Introduction

The purpose of this manual is to help hospitals start mercury pollution prevention programs or accelerate programs that have already begun. New federal regulations greatly reduce the amount of mercury that is allowed to be discharged from a municipal wastewater system or an incinerator. By implementing the *best management practices* described in this manual, you can reduce the level of mercury in the environment and avoid the need for increased regulations in the years to come.

The manual offers general guidance on how to initiate a program and technical guidance for implementing the program. The manual includes:

- Information about mercury and its impact on people and the environment (Chapter 1)
- Overview of pollution prevention strategies (Chapter 1)
- How to start a mercury pollution prevention program in your hospital (Chapter 2)
- How to monitor your program, educate staff and measure success (Chapter 2)
- Alternatives for mercury-containing products (Chapter 3)
- Best management practices for handling, recycling and disposing of mercury-containing products still in use (Chapter 3)
- Contacts for further information, case studies and other information (Appendices)

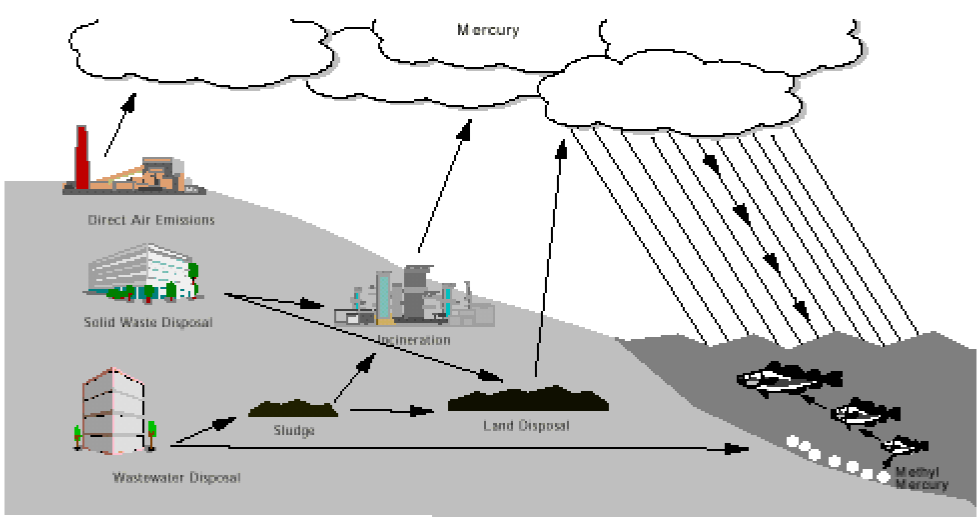
Background on Mercury

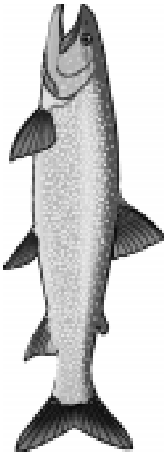
Mercury is a toxic metal that occurs naturally in the environment. There are both inorganic forms and organic forms of mercury. Many of the forms of mercury circulate in the environment, moving from land or water to air and back again, and the forms of mercury may change from one to another as they circulate.

Human activities significantly redistribute mercury and release it into the environment. They allow mercury that was formerly unavailable to the *biosphere** to be mobilized and carried to new areas via air and water. In the water or soil, microorganisms can convert inorganic mercury into a more toxic organic form, methylmercury. Fish take in methylmercury from their diet and from water passing over their gills. They *bioaccumulate* the methylmercury in their bodies because the rate of intake of methylmercury is much greater than its elimination. Methylmercury bioaccumulates in the tissues of a fish throughout its lifetime. It can build up to high levels in predator fish at the top of the aquatic food chain – levels that are tens of thousands to millions of times above the level found in the surrounding water. Fish with high levels of methylmercury may be caught and consumed by humans, waterfowl or other wildlife.

* *Words in italics are defined in the Glossary (Appendix Q).*

Figure 1. Mercury Transport and Bioaccumulation





Health Impacts of Mercury Exposure

All forms of mercury are toxic to humans, but the various forms of organic and inorganic mercury have different toxicity. Generally, organic forms are much more toxic than inorganic forms.

The organic forms of mercury are primarily neurotoxins. Therefore exposure can damage the brain and nervous system. The developing brain of a fetus or child is especially vulnerable to organic mercury exposure. Inorganic forms of mercury primarily affect the kidney, but are also neurotoxins. Other organs and systems of the body can be harmed by exposure to mercury.

A human can be exposed to mercury via all three routes of exposure: inhalation, ingestion, and dermal. The most likely routes of exposure are inhalation of inorganic mercury vapor after a spill or during a manufacturing process, or ingestion of methylmercury from contaminated fish. The fetus of a mother who eats contaminated fish can be exposed to methylmercury via the mother's blood, and an infant can be exposed by ingestion of breast milk. Mercury cannot be removed from fish before they are eaten because methylmercury accumulates in the muscle, not the fat. Most of the states in the U.S., including New York State, issue cautionary advisories about eating the fish caught in some of their waterways because of the presence of mercury. These advisories represent conservative measures to protect human health.

Mercury in Medical Facilities

The following lists show some of the common uses of mercury that may be found in hospitals.

Medical uses:

- Thermometers
- Sphygmomanometers (blood pressure monitors)
- Esophageal dilators (also called bougie tubes)
- Cantor tubes and Miller Abbott tubes (used to clear intestinal obstructions)
- Feeding tubes
- Dental amalgam
- Laboratory chemicals (fixatives, stains, reagents, preservatives)
- Medical batteries

Nonmedical uses common in medical settings:

- Cleaning solutions with caustic soda or chlorine that were contaminated with mercury during the production process
- Batteries
- Fluorescent lamps and high-intensity lamps
- Non-electronic thermostats
- Pressure gauges
- Some electrical switches used for lights and appliances

More complete lists can be found in *Appendix A* and *Appendix B*. There is minimal risk of mercury exposure during normal use of products that are handled correctly. However, problems may occur if the mercury in a product is exposed to air, or if a product is not properly discarded so as to keep mercury out of the environment.

Mercury Pollution Prevention

Concerns about the health impacts of mercury are leading to mercury *pollution prevention* programs at the federal, state and local levels. The highest priority of any pollution prevention program is *source reduction,* which means not using mercury in the first place. For example, some states have banned the deliberate use of mercury in certain products for which alternatives are available.

When adequate mercury alternatives are not available and mercury must be used, it may be possible to recycle it. Recycling is the second priority of mercury pollution prevention. Disposal of mercury should be the last resort. It is expensive and increases the potential of mercury being dispersed into the environment.

Pollution prevention programs are driven by voluntary efforts and by increasingly strict federal and state regulations. Some of the regulations govern occupational exposures and waste disposal. Other regulations result from the federal Clean Air Act Amendments of 1990. The 1995 federal Great Lakes Water

Quality Guidance (also referred to as the Great Lakes Initiative) sets strict water quality standards for mercury in the eight Great Lakes States. (For contacts for regulatory information, see *Appendix C*.)

Best Management Practices (BMPs) for the management of mercury within hospitals might involve:

- Use of alternatives for products that contain mercury
- Recycling of mercury-containing products when they can no longer be used
- Correct handling and disposal of mercury, mercury-containing equipment and laboratory chemicals
- Proper cleanup of spills involving mercury
- Hospital policies that support BMPs

The BMPs are intended to result in the greatest reduction in mercury discharge to the environment that is currently feasible for hospitals.

Benefits of Mercury Pollution Prevention

Mercury pollution prevention in the hospital provides many benefits:

- Protection of human health and wildlife by reducing occupational exposures and releases of mercury to the air, water and land from wastewater discharges, spills, landfilling or incineration
- Avoidance of the costs associated with the use of mercury, such as disposal or recycling, collection and storage prior to disposal, paper work for tracking hazardous waste disposal, training and equipment for spill response, training for hospital employees who handle mercury-containing products, and liability for environmental problems or worker exposure
- Avoidance of increased regulation in the future
- Increase in the public's awareness about the dangers of mercury through publicity about the hospital's program
- Enhancement of the positive public image of the medical facility due to publicity about success stories

How to Establish Mercury Pollution Prevention in Your Hospital

Get Started

(See the flow chart on the following page that corresponds with this section.)

