mercury-free device.



**Figure 12** A Blakemore tube has three connections. One inflates the bulb, one inflates the tube, and one is for gastric lavage and administering fluids. (Pollution Prevention Project Photograph)

**Figure 13** This mercury barometer, used to standardize blood gas measurements, can be replaced with an aneroid device. (Pollution Prevention Project Photograph)



## Barometers in Respiratory Therapy

In several hospitals visited, the respiratory therapy department had one of the largest repositories of mercury in the hospital. Hospitals have historically used mercury barometers to calibrate blood gas analyzers. One popular brand of barometer in use holds 14 ounces of elemental mercury. The manufacturer does not sell any safety devices for this barometer.

Some hospitals have replaced barometers with aneroid units, or simply call their local airport periodically for a barometric pressure reading.

## Thermometers

A possible source of mercury thermometers in the household can be newborn nurseries. Most hospitals give the new mother a kit with commonly needed baby items upon discharge after delivery. Previously, these kits would typically include a new mercury thermometer. This practice is no longer as common, and hospitals should provide non-mercury substitutes. A potential method to “get the word out” about mercury is through childbirth classes. Many hospitals require classes on childbirth and newborn care prior to delivery. Educators can be encouraged to teach expectant mothers about alternatives to mercury thermometer use in the home.

Mercury thermometers may also be found in refrigerators used throughout the hospital. Hospital refrigerators must have thermometers, but mercury



**Figure 14** Every hospital refrigerator must have a thermometer. This mercury thermometer could easily be replaced with an alcohol/spirit thermometer. (Pollution Prevention Project Photograph)



**Figure 15** On the bottom shelf of this refrigerator are (left) a mercury minimum/maximum thermometer, and (center) a non-mercury recording thermometer. Upper shelf, at 1 o'clock, a home refrigerator alcohol/spirit thermometer. At 11 o'clock, a "lab quality" mercury one. Mercury thermometers should be replaced with non-mercury thermometers and the number of thermometers in use could be reduced. (Pollution Prevention Project Photograph)

thermometers may easily be replaced with alcohol/spirit thermometers. When conducting the mercury audit an explanation about the P-2 Project and the need to find all mercury-containing devices such as thermometers helped to encourage laboratory staff to find all mercury thermometers within their labs.

## Intraocular Pressure Devices

Prior to ophthalmic surgery, pressure within the eyeball can be reduced to simplify surgery. Mercury-filled devices, such as the “Wee Bag O’Mercury,” have been used for this procedure. The egg-shaped device contains approximately 600 grams of elemental mercury. When placed on the eye for 30-45 minutes prior to surgery, the weight of the mercury on the eyeball keeps fluid from accumulating at the normal rate, softening the eyeball.

Newer micro-surgical procedures have relegated this device to forgotten drawers in most facilities because pressure reduction is not always necessary. The stored pressure reducer may create a waste problem because it may be easily discarded inappropriately due to its small and inconspicuous size. Staff from the P-2 Project found a Wee Bag O’Mercury that had not been in use for 14 years stored in the back of a drawer in one hospital. Effort must be exerted to search for these unused items and to properly dispose of them while the hospital is actively involved in its mercury elimination project. No manufacturer could be found that is still making mercury pressure reducers and no recycling programs are in place for them. It is the responsibility of the facility to find, recycle, and replace these devices.



**Figure 16** *Wee Bag O’Mercury* ocular pressure reducing device contains over 600 grams of mercury. (Pollution Prevention Project Photograph)

A similar device consists of a hard, formed plastic egg with one convex side that snapped to a headband. Many staff consider the device inferior to the Wee Bag O’Mercury, raising concerns that staff may revert to using mercury-filled devices. Without a replacement available, physicians may request repair of one of the old-style mercury pressure reducers, unnecessarily exposing staff and patients to possible elemental mercury.

If a replacement is desired, the Lebanon Corporation offers the Honan Intraocular Pressure Reducer or Eye Softener. It is a pneumatic device with a pressure gauge to maintain even pressure on the eyeball.

## B-5 Fixative

Laboratories widely use a compound called B-5 fixative. This mercury-containing fixative has been used in histology to aid in identification of certain cell types. The tissue is placed in a container with the B-5 fixative and left until the solution has penetrated the tissue. Then the tissue is stained and placed onto a slide for microscopic examination. During the rinse process some mercury is discharged into the facility sewer system.

Several brands of B-5 fixative use zinc chloride instead of mercury. Laboratory suppliers should be able to provide a listing of possible substitute brands.



**Figure 17** “B-5” Fixative previously containing mercuric chloride has been replaced with zinc chloride as noted on the label. (Pollution Prevention Project Photograph)

## Mercury-Free Cleaning Products

Small, and potentially overlooked, sources of mercury in the hospital are cleaning products. The electrolytic process of chloralkali production (manufacture of chlorine products and sodium hydroxide products) often relies on mercury electrodes, resulting in mercury contamination of the products. Many cleaning products consequently contain low levels of mercury. Although these products contain mercury in quantities that are in parts per million or billion, the amount of cleansers used in hospitals can result in a contribution to mercury in wastewater through normal use. Hospital purchasing departments should be aware of this situation and request mercury-free product verification from their suppliers.