Get support from the top

Support from the hospital's Chief Executive Officer (CEO) is one critical factor in ensuring the success of a mercury pollution prevention program. A first step should be to communicate with the CEO on the benefits of such a program and to request support. A partial listing of program benefits to use in communicating with the CEO is shown in *Appendix D*. When communicating with the CEO, it is important to be clear how the CEO can help. CEO designation of highly respected, knowledgeable individuals to be responsible for policy and operational leadership roles is one important action for the CEO.

Identify and involve staff

The CEO should designate one or more project leaders, including:

- A person to be responsible for developing mercury pollution prevention policy and confirming implementation. The CEO may choose to accept this role or may designate another who is familiar with the workings of the entire hospital and the procedures for approval of policy.
- A person to be responsible for implementing the program. This should be a mercury pollution prevention "champion" who will be enthusiastic about the program and will be dedicated to it. He or she may well be the one who proposed mercury pollution prevention in the first place and who approached the hospital's administration about it. The implementor is often a staff member who is involved in hazardous waste and medical waste management as part of his or her job.

Because mercury appears in so many different locations in a hospital, it takes a team effort to reduce or eliminate its use. The project leaders described above should select a contact from each department who will help to build support for the program and who has the authority to make changes in the department. It may be time-efficient to hold a "kick-off" meeting to introduce the mercury pollution prevention program. However, it would not be necessary to hold meetings as long as the program leaders effectively communicate the objectives of the program to each person who will be involved, and maintain communication until the mercury pollution prevention program has reached its goal.

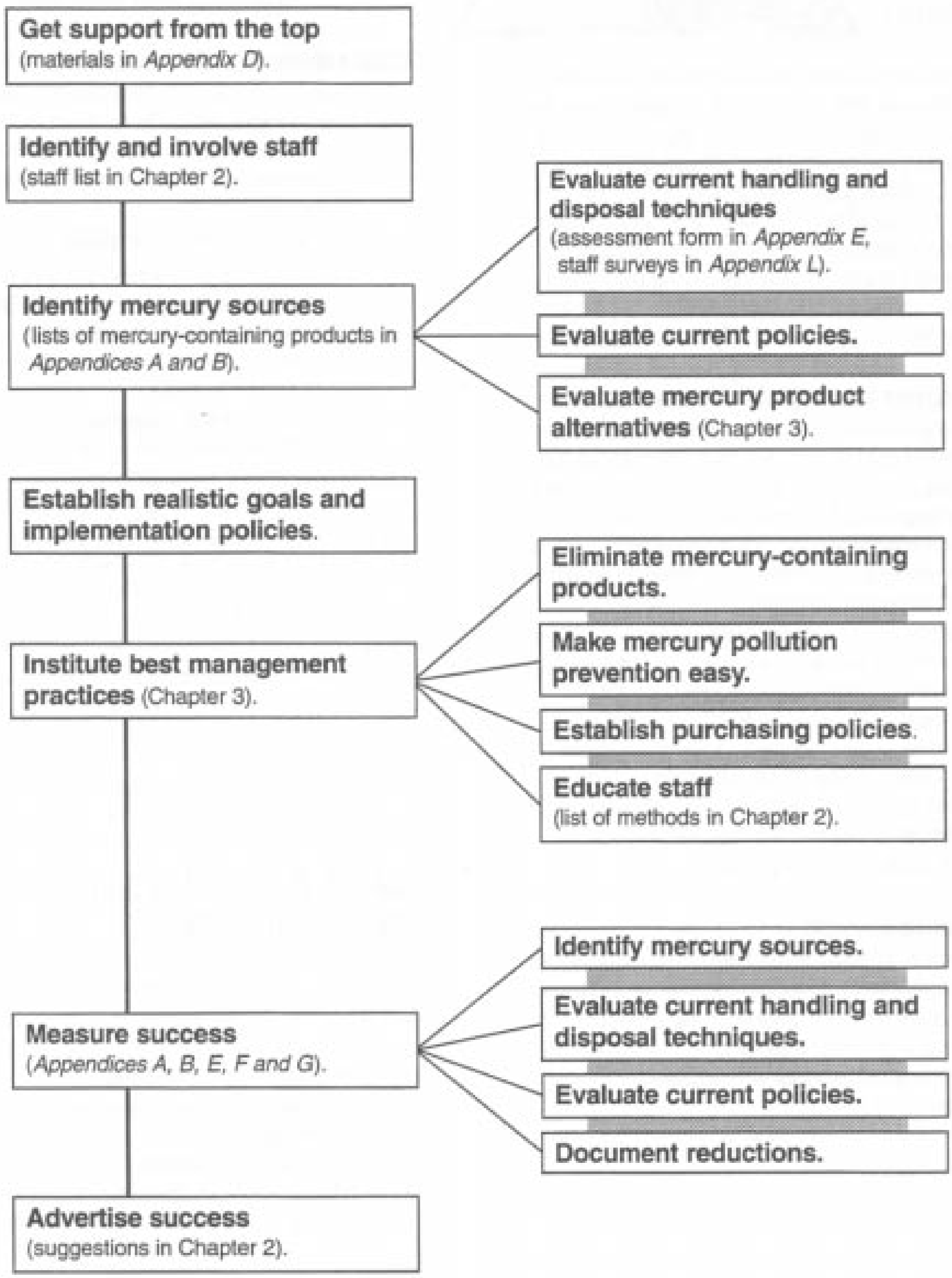
Staff persons that should be directly involved are those with the following functions:

Administrator/policy leader
Safety officer
Champion/implementor
Purchasing officer
Nurse
In-service educator/trainer
Laboratory manager
Maintenance/facilities manager
Engineer
Housekeeping manager
Hazardous waste management coordinator
Supply manager

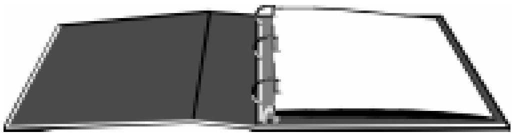
(Note that titles of hospital personnel vary considerably from hospital to hospital.)

All employees of the hospital need to be informed about the program, including employees at off-site locations.

Figure 2. How to Establish Mercury Pollution Prevention in Your Hospital



Gather Data



Identify mercury sources

The first task of the implementor is to create a baseline assessment from which progress can be measured. The department contacts should assist in this effort. Use the checklist of possible mercury-containing products (see *Appendix A*) and/or the checklist of categories of possible mercury-containing laboratory chemicals (see *Appendix B*) as guidelines. The department contacts should perform an audit of all uses and sources of mercury in their own departments.

Evaluate current handling and disposal techniques

The program implementor, with the assistance of department contacts, should assess the status of current hospital practices for handling mercury and staff knowledge about mercury sources and spill prevention and management. (See *Appendix E* for a form for recording your hospital's baseline assessment and four yearly updates.)

If possible, wastewater sample results should be included in the baseline assessment. If the hospital does not currently sample wastewater, work with the hospital's wastewater regulator to learn what data is available or may be collected. Total discharges of mercury in pounds should be calculated. Total discharges are a better indicator of the hospital's impact on the environment than concentration. (See *Appendix F* for further information.)

Evaluate current policies

Department contacts can help to consolidate the hospital's policies that pertain to mercury such as:

- Handling of mercury-containing products
- Mercury spill management
- Recycling or disposal of mercury-containing products
- Purchase of alternatives to mercury-containing products

Policies that address hazardous materials management and laboratory chemical management may be pertinent to mercury, even though mercury may not be mentioned specifically. Hospital policies may be collected by either of the two project leaders.

Evaluate mercury product alternatives

Use the information in Chapter 3 to learn more about mercury-free substitutes for the mercury sources noted on your baseline assessment. Hospital suppliers can also assist you in finding mercury-free alternatives.

Questions to ask when comparing a mercury-containing product and a mercury-free substitute include:

- Is the performance of the substitute as good as the mercury-containing product?
- If the performance is not as good, is it adequate for the purpose?
- What are the costs for purchase? For calibration (if applicable)? For accessories? For maintenance? For disposal?
- Is added cost offset by lower handling, disposal and liability costs?
- Does the substitute introduce new problems for maintenance, handling or disposal?

(For examples of cost/savings worksheets, see *Appendix G*.)

Once a decision has been made to introduce a substitute, it can be decided how to implement the substitution. Some hospitals replace mercury-containing products all at once. Some make substitutions gradually, replacing mercury-containing products when they become unusable.

Establish Realistic Goals and Implementation Plans

The long-term goal of the hospital may be to eliminate the use of mercury entirely. This is true pollution prevention. It will be easier and more satisfying to measure success if the hospital also develops short-term goals, such as eliminating the use of mercury sphygmomanometers within two years. The project leaders should get the support of the CEO for the goals and create a comprehensive plan that lays out how the hospital will achieve its mercury-free status. Contacts from the departments should be key players in establishing the plan. Key components of the plan could include:

- Best management practices (see Chapter 3)
- Policies for the medical departments, the purchasing department and the waste management department
- Training and continuing education programs for staff and administrators
- A process to review progress regularly

Institute Best Management Practices

Obtain the CEO's stamp of approval for all of the best management practices that are selected to become part of the hospital's mercury pollution prevention program.

Eliminate mercury-containing products

The highest priority of the pollution prevention program is the elimination of mercury. The hospital should phase-in alternatives if evaluation has demonstrated them to be acceptable and cost-effective (taking into account disposal costs).

Make mercury pollution prevention easy

Chapter 3 of this manual describes best management practices to keep mercury out of the environment. The chapter is organized by product (thermometers, laboratory chemicals, electrical equipment, etc.).

The hospital can make proper disposal easy by creating convenient locations for disposal of mercury products, as well as other hazardous materials. Establish an internal "take-back" program for electrical equipment by placing a collection box for old equipment at the point where the new equipment is picked up. Find a way to label mercury-containing products so that each user is aware of his or her responsibility for proper use and disposal.

Establish purchasing policies

Consider a policy that bans the purchase of any mercury-containing item if an adequate alternative exists. The policy could include a requirement for specific authorization by the hospital CEO or other designated official for the purchase of a mercury product. Authorize the purchasing department to make "mercury-free" a part of product specifications, to insist on mercury disclosures on all products coming into the hospital, to specify the use of recovered mercury in all products that do not yet have mercury-free alternatives, and to include disposal costs in cost evaluations.

It is becoming a competitive issue for vendors to ensure that their products do not create unnecessary waste or that they are made from recycled materials. Your vendors need to know that mercury-free alternative products are required by your hospital. Ask them to verify in writing that their products are mercury-free or that they will assist you in selecting mercury-free products. For laboratory chemicals, a Certificate of Analysis can be requested. See *Appendix H* for a sample letter requesting mercury information and a sample Certificate of Analysis. For other products, a vendor product mercury-content disclosure can be requested (see *Appendix I*).

Investigate opportunities for reduction in the cost of mercury-free products or reduction in recycling costs through group purchasing of products and services with other hospitals or clinics.

Educate staff

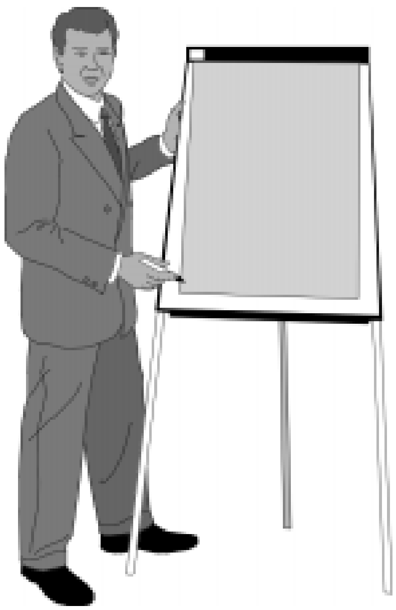
Employee education in mercury pollution prevention is an important component of successful programs. Determine which groups within the hospital need instruction and identify the most important topics for each group. Each segment of the training program should be adapted for the educational level of the group being trained and the intensity of training needed.

Try to incorporate mercury pollution prevention into existing training programs such as new employee orientation, safety training, right-to-know training, department meetings and grand rounds. Training should be continued on an annual basis until mercury-containing products are eliminated from the hospital.

Educational methods include:

- Train-the-trainer program
- Presentations at meetings

- Display in cafeteria or other common area
- Survey about mercury awareness
- Articles in hospital newsletter and other existing publications
- Distribution of articles from professional journals or newsletters
- Employee handbook page on the guidelines for handling and disposing of mercury
- Paycheck enclosure
- Recycling guide
- Posters, fliers and stickers
- Signs near red bags, sharps containers and sinks, and in supply areas and disposal areas
- Labels on instruments that use mercury materials



- Video
- E-Mail
- Verbal instruction from supervisors and from medical engineers who work throughout the hospital
- Incentive program to reward workers with good ideas that make mercury pollution prevention easier
- Reports on internal audits

(See list of Educational Resources for a Mercury Pollution Prevention Program in *Appendix J*.)

Measure and Document Success

Evaluate the status of the mercury pollution prevention program

Measurement of success is a vital component of pollution prevention that allows the hospital staff and the community to realize the effectiveness of the program. Start by repeating the mercury source identification that was done at the beginning of the program (see *Appendix E*), using the checklist of possible mercury-containing products in *Appendix A* and *Appendix B*. If it is not practical to repeat every measurement, select a few good indicators from the table to track from year to year. If possible, take wastewater samples or have them taken by an independent testing laboratory so that the total mercury discharge can be calculated and compared with the baseline assessment.

Note the sources and quantities of mercury that have been eliminated. Compute the costs or savings to the hospital of the substitution of mercury-free products purchased since the baseline assessment (see *Appendix G*). Quantify and document new policies or changes to former policies since the baseline assessment if they are related to mercury pollution prevention.

The hospital should realize a reduction in:

- Mercury products purchased, used and stored
- Mercury spill incidents
- Quantity of mercury shipped off-site for recycling or disposal, and associated costs
- Mercury concentration in wastewater and in incinerator ash, because mercury is not being improperly disposed

Document the reductions and prepare periodic progress reports about your mercury pollution prevention achievements.

Advertise Success

List entities inside and outside of the hospital who should share in the good news of your success. Develop a communication plan that includes both formal reports and informal updates on progress.

Communicate with:

- The hospital board of directors through an annual report that describes accomplishments, upcoming actions and expected outcomes.
- Other hospitals through hospital association meetings and mailings.
- Employees through individual letters, departmental letters that can be read at meetings, a hospital newsletter or posters. Go beyond a progress report and include congratulations and awards for employees who have made useful suggestions for reducing mercury.
- Local officials, such as wastewater treatment plant officials and the health department, through formal letters.
- The general public through press releases, stories in local newspapers, participation in health and environmental fairs, and pamphlets or posters available for doctors' offices.

Best Management Practices for Mercury-Containing Products in the Hospital

Introduction

"Best management practices" for mercury are the procedures that have been found by experience to effectively prevent the release of mercury into the environment. By implementing best management practices now, the hospital can help to avoid the need for increased regulations in the future. For most mercury-containing products in the hospital, the preferred best management practice is to replace the item with a mercury-free product. However, it may not be possible to replace all of the hospital's mercury products at once and, in a few cases, there may not be a substitute that is considered to be reliable and cost-effective. For these products, best management practices are effective procedures for handling and either recycling or disposing of the mercury-containing products. Recycling is recommended. Disposal should be the last resort.

"For most mercury-containing products in the hospital, the preferred best management practice is to replace the item with a mercury-free product."