## MERCURY CONCERNS IN HOSPITAL OPERATIONS

To ensure safety and contamination control, activities that remove mercury from the facility must be consistent and predetermined. This may involve establishing a facility-wide, dedicated mercury management program. The suggested elements of

such a program, which would also include spill reaction and mercury exclusion policies, are set forth below.

### **Mercury-Containing Devices In Medical Waste or Sharps Containers**

Staff must clearly understand that any broken mercury-containing device must be managed as hazardous waste even if contaminated by medical waste. Whether broken or intact, mercury devices must never be placed in red bag medical waste containers or sharps containers, but rather collected for recycling or hazardous waste disposal. Even though the increased use of digital and other non-mercury substitutes has drastically reduced the incidence of broken fever thermometers, this principle applies to clinical, laboratory, and all other sources within the healthcare facility.

### **Mercury Collection Areas**

Mercury-containing material will ultimately either be recycled or disposed as hazardous waste. To assure all devices earmarked for removal actually leave the hospital, a single, dedicated, secure pre-collection location for consolidation of mercury, mercury-contaminated waste from spills, and mercury-containing devices is a necessity. Procedures for removal of mercury-containing material to consolidation locations must also be established.

Some practitioners may be reluctant to switch from familiar and trusted mercury-containing devices to mercury-free models. To prevent these practitioners from retaining mercury-containing devices when the hospital is trying to replace them, change-out procedures must dovetail with the transport system.

### **Transporting Mercury Devices**

Change-out activities, whether for bedside sphygmomanometers, mercury thermostats, or mercury devices in the boiler room, should also be coordinated with planned secondary containment and transportation to a prescribed storage location arranged in advance. Ad hoc improvements or changes are to be discouraged. Ultimately, mercury-containing items will be consolidated at the facility's hazardous waste storage area for recycling. Procedures should clearly state proper storage methods at each storage area and scheduled transportation to the consolidation area.

## **Spill Clean Up**

It is important to have individuals available at all times who are trained and familiar with management of mercury spills and the use of a spill kit. Notices should be adequately posted throughout the facility listing these individuals and how they may be contacted. A mercury spill must be treated as a hazardous waste spill. Staff throughout the hospital must be informed of procedures for notifying of the trained personnel for mercury clean up. Training and clear communication on the importance of proper procedures in mercury clean up are imperative.

## **Spill Clean Up Kit**

Spill clean up kits should be easily accessible to staff on call for mercury clean up. Any laboratory or safety supplier will have choices of spill clean up kits available. Some of the components the kits should contain are:

- Mercury Suppressant - a solution that will prevent vaporization of elemental mercury.
- Mercury Indicator - a powder that changes color to indicate the presence of mercury.
- Mercury Absorbent - a powder that amalgamates with mercury to facilitate clean up.
- Mercury Aspirator or Vacuum - a syringe to a dedicated vacuum for mercury and used to suction mercury from surfaces. It is very important that regular vacuum cleaners are not used on spilled mercury, as they spread the contamination through aerosolization of the mercury particles.
- Clean up materials - gloves, safety glasses, screw cap containers, plastic bags, paper towels, and similar clean up aids.

Mercury spill clean up kits can be made in-house or purchased from a safety equipment supplier.

The cost of a vacuum specifically for mercury may be prohibitive for small facilities. Hospital groups may purchase one to share between facilities. Hospitals in a city or region could also cooperatively purchase one mercury vacuum to share. Some governmental agencies and university hazardous materials emergency response departments or companies have mercury vacuums available. Be prepared and know whom to contact before the spill occurs.

## **Keeping Mercury Out of the Hospital**

After removal of mercury sources from the hospital it is important to keep new sources from entering the hospital. To help keep mercury from entering the hospital, purchasing personnel need to become knowledgeable and committed to buying mercury-free items when available. Facilities should require their departments to inform the purchasing department when items requested contain mercury and why available alternatives are not appropriate. Conversely, personnel involved in purchasing must continually update their familiarity with the availability and applicability of new mercury-free alternatives.

## **Mercury Assessment**

The mercury assessments conducted as part of the P-2 Project were much more thorough and effective when a limited number of people conducted the assessment. A three-person team is ideal for conducting the assessments, as that number does not crowd the area being surveyed or, more importantly, stifle staff interaction. Incidental comments from staff working in the area being surveyed often led to the discovery of mercury-containing devices that may have been overlooked without their input. Where larger assessment teams were used, comments from staff and supervisory personnel were reduced. The smaller team also was able to cover more areas of the facility in a rapid fashion. When smaller teams were used, they surveyed areas not previously targeted, in addition to the areas staff had planned to visit. These more comprehensive surveys often resulted in fewer follow-up activities needed by the hospital staff.