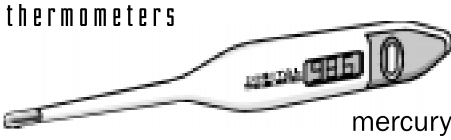
Mercury-containing products can be found almost anywhere in the hospital. They range from medical instruments and clinical laboratory chemicals to electrical equipment and cleaning solutions. This chapter is organized by product (thermometers, laboratory chemicals, etc.). For each product the chapter describes:

- The alternatives for mercury-containing products
- The best management practices for handling and recycling or disposing of mercury-containing products that are still in use

In all cases, when a mercury-containing product is still in use, the hospital's hazardous waste management coordinator will have the ultimate responsibility for its recycling or disposal. All personnel within the hospital who handle mercury-containing products must cooperate with the hazardous waste management coordinator to develop appropriate procedures for the handling of items to be discarded and their transportation to the designated hazardous waste collection point.

Fever Thermometers

Alternatives for mercury-containing thermometers



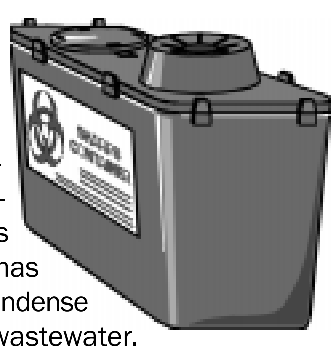
See the table of alternatives for mercury-containing thermometers following the “Fever Thermometers” section.

Take-home thermometers

If some units of the hospital send thermometers home with their patients, hand out mercury-free thermometers. The take-home thermometer might be digital, chemical strips or a glass thermometer filled with a non-mercury liquid metal alloy. The use of a mercury-free alternative will prevent the release of mercury into the environment when the family breaks or otherwise discards the thermometer.

If an alternative has not yet been evaluated and chosen, and mercury thermometers must be distributed in the meantime, educate patients about how to recycle the mercury after a thermometer has been broken or if one is to be discarded. This can be done most easily by handing out written information with the thermometer. This information should also be available at the hospital’s information desk. (See *Appendix K* to learn how mercury from thermometers should be recycled in several counties. Use it as a handout to give to your patients.)

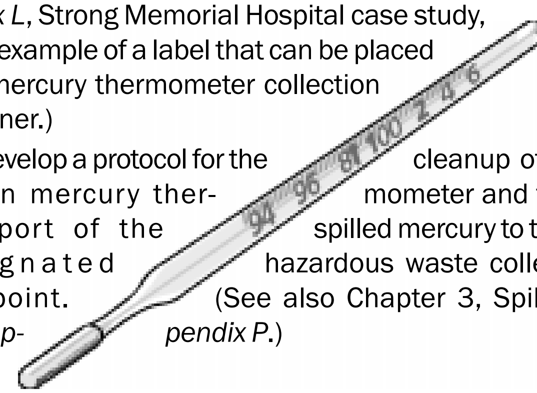
Keep mercury thermometers out of red bags and sharps containers



Mercury volatilizes easily. When a mercury thermometer has been placed in a red bag or sharps container that is incinerated or autoclaved, the mercury becomes a gas and enters the air. Mercury that has vaporized in an autoclave may also condense along with the steam and enter wastewater. Mercury thermometers should not be placed in red bags or sharps containers, even in an isolation unit. The hospital’s protocol for isolation units should make it clear that thermometers can be removed from the unit as long as they are disinfected first. (See *Appendix L*, Strong Memorial Hospital case study, for an example of a “no mercury thermometers” label that can be placed on a red bag container or sharps container.)

Recycling/disposal of mercury-containing thermometers

Develop a procedure for discarding mercury thermometers. The thermometers could be placed at a collection station that is convenient for nursing personnel and that is designated specifically for the temporary storage of hazardous materials. Make a container available at the collection station for the thermometers and label it clearly. The container could be emptied or picked up on a regular basis or on an as-needed basis, according to the instructions of the hazardous waste management coordinator. (See *Appendix L*, Strong Memorial Hospital case study, for an example of a label that can be placed on a mercury thermometer collection container.)



Develop a protocol for the cleanup of a broken mercury thermometer and for transport of the spilled mercury to the designated hazardous waste collection point. (See also Chapter 3, Spills, and *Appendix P*.)

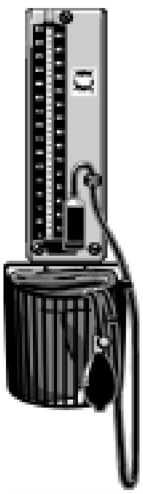
Table 1. Alternatives for Mercury-Containing Thermometers

Type of thermometer	Cost	Accuracy	Time for Reading	Calibration Frequency	Comments
Electronic (digital): oral/rectal	Thermometer: approx. $300. Disposable probe covers: pennies apiece. Take-home can be < $5	Comparable to mercury	Oral: seconds Rectal: seconds	Every 6 mo. - 1 year (Some need initial testing only)	Requires batteries
Electronic (digital): tympanic (also called infrared thermometer)	Thermometer: approx $300. Disposable probe covers: pennies apiece.	Comparable to mercury	Seconds	Every 6 mo.-1 year. (Some need initial testing only)	Requires batteries. Must use “pull and tug” method to get correct placement. Can select to give equivalent oral/rectal reading.
Chemical strip, single-use dispos-able (plastic or paper strips with dots filled with different chemical mixtures, each formulated to melt and change color at a given temperature)	Pennies apiece	Comparable to mercury	Oral: 1 minute Axilla: 3 minutes	None required	Does not record temperatures below 35° C (95° F)
Glass filled with with alloy of gallium, indium and tin; a liquid at room temperature	Approximately $3.00	Comparable to mercury	3 minutes	None required	Breakable
Mercury	Approximately $0.40	Considered to be the “gold” standard” for accuracy comparisons	Oral: 5 minutes Axilla: 7 minutes	None required	Breakable. Average life expectancy 80 days in hospital setting, if reused. Disposal is expensive.

Sphygmomanometers

Table 2. Alternatives for Mercury-Containing Sphygmomanometers

Type of Sphygmomanometer	Cost	Comments
Aneroid	Wall model adult: $50-$80; portable model adult: $30-35	Needs calibration annually. Accuracy comparable to mercury.
Electronic	On the order of $2,000	Common where long-term continuous monitoring is needed, such as intensive care.
Mercury	Wall model adult: $60-70; portable model adult $60-70	Requires annual refilling and calibration. Easily breakable. Disposal is expensive. Not recommended for carpeted areas.



Refilling mercury-containing sphygmomanometers

In order to ensure optimal performance, manufacturers of sphygmomanometers recommend that the mercury be removed and filtered at regular intervals. Once a year is a typical interval, but the mercury should also be removed and filtered any time there is a question about the performance of a sphygmomanometer. If a broken device is to be repaired, it too must have the mercury removed and filtered.

If it is not yet feasible for your hospital to replace all of its mercury sphygmomanometers, make sure there is a protocol for their handling and refilling that is consistent with manufacturer's instructions and Occupational Safety and Health Administration (OSHA) standards. The protocol might include the following instructions:

1. Place the sphygmomanometer to be refilled in a clear plastic bag and seal the bag. Do not use a red bag or biohazard bag.
2. Mark the bag: "CONTAINS MERCURY."
3. Place the bag in a plastic basin to contain spills while transporting to the area where the sphygmomanometer is to be refilled.
4. Wear appropriate protective clothing and work within a hood to provide ventilation.
5. Handle over a tray to contain any spills. Never handle mercury over a sink or floor drain.
6. Carry the sphygmomanometer back to the patient room as described in steps 1-3 after refilling.

(See the Chapter 3 section on Spills for other precautions.)

Recycling/disposal of mercury-containing sphygmomanometers

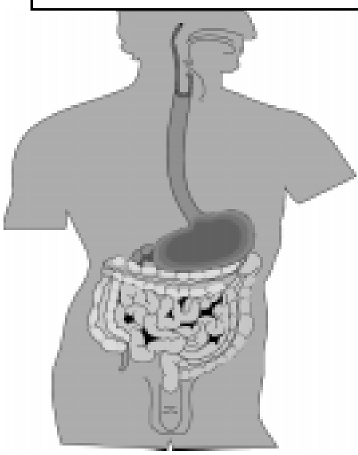
Develop a protocol for the preparation of mercury sphygmomanometers for recycling or disposal that is consistent with U.S. Environmental Protection Agency, New York State Department of Environmental Conservation (NYSDEC) and local regulations, and other pertinent standards. (*See Appendix C* for NYSDEC and local contacts.) Contact your hazardous waste management coordinator for details about packaging, labeling and transporting that are specific to your facility. A suggested protocol might include the following instructions:

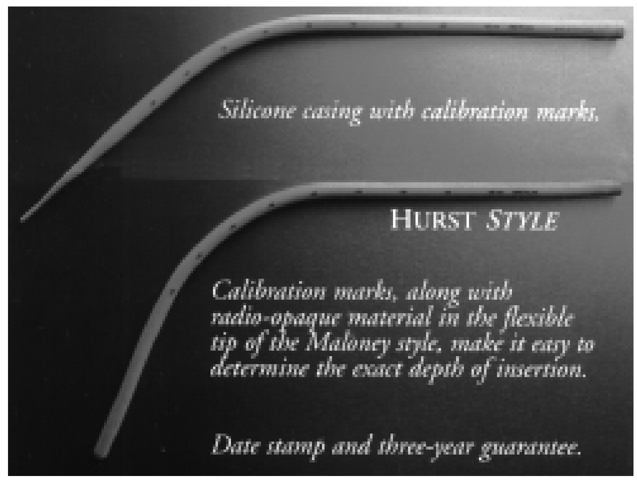
1. Place the sphygmomanometer in a clear plastic bag and seal the bag. Do not use a red bag or biohazard bag.
2. Mark the bag: "CONTAINS MERCURY."
3. Place the bag in a plastic basin to contain any spills during transport to the designated hazardous waste collection point.

Gastrointestinal Tubes

Table 3. Alternatives for Mercury-Containing Gastrointestinal Tubes

Type of GI Tube	Mercury-Free Alternative and Effectiveness
Bougie tubes (esophageal dilators)	Tungsten. Considered to be as effective as mercury.
Cantor tubes (used to trace the GI tract)	Tungsten. Can be purchased empty of weighting and hospital adds the weighting material, either mercury or tungsten. Some feel tungsten weighting is not as effective as mercury because it is not as heavy.
Miller Abbott tubes (used to clear intestinal obstructions)	Tungsten. Can be purchased empty of weighting and hospital adds the weighting material. Tungsten replacement is considered to be as effective as mercury.
Feeding tubes	Tungsten. Considered to be as effective as mercury.

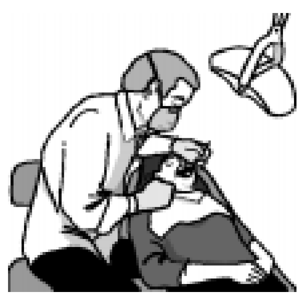




Recycling/disposal of mercury-containing gastrointestinal tubes

Gastrointestinal tubes typically have expiration dates, after which their use must be discontinued. Make sure the hospital has a protocol for the handling and recycling or disposal of mercury-containing tubes that is consistent with U.S. Environmental Protection Agency, New York State Department of Environmental Conservation (NYSDEC) and local regulations, and other pertinent standards. (*See Appendix C* for NYSDEC and local contacts.) Contact your hazardous waste management coordinator for details about packaging, labeling and transporting that are specific to your facility. A suggested protocol might include the following instructions:

1. Place the tube(s) in a clear plastic bag and seal the bag. Do not use red bags or biohazard bags.
2. Mark the bag: "CONTAINS MERCURY."
3. Place the bag in a plastic basin to contain any spills during transport of the tubes to the designated hazardous waste collection point.



Dental Amalgam and Mercury

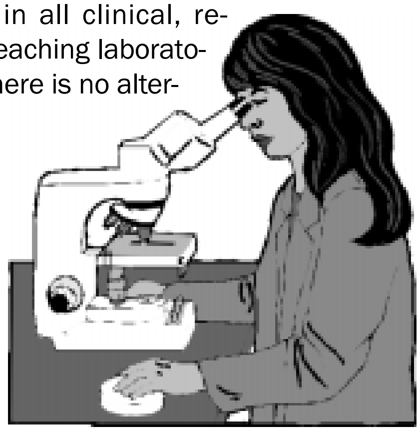
Many hospitals do not have dental facilities. However, some hospitals do have a clinic within the hospital or as part of another facility with which they are affiliated, such as a nursing home. For the benefit of hospitals that have dental clinics, a booklet, "Prevent Mercury Pollution: Use Best Management Practices for Amalgam Handling and Recycling" can be found in *Appendix M*. The mercury pollution prevention best management practices described in the booklet were developed simultaneously with those described in this manual.

Laboratory Chemicals

Whenever laboratories use mercury-containing chemicals, there is the potential for the release of mercury into wastewater. Once mercury in wastewater enters a wastewater treatment plant, most of it concentrates in the sludge. The sludge may either be spread on land or incinerated. Either way, the mercury in the sludge will eventually be released into the environment.

Phase out all nonessential uses of mercury in laboratories:

- Eliminate the use of mercury-containing compounds in all clinical, research and teaching laboratories unless there is no alternative.
- Eliminate all nonessential mercury devices, such as thermometers and barometers, and replace them with mercury-free devices.
- Clear laboratories and storage areas of unnecessary mercury compounds.



See *Appendix B* for categories of laboratory chemicals that may include mercury.

Alternatives for mercury-containing laboratory chemicals

The mercury compound in a chemical formulation may be an active ingredient, a preservative, or a contaminant introduced during the manufacture of one of the ingredients. The alternative depends on the reason that mercury is present. If a mercury compound is an active ingredient, the replacement may be a compound of a less hazardous metal. If a mercury compound is a preservative, the formulation can often be replaced by a formulation that uses a non-mercury preservative. If mercury is a contaminant, a formulation can often be found with ingredients manufactured by a different method. Examples of alternatives to mercury-containing chemicals common in a clinical laboratory are shown in the table.

Because mercury may be present in very small amounts as a preservative or contaminant, it may not be obvious whether or not a chemical reagent or stain contains mercury. Manufacturers might not list the ingredients of a reagent or stain if the formula is under copyright protection. Material Safety Data Sheets

Table 4. Alternatives for Mercury-Containing Laboratory Chemicals

Compound	Possible Alternatives
Histological fixatives (such as B5 and Zenker's Solution) with mercury (II) chloride as a tissue preservative	Zinc formalin; other products are available that are both mercury-free and formaldehyde-free.
Mercury (II) chloride as an oxidizer in hematoxylin	Sodium iodate as oxidizer.
Chemical used for acidic drug analysis of barbiturates and benzodiazepines by thin layer chromatography (such as Toxi-Dip B3)	Gas chromatography/mass spectrometry method. A hospital may need to send samples to a lab that has the equipment and specially trained staff required.
Thimerosal (Trademark Merthiolate) as a preservative in stains and other products in the pH neutral range	Methyl paraben, propyl paraben

might not list mercury in a product if the formula is under copyright protection or if the amount is less than one percent. However, the contribution of many low-concentration sources accounts for a large fraction of the mercury in the wastewater stream.

The hospital purchasing agent should contact the hospital's suppliers and request that mercury-free reagents be supplied. If the usual supplier cannot provide mercury-free reagents, locate one that can. Request that all vendors disclose mercury concentration on a Certificate of Analysis. Products with no or low mercury can then be selected for purchase. The Certificate of Analysis should list mercury content in parts per billion (ppb), not as a percentage. (See a sample letter requesting a Certificate of Analysis and a sample Certificate of Analysis in *Appendix H*.)

Wherever possible, change methodologies to processes that do not involve mercury. For chemicals that normally include a preservative, select chemicals that use a mercury-free preservative. Watch for new products. Many reagents and stains that once contained mercury have been reformulated so that they are now mercury-free.

The cost of mercury substitutes can be comparable and, in some cases, may be less than the cost of mercury-containing chemicals. Some substitutes may also carry some environmental risk, but it will probably be less than the risk associated with mercury.