## **Plumbing Traps**

Residual mercury from past disposal practices in hospitals has been known to collect in plumbing traps. Lack of awareness of this hidden mercury may result in spills during plumbing or demolition activities if the appropriate staff does not provide secondary containment when disassembling a trap. This can easily be accomplished by placing a shallow bucket or other similar container below the plumbing traps prior to disassembling the trap. Staff training greatly lessens the risk of uncontained contamination.

## **Fluorescent Lighting**

Measuring mercury contributed by fluorescent lighting is a formidable task. The engineering department from one of the hospitals participating in the P-2 Project provided a complete inventory of all fluorescent fixtures, from which project staff could calculate a conversion factor of 0.57 milligrams per square foot (mg/ft<sup>2</sup>) for use throughout all the hospitals. This was based on the premise that, due to mutual compliance with a wide variety of regulations, lighting in each of the participating hospitals could justifiably be approximated to be the same level as found at the hospital that undertook the inventory of fluorescent fixtures.

Effective March 7, 2000, the California Department of Toxic Substances Control adopted emergency regulations (the universal waste rule) that require all fluorescent tubes be either recycled or disposed of as hazardous waste.

### **Electrical Supplies**

The electrical supply for a large hospital may employ certain mercury-containing devices such as high-current service cutoff switches, relays, and mercury vapor circuit breakers. These devices are not hospital specific, and there are no substitutes available. These devices, common to many large commercial and industrial facilities, are self-contained and physically isolated, minimizing risk of mercury escape. They are also very long-lived, so their replacement, and the resultant generation of waste mercury, typically occurs coincidentally with other major electrical changes. The facility plan should reference any such devices in use in the facility, and prescribe procedures for recycling or disposal at time of replacement.

### **Calculations and Quantification**

The P-2 Project relied on several sources for quantifying mercury contained in a particular device. The capacities of the two kinds of barometers found were also estimated volumetrically, by calculation from the measured heights and internal diameters of the cisterns and columns. Although no mercury was actually found, measurement of bulk mercury from plumbing traps was to be done volumetrically. The following procedure should be followed if mercury is found. Decant the majority of the trap aqueous liquid, pour the mercury and any remaining water into a graduated cylinder and note the volume of the denser mercury.

The weight of mercury for light fixtures was based on an actual fixture inventory performed by one participant facility. Published information from a manufacturer of low-mercury fluorescents states that conventional fluorescent tube production technology could achieve no less than 22 milligrams of mercury per four-foot tube. Since an underestimate would be counter to the best interests of their advertising, the P-2 Project accepted that number as a conservative minimum. The facility inventory yielded a multiplier of 24,156 linear feet of tube. The facility calculated its mercury total from fluorescent lights to be 133 grams. With 233,900 square feet of floor area in the facility, the mercury in fluorescent lights was 0.57 mg/ft<sup>2</sup>. The P-2 Project staff assumed that all hospitals would be required to meet the same lighting standards and therefore used the 0.57 mg/ft<sup>2</sup> factor in calculating fluorescent tube mercury for all other facilities based upon their square footage.

Factory specifications were particularly difficult to acquire. Contrary to the project goal of eliminating mercury-containing devices for facilities, the device manufacturers continue to sell mercury-containing products.

## **Business Plan**

The 1999 Memorandum of Understanding between the U.S. EPA and the American Hospital Association targeted 2005 for the virtual elimination of mercury in waste streams from hospitals. All hospitals should ascribe to that goal. Following a mercury audit, hospitals should develop a business plan for replacing mercury-containing devices with mercury-free devices. The business plan should be based on the findings and utilize the data generated from the audit. The business plan should consider three matters of fact that may impact on the processes that they choose in eliminating mercury from their hospital.

- The practical feasibility, based on use, change-out and disposal costs and the ability to overcome resistance to new devices may drive the rate at which change can occur.
- Certain devices or products, particularly diagnostic lab packs and multi-dose vaccines (preserved with thimerosal) are often not available without mercury. Mercury reduction can proceed only at a pace determined by the emergence of suitable substitutes in the marketplace.
- New earthquake standards developed by the Office of Statewide Health Planning and Development may require structural changes that include demolition or remodeling of the facility. If demolition or remodeling of the facility is undertaken, caution must be exercised for the removal of mercury-containing fixtures. Many of these mercury-containing fixtures may be presently unknown, such as mercury in plumbing traps and silent mercury light switches that are virtually indistinguishable from their non-mercury counterparts. Discovery and change-out of such fixtures where appropriate is advised, so that they are not present when demolition or reconstruction commences.

## **FOLLOW UP**

Along with reduced use of mercury-containing items, and their removal from the hospital, comes another responsibility—keeping out new mercury sources. Educate the purchasing department in each facility to be alert for the possibility of reintroduction of mercury and to scrutinize vendor agreements. In addition, other departments must be alert that devices that have been removed are not replaced with other mercury-containing devices. The laboratory must continue to use zinc-based fixatives, and to be alert for thimerosal preservatives in commercially prepared stains. Wherever possible the pharmacy should encourage the use of thimerosal-free vaccines. Rarely, resistance to these changes from professional staff has been observed. Administration staff at each hospital must be ready to step in if mercury-containing devices reappear following removal.