Recycling/disposal of mercury-containing laboratory chemicals

When the laboratory staff has training on the proper use, handling and disposal of hazardous materials, incorporate the importance of keeping mercury out of wastewater. Make the staff aware of laboratory products that are known to contain mercury. It is important that laboratory chemicals ready for recycling or disposal be kept separately from each other and not mixed. This will minimize any increase in the amount of hazardous waste generated.

If using a mercury product is essential, the mercury-contaminated waste should be collected and disposed as hazardous waste. Check with your local sewer district for information about the proper disposal of mercury-contaminated rinse water.

Even if mercury-containing chemicals are not still in use, they may still be present in storage areas and they must be disposed as hazardous waste. Contact the hospital's hazardous waste management coordinator about transporting the chemicals to the designated hazardous waste collection point. Protective clothing or debris that is contaminated with a mercury compound should be managed in accordance with U.S. Environmental Protection Agency and New York State Department of Environmental Conservation (NYSDEC) regulations. (See *Appendix C* for NYSDEC contacts.)

Pharmaceutical Products

Currently mercury can be present in pharmaceutical products even when it is not listed on the label or on the product information sheet. As can be seen in the table below, the mercury is usually introduced as a preservative.

Alternatives for mercury-containing pharmaceutical products

Be aware of changes in the pharmaceutical industry. In many cases, products with mercury-free preservatives are available, and additional alternatives are likely to be available in the near future. In the meantime, request mercury-free pharmaceutical supplies whenever possible. Ask your vendor to assist the hospital in selecting mercury-free products for the pharmacy. (See sample vendor product mercury-content disclosure in *Appendix I*.)

Table 5. Pharmaceutical Uses of Mercury

Product	Notes
Merbromin/water solution	Used in plastic/reconstructive surgery as a disinfectant and marker
Ophthalmic and contact lens products	May contain mercury preservatives: thimerosal, phenylmercuric acetate, phenylmercuric nitrate
Nasal Sprays	May contain mercury preservatives: thimerosal, phenylmercuric acetate, phenylmercuric nitrate
Vaccines	May contain thimerosal (primarily in hemophilus, hepatitis, rabies, tetanus, influenza, diphtheria and pertussis vaccines)

Cleaners and Degreasers

Mercury as a contaminant

The mercury-cell process is one of the processes that may be used to manufacture common ingredients of cleaners and degreasers: sodium hydroxide (caustic soda), potassium hydroxide, chlorine and hydrochloric acid (muriatic acid). When these chemicals are used to make other products, such as bleach or soaps, mercury contamination can be introduced into the final product. The Massachusetts Water Resources Authority (MWRA) and Medical, Academic and Scientific Community Organization, Inc. (MASCO), through a public-private partnership called the MWRA/MASCO Mercury Work Group, performed laboratory analyses on some of these products. (See *Appendix J*, Educational Resources for a Mercury Pollution Prevention Program and the MWRA/MASCO case study in *Appendix L*.)

Table 6. Mercury Content of Selected Cleaning Products*

Information from MWRA/MASCO Mercury Work Group	
Product	Mercury Content (ppb)
Ajax Powder	0.17
Comet Cleaner	0.15
Lysol Direct	<0.011
Soft Scrub	<0.013
Alconox Soap	0.004 mg/kg, 0.005 mg/kg, <0.0025 mg/kg (3 tests)
Derma Scrub	<5.0, <2.5 (2 tests)
Dove Soap	0.0027
Ivory Dishwashing Liquid	0.061
Joy Dishwashing Liquid	<0.01
Murphy's Oil Soap	<0.012
Soft Cide Soap (Baxter)	8.1
Sparkleen Detergent	0.0086
Sunlight Dishwashing Detergent	<0.011

*Testing on cleaning products has been limited and many common cleaning products have not been tested. The data should not be used as a substitute for testing specific products/chemicals.

Alternatives for mercury-containing cleaners and degreasers

To learn the mercury content of the cleaners and degreasers used by the hospital, request Certificates of Analysis from all suppliers when purchasing materials. Choose mercury-free products, if possible. If there are no mercury-free products that meet the needs of the hospital, choose those that are the lowest in mercury concentration.

The Certificate of Analysis should list mercury content in parts per billion (ppb), not as a percentage. A Material Safety Data Sheet is *not* equivalent to a Certificate of Analysis. (See *Appendix H* for a sample letter requesting a Certificate of Analysis and a sample Certificate of Analysis.)

Batteries

Mercury-containing batteries

Mercuric oxide (mercury zinc) batteries and button batteries are the only batteries made in the United States that may contain added mercury if newly purchased (see table). Mercuric oxide batteries offer a reliable and constant rate of discharge and can be made in a wide variety of sizes intended for use in medical devices. In the 1990s, manufacturers stopped designing equipment that requires mercuric oxide batteries. New models generally require zinc air batteries. However, mercuric oxide batteries may remain in hospital stock for many years for use in older equipment. The shelf life of mercuric oxide batteries is up to ten years.

Some of the medical devices that may still require mercuric oxide batteries include cardiac monitors, pH meters, oxygen analyzers and monitors, and telemetry instruments. See *Appendix A* to see the variety of devices in which mercury-containing batteries have been used.

Alternatives for mercury-containing batteries

Table 7. Batteries (Newly Purchased) That May Contain Added Mercury (1998)

Battery	Quantity of Mercury	Use	Voltage	Available Alternatives
Mercuric oxide (mercury zinc)	33-50% by weight	Medical	Multiples of 1.4 v	Zinc-air (may contain up to 25 mg mercury, 0.4-1.0% by weight)
Button batteries: Zinc air	No federal law, but addition of mercury over 25 mg prohibited by some states. Manufacturers use this standard for all button batteries.	Medical	Multiples of 1.4 v	None
Button batteries: Alkaline-manganese	Federal law allows up to 25 mg mercury	Consumer	Multiples of 1.5 v	Silver oxide (lasts longer, costs more, does not come in a full range of sizes)
Button batteries: Silver oxide	Contains some mercury but less than alkaline-manganese button batteries	Consumer	Multiples of 1.5 v	None

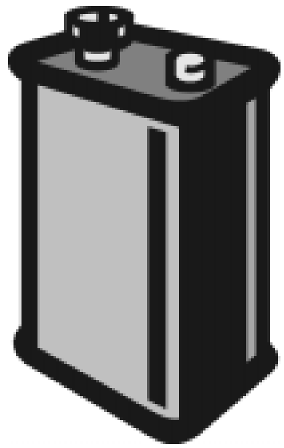
The alternative for mercuric oxide batteries is zinc air batteries. However, the alternative may not be mercury-*free*. A zinc air button battery may contain up to 25 mg of mercury. Larger zinc air batteries are made up of stacked button batteries, each of which may contain up to 25 mg of mercury. It is not yet possible to eliminate mercury from these batteries. In the absence of mercury, the zinc electrode corrodes and creates hydrogen gas. Because the batteries are tightly sealed, they can bulge when the gas is created and may even explode. Note that zinc air batteries include a tab that prevents exposure of the internal part of the battery to air (air serves as one of the electrodes). Once the tab on a zinc air battery is pulled off, the internal part of the battery is exposed to air and it begins to discharge.

For medical devices, there are Food and Drug Administration and Underwriters Laboratory certification concerns with replacing a battery. It is important to contact the equipment manufacturer before replacing a mercuric oxide battery with a substitute to ensure that the device has been approved for use with the alternative battery.

Rechargeable (nickel-cadmium) batteries cannot be used as an alternative to mercuric oxide batteries.

Recycling/disposal of batteries

Provide many convenient collection points for batteries throughout the hospital, including areas where replacement batteries are obtained. There are two options for collection:



1. Collect only mercury-containing batteries. This would put the responsibility for knowing mercury content on the person who is discarding the battery. The hazardous waste management coordinator could post written guidance at the collection location. However, this option could be confusing for the user.
2. Collect all batteries. The hazardous waste management coordinator or recycler would take responsibility for sorting the batteries. The coordinator should determine which types of used batteries are hazardous waste, which types can be recycled and which types can be thrown away as trash. Spent mercury-containing batteries should be recycled.