## HAZARDOUS MATERIALS MINIMIZATION

Wherever possible hospitals should reduce the use of hazardous materials in an effort to curtail the generation of hazardous waste. Hospitals will continue to need devices containing hazardous materials, but in an increasing number of cases recycling is being required after use. New universal waste regulations require fluorescent lights and cathode ray tubes to be sent for recycling instead of to the landfill. Additionally, several easy to implement practical steps can be initiated within the hospital to help achieve a reduction in the hazardous waste stream.

The first step is to develop a formal mission statement outlining the hospital's commitment to source reduction. It is important to encourage employees to participate in hazardous materials source reduction as a way to reduce or eliminate hazardous waste generation. Hospitals should consider an incentive program to encourage employees to follow good housekeeping practices that reduce hazardous materials use. An incentive program can easily be instituted through an employee or team recognition or awards program.



**Figure 18** Environmental Services staff using the MicroScrub mop system. (Pollution Prevention Project Photograph)

A second step involves training employees on source reduction techniques and encouraging them to develop innovative ideas to reduce hazardous materials use within the hospital. Training should include proper handling and storage of hazardous materials so that spills can be prevented or immediately responded to so as to minimize their impact. Trade associations, equipment vendors, and local environmental health programs often sponsor employee training on this subject as part of the services they provide to hospitals. An on-going commitment to employee training in hazardous materials source reduction must be made and include periodic training sessions held to keep employees current so that they can perform their duties more efficiently.

A third step to reduce the hazardous waste stream is to implement a program of inventory controls for hazardous materials. A computerized inventory enables policies that facilitate sharing of materials among departments and prevent duplicate purchases.

Such policies save money and reduce the amounts of hazardous waste generated from leftover materials.

A fourth step involves using improved technologies that reduce hazardous wastes. The MicroScrub mop system is replacing the traditional wringer mop that was patented in 1893 and has been in use since then. The wringer mop system uses

disinfectants in a bucket containing two to three gallons of water, mopping three to four rooms before emptying the bucket in a janitor's sink and refilling for use in another three to four rooms. The MicroScrub system uses a single flat cloth mop per room, with the cloths stored until use in a gallon bucket with a third of a gallon of water covering the cloths. When a cloth is needed it is pulled from the bucket and used in a single room. When the floor of the room is finished being mopped, the mop cloth is removed



**Figure 19** Chemical dispensing unit mounted in a janitorial closet ensures precise amount of chemical is used. (Pollution Prevention Project Photograph)

and placed in a bag and a new one used for the next room. At the end of the day all the dirty cloths are laundered and dried for use the next day. String mops last approximately a month before needing to be replaced. MicroScrub mop cloths have been in use at Sacramento's Mercy General Hospital for over three years with no signs of wear. Additionally the MicroScrub system is lighter and easier to use, thus reducing repetitive motion injuries. Some hospitals have paid for implementing the system through risk management funds from anticipated ergonomic injury reduction savings.

The use of chemical dispensing units within hospitals can reduce the amount of chemicals used by removing the "human factor" in "eye-balling" the quantity of chemicals to be used. Suppliers install chemical dispensing units within janitor's closets where chemical-using equipment is filled. Different sized dispensing heads meter out a measured amount of chemicals as required for the cleaning procedure being performed. Facilities realize cost savings by reducing the amounts of chemicals used.

Substituting non-hazardous or less-hazardous materials for hazardous materials can reduce or eliminate the hazardous waste stream. Some hospitals have routinely used hepatitis B quaternary disinfectants daily on floors. Infection control specialists have recently directed that this process should only be used for cleaning and disinfecting blood spills, and that daily floor cleaning can be accomplished using a floor soap or clear water. This process will assist infection control within the hospital

by reducing the possibility of developing resistant strains of pathogens from the continued use of hepatitis B quaternary disinfectant cleaners. Additionally, this reduces the amounts of chemicals used within the facility and the cost associated with their use.

Hospitals can substitute gelled electrolyte lead-acid batteries (commonly called “gel cells”) for traditional wet cell lead-acid batteries in several sizes of floor scrubbing and polishing machines. The gel cell is a “recombinant” battery. The oxygen that is normally produced on the positive plate in all lead-acid batteries recombines with the hydrogen given off the negative plate. The recombination of hydrogen and oxygen produces water that replaces the moisture in the battery. This makes the gel cell battery maintenance-free because it need not be topped off with water like wet cell batteries. A gel cell battery is pressurized and sealed using special valves. This self-contained feature prevents battery acid spills and the need for special cleanup kits. Recharging does not produce fumes, which is very beneficial in hospitals.



**Figure 20** Gel cell batteries installed on a floor scrubbing machine. (Pollution Prevention Project Photograph)

A fifth step to reduce hazardous wastes is to prepare and implement a hazardous materials spill response plan. An immediate response to hazardous materials spills or improper storage of hazardous wastes can minimize employee or patient exposure, damage to the hospital facility and surrounding environment, liability, and disposal costs. Routine inspections of hazardous materials containers and hazardous waste storage drums can identify potential problems such as leaks and improper storage practices that could result in costly remediation if action is not taken to remedy the situation. Periodic drills to respond to hazardous materials spills can improve the readiness of hospital response staff to take appropriate action during an emergency. A quick and appropriate response will reduce the amount of hazardous wastes generated during a spill and reduce the cost of the cleanup. Hazardous materials should be stored separately from non-hazardous materials to prevent the creation of larger amounts of hazardous waste if a spill takes place in the storage area. Hazardous materials are best protected in a covered area where they are not exposed to the elements. Sunlight has the potential to degrade some hazardous materials and absorbed heat can raise the pressure inside containers, creating potentially dangerous conditions.

## CHAPTER IV SOLID WASTE MINIMIZATION

Health care facilities generate approximately two million tons of solid wastes per year. This represents one percent of the Nation's solid waste stream. Table 1 represents a breakdown of the typical hospital solid waste stream.

Table 1.  
Composition of a typical hospital solid waste stream

Waste Type	%
Paper	54 %
Organics (including yard waste)	19%
Plastics	15 %
Metals	3 %
Glass	2 %
Other (including disposable diapers)	7 %

Paper represents the largest portion of the hospital solid waste stream and is composed of cardboard, kraft, high-grade paper, newspaper, magazines, phone books, directories, and other mixed paper. Many hospitals have instituted programs to bale and recycle cardboard.



**Figure 21** Many hospitals recycle cardboard. (Pollution Prevention Project Photograph)

The second highest percentage of the hospital solid waste stream is organic wastes including yard wastes. The largest component of the organic waste stream from hospitals is food wastes.

Plastics, at 14.6 percent, represent the third highest percentage of the hospital solid waste stream. If significant reductions in the solid waste stream are to be achieved, these portions of the waste stream are the leading candidates for intervention strategies.

## **PERFORMING THE SOLID WASTE AUDIT**

Hospitals should select the solid waste audit team from staff knowledgeable with the layout and waste operations of the facility. Candidates for the team are managers, supervisors or others from housekeeping, environmental management, and health and safety, as well as infection control. The team should be small enough so as not to disrupt the operations of the areas being reviewed. The major difference between the mercury assessment discussed in the preceding chapter and the solid waste audit is that the mercury assessment looks for fixed or transient locations of mercury-containing devices, equipment or materials, whereas the solid waste audit reviews the solid waste stream that is being generated and moving through the facility. A team of three to four individuals works best in conducting the solid waste audit. The team walks through the facility and notes solid waste handling practices and observes what wastes are being disposed of in the waste receptacles. The team needs also to gather pertinent data as to the amount of solid wastes being generated and the solid waste company handling the waste stream. Note must be made of the amount of material being diverted from disposal through reduction, reuse, and recycling activities as the total amount of waste generated equals the amount disposed plus the amount diverted.

The audit should note how wastes are handled and stored. The team should document the location of recycling containers and other devices, such as cardboard balers. If possible, the cost of the recycling activities should be obtained. This information can be valuable should reduction strategies eliminate the need for recycling of specific products. Documenting the success of solid waste minimization efforts requires knowledge of the costs before the minimization interventions.

## **SUCCESSFUL SOLID WASTE REDUCTION STRATEGIES**

Most of the hospitals that participate in the P-2 Project had already instituted cardboard recycling prior to joining the program. However, there is a cost to recycling the cardboard. Staff must breakdown the cardboard containers, haul them to a baler, and bale them. The Northern California Kaiser Hospitals use plastic totes to send materials from their central supply warehouse to the participating hospitals. The totes replace the cardboard containers and greatly reduce the amount of cardboard needing to be baled for recycling. When empty, the plastic totes stack within each other and are easily stored while awaiting pickup and return to the warehouse for reuse. Color-coding the plastic totes assists the receiving facilities in knowing where to send the supplies (such as medicines in yellow totes to the pharmacy). Gray totes are packaged for specific floors designated on a three-by-five card placed in an address area on the tote. This expedites supply delivery and reduces the cost of processing the material through central supply.



**Figure 22** Empty plastic totes nested and ready for return to warehouse for reuse. (Pollution Prevention Project Photograph)

Most communities within California have instituted recycling programs for households, and employees often have commented that when they come to work at the hospital they are surprised to find that little recycling is being done. Hospitals in many California localities can work with their waste authorities and refuse companies to implement recycling programs for aluminum cans, paper, and glass. The waste authorities often have lists of recyclers for various types of materials and can even be a source of small grants to assist the hospital in getting their recycling program underway.