Some battery manufacturers offer recycling programs for mercuric oxide batteries. Check with the hospital's battery suppliers to learn if they have collection plans and if they will coordinate packaging and transportation to their facilities. Check with the New York State Department of Environmental Conservation (NYSDEC) to ensure that the specific program is legal. (See *Appendix C* for the NYSDEC hazardous waste regulations telephone number.)

Lamps

Energy efficiency of mercury-containing lamps

Fluorescent lamps, high-intensity discharge (HID) lamps and ultraviolet lamps (used in biosafety cabinets) are among the few mercury-containing products within hospitals for which adequate non-mercury substitutes do not exist.

Fluorescent and HID lamps are efficient sources of white light, typically 3-4 times more efficient than incandescent lamps. Since fossil fuels contain mercury, power generation releases mercury and other pollutants to the environment, and these releases are greater when less efficient lamps are used. Considering both mercury emissions from power generation and mercury contained in the lamps themselves, incandescent lamps put more mercury into the environment than do fluorescent lamps.

Investigate the mercury content of fluorescent and HID lamps and purchase those with a relatively low mercury content. In recent years, lamp manufacturers have been reducing the amount of mercury in fluorescent lamps. Some lamps are low enough in mercury content to be considered nonhazardous for waste recycling and disposal purposes. Check verifiable product information on Toxicity Characteristic Leaching Procedure (TCLP) testing to learn if this is the case.

Recycling/disposal of mercury-containing lamps

There should be several convenient collection points for spent lamps within the hospital. Lamps from the collection points should be taken by the hazardous waste management coordinator to the hospital's designated hazardous waste collection point. The lamps can be sorted for recycling or disposal at the collection point. *Do not break or crush lamps*, unless using a commercial lamp crusher that captures mercury vapor. Because crushing lamps may be considered to be "treatment," consult with your regional office of the New York State Department of Environmental Conservation (NYSDEC) before purchasing a lamp crusher. (See *Appendix C* for telephone number.)

If a lamp is accidentally broken in the hospital, store all of the debris in a sealed plastic container. Request pick-up by the hazardous waste management coordinator.

The exact procedures for sorting, storage, packing, and recycling or disposal will partly depend on the requirements of the NYSDEC. (See *Appendix C* for the NYSDEC hazardous waste regulations telephone number.) It is important to know your generator status before asking questions. Some of the questions to ask the NYSDEC are:

1. Which lamps can and cannot be recycled?
2. Which lamps must be considered as hazardous waste?
3. How should lamps for recycling be packed for transporting? Should they be whole or crushed in a bulb crusher? What is the cost of a bulb crusher?
4. How should broken lamps be packaged?

Since fluorescent and HID lamps fail TCLP testing for mercury a high percentage of the time, it is suggested that expensive TCLP testing be minimized and that those disposing of these lamps assume them to be hazardous unless verifiable product information states that the lamps are nonhazardous.

Watch for changes in the regulations that affect mercury-containing lamps. Get the latest information from the NYSDEC. (See *Appendix C*. Also see *Appendix N* for a partial list of fluorescent lamp recyclers.)

U.S. Environmental Protection Agency (EPA) Green Lights Program

The EPA's Green Lights Program can help the hospital save money on lighting costs and, at the same time, reduce the amount of mercury that is emitted to the air when fossil fuels are burned at the local power plant that supplies electricity.

Organizations, such as hospitals, that join Green Lights sign a Memorandum of Understanding with EPA to become a "Partner." Partners agree to consider available technologies and install the mix of lighting products and controls that maximize energy savings and maintain or improve lighting quality.

EPA offers information, analysis, and planning and communications services to the Partner. For further information, contact the Green Lights Program by phone at 202-775-6650 or by fax at 202-775-6680.

Electrical Equipment

Alternatives for mercury-containing electrical equipment

Mercury can be found in many types of electrical equipment (see table below) and the equipment can have a lifetime measured in decades. Renovation is usually the reason that the equipment is replaced. Even if mercury use in newly manufactured equipment is discontinued, the recycling or disposal of used equipment will require an awareness of the mercury content for a long time to come.

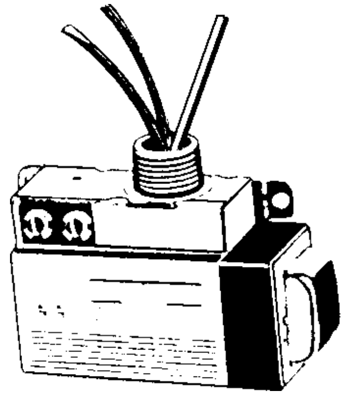


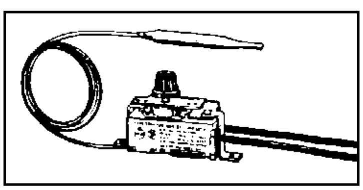
Table 8. Mercury-Containing Electrical Equipment

Type of Switch	Where Equipment is Used	Possible Alternative
Tilt switch	–Airflow/fan limit control –Building security systems –Clothes iron –Fire alarm box –Fluid level, pressure or temperature control devices –Laptop computer screen shutoff –Lids of clothes washers and chest freezers –Silent light switch –Space heater –Thermostats	-Mechanical switch
Float switch	–Bilge pumps –Septic tank –Sump pump	–Magnetic dry reed switch –Optic sensor –Mechanical switch
Thermostat	–Temperature control device may have a mercury tilt switch.	–Electronic thermostat
Reed relay	–Low voltage, high precision analytical equipment such as electron microscope	–Solid state relay –Electro-optical relay –Dry reed relay
Plunger or displacement relay	–High current, high voltage applications such as lighting, resistance heating, power supply switching	–Mechanical switch
Thermostat probe	–Electric stoves –Hot water heaters	–Non-mercury probe

Manufacturers have not eliminated mercury in all electrical equipment due to cost considerations. However, because of an awareness of mercury problems, manufacturers are increasingly making alternatives available. Ask your vendor to assist the hospital in selecting mercury-free products. (See sample vendor product mercury-content disclosure in *Appendix I*.)

Recycling/disposal of mercury-containing electrical equipment

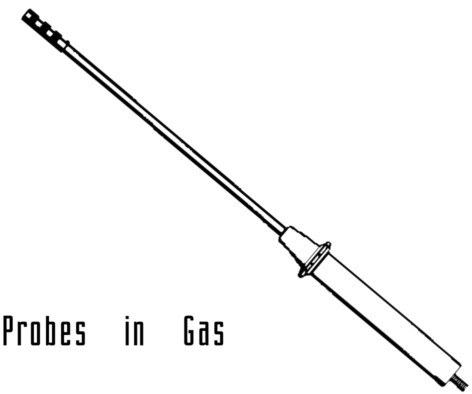
If the hospital is preparing used electrical equipment for recycling or disposal and there is a question about the mercury content, obtain this information from the manufacturers. Remove any mercury-containing parts from the equipment. Store the parts in a tightly covered container labeled as to its contents. Parts from switches, thermostats, relays and thermostat probes (including the thermostat probes described in the section on Thermostat Probes in Gas Appliances) can be stored in the same container. The container could be located in the supply area of the hospital where replacement parts are stored until it is full and ready for transport to the hospital's designated hazardous waste collection point. Recyclers are available that accept these equipment components. (See *Appendix N*.)



Take-back programs for thermostats

Honeywell Corporation has a free take-back program to collect any brand of used mercury-containing thermostats. To use the system, contact a heating, ventilating and air-conditioning wholesaler to learn if the wholesaler is participating in the program. Honeywell provides a special container for thermostats to each participating wholesaler. Do not remove the switches from your thermostats before taking them to the wholesaler. (Call 800-345-6770 for further information.)

Honeywell is one example of a take-back program. Other companies may have such programs. Contact your supplier to learn if this option is available. Take-back programs may be subject to Universal Waste Rules that have been adopted by New York State. Check with the New York State Department of Environmental Conservation (NYSDEC) to ensure that the specific take-back program is legal. (See *Appendix C* for NYSDEC hazardous waste regulations telephone number.)