California hospitals have recently been presented with an opportunity to recycle blue wrap and other plastic films such as shrink-wrap, stretch wrap, bubble wrap/blister pack, and plastic bags. Marathon Recovery is a raw material recovery program initiated by Boise Cascade Corporation to procure polyethylene and polypropylene plastic films waste. They have established a receiving center in Oakland, California, and are building a plant in the State of Washington where the recovered plastic film waste will be used to produce a wood/plastic composite building material that will be in the marketplace in the near future. Through this process, hospitals avoid the cost of solid waste disposal for their plastic wrap waste and it in turn is converted into a new building material. Clean Source, a hospital supply company, is assisting this process by backhauling blue wrap and plastic films from the hospitals they service so that waste stream can be easily taken to Marathon's Oakland receiving center. Blue wrap, which is ubiquitous in hospitals, and other plastic film products are being converted from a waste stream component into a valuable recycled product.



**Figure 23** Blue wrap used to wrap surgery equipment for sterilization is being recycled and used with wood chips to make wood siding. (Pollution Prevention Project Photograph)

Many communities in California have instituted yard waste composting to remove this component of the solid waste stream. Hospitals should check with their waste authority to obtain information about possibilities within their locality for diverting yard wastes from the solid waste stream.

Norcal Waste Systems, Incorporated, has instituted a program for composting yard wastes, pallets, and food scrap wastes from San Francisco restaurants at one of their landfill sites in Northern California. Norcal runs the wastes from these three waste streams through a chipper and then places it in plastic silage bags (capable of holding 200 tons of material) for eight weeks of composting, with controlled temperatures aiding the process. The compost that results from this process has been used as a soil amendment in agricultural and horticultural operations. Norcal sends the used plastic silage bags to Marathon for use in their plastic film recovery program. Norcal is exploring the feasibility of using this process for handling the food waste from hospitals. By composting the yard and food wastes, which compose the second largest category of solid wastes from hospitals, this process could reduce the hospital's solid waste stream by approximately 19.1 percent.



**Figure 24** Food waste composting is chipped and mixed with yard wastes and pallets in silage bags to create a soil amendment. (Pollution Prevention Project Photograph)

All activities to reduce the solid waste stream in hospitals must be closely tracked so that progress can be measured. The reduction of the solid waste stream should be prominently displayed in graphic form in the hospital so that staff and the public can see the achievements.

## CHAPTER V MEDICAL WASTE MINIMIZATION

Although medical waste management practices will vary from one hospital to another, a common ingredient in all effectively managed medical waste systems is leadership. Effective management of medical waste requires the hospital to meet all legal obligations, achieve public and environmental protection, and accomplish this in a cost-efficient manner. Overlaying the proper management of medical waste is the increasing attention on reducing the medical waste stream through pollution prevention activities. Balancing these issues is a challenge that requires a commitment from the highest levels of management and from staff entrusted to carry out the medical waste handling activities throughout the hospital.

### MEDICAL WASTE MANAGEMENT LEADERSHIP

Many people think that the terms leadership and management are interchangeable. University of Southern California professor, Warren Bennis, provides the distinction between leaders and managers as follows: “Leaders are people who do the right things; managers are the people who do things right.” He acknowledges that both play critical roles within the organization; but they differ profoundly. People in top positions are often found doing the wrong things well.<sup>4</sup>

Knowing what is right for the hospital is at the heart of the leader’s responsibilities. Burt Nanus in his book, *Visionary Leadership*, emphasizes that twenty-first-century organizations demand visionary leadership. He indicates that most organizations are faced with accelerating technological changes, a diverse staff of intelligent workers, and a variety of customer and constituency needs that would cause most organizations to self-destruct if not for a sense of direction provided through management’s vision of the future. Visionary leadership is vital to align the thousands of disparate tasks and tap the energies of the workers within the organization.<sup>5</sup> This is especially true in attempting to reduce medical waste while ensuring its proper handling in a complex organization such as the hospital setting.

Proper management of medical waste is just one of many systems driving the hospital towards fulfilling its overall vision of providing excellent health care to its clients and the greater community at large. The vision helps to frame the “right things” upon which the hospital should be focused. Absent a picture of a future state to strive towards, we are condemned to the paradigm of: “This is how we have always done it around here.” Visionary leadership also supports the concept of continuous improvement in the ways systems are operated. The P-2 Project always requires the approval of the top management of the hospital before activities are initiated so that their buy-in is assured.

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<sup>4</sup> Bennis, Warren, *Why Leaders Can’t Lead – The Unconscious Conspiracy Continues*, Jossey-Bass Publishers, 1991, page 18.

<sup>5</sup> Nanus, Burt, *Visionary Leadership*, Jossey-Bass Publishers, 1992, pages 178-179.

## **SUCCESS THROUGH STAFF PROCESS OWNERSHIP**

An unnecessary burden is placed upon managers if they shoulder the sole responsibility for the performance of their programs. A great deal of wasted effort and inefficiency results when intelligent workers must wait to be commanded or directed to carry out their work tasks. In their national bestseller book, *Flight of the Buffalo – Soaring To Excellence, Learning To Let Employees Lead*, James Belasco and Ralph Stayer indicate, "...that the key to organizational success today is in getting the people to want to own the responsibility for their own performance."<sup>6</sup> Effective and successful management of the medical waste system within a hospital can best be accomplished when everyone involved is allowed to take responsibility and ownership for the process.

Representatives from the various groups of staff involved with the medical waste stream throughout the hospital can participate on teams to establish strategies for reducing the amounts of medical wastes generated and for handling the remaining medical waste stream. Such team participation can increase coordination across the spectrum of professional classifications within the hospital. The team should consist of those generating the waste, those handling it within a designated area or floor, those responsible for infection control, those moving it through the facility to treatment or storage, and those responsible for purchasing or contracting for these waste services. Representatives from these groups can jointly develop strategies that are understood by staff in all the various organizational groups within the hospital who are involved with the medical waste stream. When employees from these groups own the process, improvements and increased accountability are likely to follow.

Most of the principles of medical waste minimization can be applied to other systems within the health care facility, resulting in more cost-efficient operations and an improved bottom line on the balance sheet. Medical waste minimization centers on eliminating or reducing the medical waste stream. There are several measures that can be instituted to achieve medical waste minimization including the following:

- Waste prevention – eliminating the generation of medical waste
- Source reduction – reducing the amounts of medical waste generated
- Re-use – finding another use for a component so it does not become part of the medical waste stream
- Recycling – handling or treating the material so it can be used in another process

## **DEVELOPING STRATEGIES TO MINIMIZE MEDICAL WASTES**

Essential activities in implementing a medical waste minimization program are to recognize the various waste streams, to initiate strategies to ensure that staff is

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<sup>6</sup> Belasco, James A., and Ralph C. Stayer, *Flight of the Buffalo – Soaring To Excellence, Learning To Let Employees Lead*, Warner Books, Inc., 1993, page 249.

aggressively trained to minimize the generation of wastes in a higher waste stream, and to ensure that the wastes do not become unnecessarily combined. These tasks will require leadership by management in developing policies and training staff. For example, diapers from a nursery can be handled as solid waste; but when medical waste hampers are placed in the nursery, staff often utilize them for disposal of the diapers. This practice will unnecessarily increase the cost for disposing of the diapers because these items must now be handled as medical waste. Management can minimize the medical waste stream by implementing a policy directive that baby diapers are to be disposed as solid waste. This action should be reinforced through a training program on waste handling and waste stream monitoring.

Management and staff must be committed to medical waste minimization to make it a successful program within the hospital. Management must communicate the need for medical waste minimization in a manner that inspires staff to implement positive actions in this direction. This can be done by publishing a “medical waste minimization strategy” to guide the waste minimization efforts within the facility. The strategy should state the goal of the medical waste minimization program and identify new policies for handling and discarding medical waste and the non-medical wastes generated in the same setting. Other possible elements of the medical waste minimization strategy include:

- Plans for staff training and follow-up monitoring
- A monthly tracking mechanism for waste minimization
- Recognition or awards for achieving milestones in implementing the strategy
- Formation of a team or council to oversee and coordinate the medical waste minimization strategy
- Tangible reports, graphs and feedback to show results

The use of bar coding systems can assist in the waste minimization efforts by measuring and recording the medical wastes being generated in the various units of the facility on an on-going basis. Storing the assessment data in a computer for retrospective analysis can be used to show progress as the medical waste minimization efforts are implemented.

It is important to develop good baseline data of the amounts of waste generated prior to implementing the waste minimization program. Medical waste generation data from the various units within the health care facility should be recorded on a Pareto Chart with the amounts of waste displayed in descending order from the left side of the chart. Pareto analyses can easily determine the highest medical waste generating areas in which the minimization strategies should be initiated. Displaying the medical waste being generated by the various units in the facility can assist in developing “buy-in” for implementing waste minimization strategies. This information should be displayed and communicated throughout the facility.

## **MEDICAL WASTE MINIMIZATION PLANNING**

Top management within the health care facility should formally approve the medical waste minimization strategy and they should assign responsibility for the program. This responsibility can reside with an individual, a department head, team, or council. The individual or team responsible for implementing and coordinating the medical waste minimization program should be empowered by management to work across organizational boundaries in carrying out the program. Management should also communicate an expectation of cooperation from every operational unit and individual throughout the organization.

## **MEDICAL WASTE MINIMIZATION ASSESSMENT**

Data regarding the current waste streams generated within the health care facility need to be gathered during the assessment phase of the program. These data should include the amounts of waste generated for the various waste streams and the cost of disposal or treatment. For the analysis of the medical waste stream, the medical waste generated per patient population in the facility or served by the facility should be completed for future comparisons of the effectiveness of the waste minimization program.

Assessments should provide useful information to assist in determining where to initiate the waste minimization program in order to obtain maximum waste reduction and cost efficiency. Plotting the amounts of wastes generated by the different parts of the health care system also gives staff from each of these areas knowledge as to the potential gains that can be recognized for waste minimization in their areas of the facility. The ability to document success stories at a later date is contingent on having accurate initial assessment data.

## **MEDICAL WASTE MINIMIZATION IMPLEMENTATION**

Following completion of the medical waste minimization assessment the facility should be ready to implement the medical waste minimization program. Based on assessment data, the major medical waste generating areas of the facility should be targeted. These areas have the potential for the greatest accomplishments. There may be resistance to the waste minimization program because it is something new. Busy staff may build barriers to the successful performance of the waste minimization program because they may perceive it will create more work for them. To overcome these barriers will require excellent communications about the waste minimization program to everyone involved. Hospitals that have implemented aggressive medical waste minimization programs have achieved reductions of 30 to 40 percent in the medical waste stream. This degree of waste reduction results in significant cost savings.

Documenting success requires a tracking program that measures the waste being generated in the various parts of the facility. As waste minimization strategies are

initiated, their effectiveness can be measured by the tracking system. Impressive results may be achieved early in the program as easy-to-implement actions can yield big reductions. As the medical waste minimization program in the health care facility progresses, it may become harder to meet percent reduction goals because the easiest reductions have already been achieved. Reductions achieved over the life of the program should always be shown in order to give an indication of the overall accomplishments of the program since its inception.

When a strategy for medical waste minimization is initiated and the results are less than expected, a thorough analysis should be made of the strategy. Learning from failures is important so that the same strategy will not be repeated. The ability to modify the strategy and test it again for effectiveness should be an integral part of any minimization program. Strategies that work well should likewise be studied for lessons that can be applied in other areas of the hospital, and shared with other facilities through technical publications or over the Internet. The workable medical waste minimization practices should be incorporated into the on-going operations of the health care facility through policy directives to staff.

The status and results achieved should be communicated to all staff throughout the hospital and incorporated into new employee orientation. Charts showing achievements should be prominently displayed to encourage further waste minimization. Storyboards depicting the actions taken and results achieved within the various units of the facility should be developed. Success stories should be communicated to the neighboring community to demonstrate that the hospital is a good environmental steward.

## SUCCESSFUL MEDICAL WASTE REDUCTION STRATEGIES

One of the most important factors in reducing medical waste is “location“ of the medical waste container. Medical waste containers placed next to sinks will inevitably collect paper towels and other solid waste. Environmental services or house keeping staff must be properly trained as to placement of the containers in order to curtail improper disposal of solid waste. Staff that generate medical waste must also be trained in the need to keep solid waste out of the medical waste stream. Hospitals can emphasize the importance of segregating these two waste streams by producing a fact sheet comparing the high cost of disposing of medical waste versus solid waste.



**Figure 25** Medical Waste containers by the sink will be filled with paper towels instead of medical waste demonstrating the importance of the location of medical waste containers. (Pollution Prevention Project Photograph)

Sometimes reductions come from unanticipated areas. The P-2 Project learned of a bag manufacturer that was interested in designing a new red bag for medical waste use. The manufacturer set up a meeting with P-2 Project staff to gain insight as to what they would like to see in a new red bag product. Several requests had been received by the P-2 staff members from hospitals interested in using red bags with recycled plastic content. No such bags were available and some manufacturers claimed they could not make them. The new bag manufacturer indicated that he thought it would be possible to use up to 20 percent recycled content in production of his red bags. Additionally, he would use a “star seal” at the bottom of the bag that strengthened the bag by distributing the weight of its contents against all sides. The manufacturer was provided with the strength requirements for approval of the bags that consisted of passing the American National Standards Institute (ANSI) 160 gram dropped dart test. The manufacturer developed a new bag that passed the ANSI test using a dart weighing 180 grams. The high-density plastic bag and initially contained 20 percent recycled plastics content. The bag weighed from 6 to 20.48 pounds less per 100 bags than the low-density plastic red bags typically in use and was approximately 15 percent cheaper. The manufacturer calls this new product the *BioElite* bag. The bag has been well received by the hospitals using them. Through continuous improvement practices the manufacturer has raised the recycled plastic

content of the *BioElite* red bag to 30 percent. The company has also started manufacturing a *BioElite* laundry bag with greater amounts of recycled plastic content.



**Figure 26** *BioElite* high-density plastic red bag is made using 30 percent recycled plastic. It weighs less than standard low-density red bags. (Pollution Prevention Project Photograph)

Several hospitals implemented a reusable sharps container program initiated by the Integrated Environmental Systems (IES) medical waste treatment company. However, this service was discontinued when the company was sold. Reusable sharps containers are approved as a medical device by the federal Food and Drug Administration and are thicker than conventional sharps containers. It is estimated that the reusable sharps containers can be used for five or more years before needing to be taken out of service. At an off-site medical waste treatment facility the reusable sharps containers are mechanically opened and their contents dumped into an autoclave cart for processing. The containers are washed,

sanitized and reassembled for return to the hospital for reuse.

P-2 Project staff studied a 250-bed hospital that was considering starting the program and found through purchasing department records that the hospital used 18,000 sharps containers in a year. Calculations based on the size and weight of the various containers revealed that the hospital could divert 13 tons of plastics from their medical waste stream by purchasing a reusable sharps container service. This has been shown to be the most significant methodology for reducing the medical waste stream.