Thermostat Probes in Gas Appliances

Mercury-containing thermostat probes may be found in several types of gas-fired appliances that have pilot lights, such as ranges, ovens, clothes dryers, water heaters, furnaces or space heaters. They are usually present as part of the safety valve that prevents gas flow if the pilot light is not lit. The metal probe consists of a metal bulb and thin tube attached to a gas-control valve. The bulb of the probe projects into or near the pilot light. The mercury is inside the tube and expands or contracts to open and shut the valve.

A mercury thermostat probe may also be part of the main temperature-controlling gas valve. In this application, the probe is in the air or water that is being heated and is not directly in contact with any flame. These are typically found in older ovens, clothes dryers, water heaters and space heaters.

If there is a question about the mercury content of a thermostat probe, obtain this information from the manufacturer.

Alternatives for mercury-containing thermostat probes in gas appliances

Non-mercury thermostat probes are also used in the appliances listed above. They are:

- Sodium/potassium thermostat probes
- "Dissimilar metals" thermostat probes

Recycling/disposal of mercury-containing thermostat probes in gas appliances

Remove thermostat probes from the appliances to be discarded and store them along with the mercury-containing electrical equipment described in the section on Electrical Equipment. Place them in a covered container that is labeled as to the type of equipment being stored. The container could be located in the supply room of the hospital where the replacements are stored until it is full and ready for transport to the hospital's designated hazardous waste collection point.

Industrial Thermometers

Air and water heating and cooling systems employ thermometers to allow monitoring of the systems' performance. Many of these thermometers are mercury in glass.

Recycling/disposal of mercury-containing industrial thermometers

It will be necessary to properly recycle or dispose of mercury industrial thermometers if the hospital is retrofitting with mercury-free thermometers or if it is replacing an entire heating or cooling system that employed mercury thermometers. The thermometers should be packed for delivery to the designated hazardous waste collection point in a tightly closed container and in a manner that will prevent breakage of the thermometers. Contact the hazardous waste management coordinator for detailed instructions.

Table 9. Alternatives for Mercury-Containing Industrial Thermometers

Type of Thermometer	Approximate Cost	Accuracy	Comments
Digital	$39	Within 1% of scale range	Light-powered, no battery required; interchangeable with mercury thermometer as to threading and well
Bimetal	$45-47	Within 1% of scale range	Contains a glass "window" but glass does not contain a liquid; *not* interchangeable with mercury thermometer as to threading and well
Alcohol-filled	$40	Within 1% of scale range	Red-colored alcohol in glass tube; interchangeable with mercury thermometer as to threading and well
Mercury	$32	Within 1% of scale range	Mercury in glass tube

Pressure Gauges

Devices that measure pressure may contain mercury. These include:

- Laboratory manometers used by biomedical engineers to calibrate other instruments in the hospital
- Barometers
- Sphygmomanometers (see the section on Sphygmomanometers)

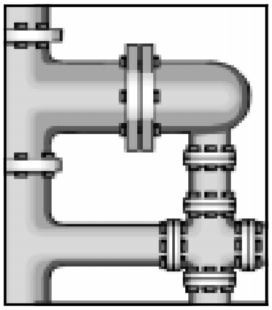
The most common alternative to a mercury-containing barometer is an aneroid barometer.

Table 10. Alternatives for Mercury-Containing Laboratory Manometers

Type of Manometer	Cost	Comments
Electronic (digital)	Several hundred dollars	An order of magnitude more accurate than sphygmomanometers. Used in biomedical laboratory to calibrate other devices. A traceable calibration must be performed with a mercury manometer, onsite or offsite, on a regular schedule. The time interval depends on the manufacturer's recommendation.
Aneroid (Bourdon, diaphragm, piston or capsule types)	Price varies widely depending on accuracy & traceability required	Manufacturers recommend calibration at least annually. Schedule can be based on experience, with annual inspections as a minimum.
Liquid filled	Price varies widely depending on accuracy & traceability required	Inadvisable to move them from place to place. Manufacturers recommend calibration at least annually. Schedule can be based on experience, with annual inspections as a minimum.
Mercury	\$100-\$150 range	One meter tall. An order of magnitude more accurate than sphygmomanometers. Used in biomedical laboratory to calibrate other devices. Annual calibration recommended to ensure good performance.

Recycling/disposal of mercury from mercury-containing gauges

Store mercury waste from servicing manometers and other mercury-containing gauges in a covered, air-tight plastic container. The container must be clearly labeled: CONTAINS MERCURY. Small amounts can be stored in vials placed in a larger covered air-tight container, such as a five-gallon plastic pail. Recycle the mercury. (See *Appendix N* for a list of recyclers.)



Plumbing

Mercury may be present in a hospital's sewer pipes, sumps and sink traps from the past use of mercury. The mercury may have entered the pipes when items were broken, discarded or spilled in sinks. Mercury in plumbing can settle at a low point such as a sump or sink trap and remain in the plumbing of a hospital for many years. Often the slow dissolution of the mercury in a pipe, sump or sink trap is enough to cause violations of wastewater discharge standards even after best management practices for mercury have been introduced in the hospital.

Whenever sewer pipes, sumps or sink traps are to be moved or cleaned, the plumber must be warned about the potential of finding mercury in the sludge. The sludge must be handled and disposed as hazardous waste unless it is demonstrated, through the Toxicity Characteristic Leaching Procedure (TCLP) or verifiable user knowledge, that it is not hazardous. Procedures for cleaning traps and pipes that were developed by the Massachusetts Water Resources Authority/Medical, Academic and Scientific Community Organization Mercury Work Group can be found in *Appendix O*.

Hospitals have reported success in lowering their wastewater levels after cleaning out their plumbing. After conducting such a cleaning program, a hospital must follow the recommendations in this chapter in order to avoid reintroducing mercury into the plumbing system.

Spills

Accidental spills of liquid mercury can increase the levels of mercury in the air or wastewater of a health care facility. Small droplets of spilled mercury may lodge in cracks, mix with dust and go down drains. Mercury may adhere to fabrics, shoe soles, watches and jewelry on which it can be transported to other locations. A small spill of mercury in a carpeted patient room can become a major clean-up challenge.

Mercury spill prevention

Follow proper procedures when cleaning or refilling instruments that contain mercury:

- Clean or refill instruments over a tray to contain any spills. Never handle mercury over a sink. Reserve the room for mercury use only. Restrict traffic in the area.
- Clean and calibrate all mercury-containing equipment according to the manufacturer's recommended handling procedures and the procedures recommended by your hospital's safety officer.
- Train all workers who use mercury devices about the properties and hazards of mercury, safe handling procedures, and specific policies related to mercury recycling and disposal.

Minimizing the impact of a spill is part of spill prevention. It is preferable to use mercury devices in rooms that do not have carpeting or other floor coverings which are not smooth and easily cleaned. Mercury devices should not be used in units which use beds that have high structures or projections off the beds that can smash wall-mounted sphygmomanometers, or in areas where patients cannot be moved.

Mercury spill response

Mercury spills are very disruptive. A large spill will require removing the patient from the room during cleanup. The room would have to remain vacant until it is ensured that there is no longer mercury vapor in the air.

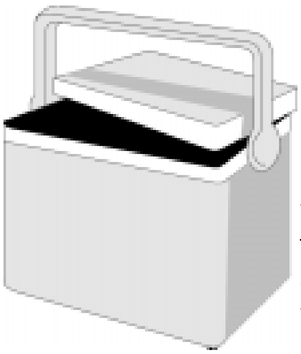
Be prepared for a spill in any area of the hospital where mercury-containing devices are used. Have a mercury vacuum cleaner or mercury spill kit readily available to consolidate spilled mercury and limit the amount of mercury released into the air. Never use a regular vacuum cleaner to clean up mercury. It will vaporize the mercury and blow it into the air. The mercury vacuum cleaner is designed to clean up liquid mercury spills. An activated carbon filter in this vacuum will absorb and contain the mercury vapors.

The cleanup of mercury spills must be performed by specially trained staff members. Carry out simulated spills and cleanup as part of training.

Create a formal mercury spill policy for the hospital. Consider the following factors when developing the policy:

- Round-the-clock availability of a competent staff person, trained for mercury spill cleanup
- Protective equipment and clothing for cleanup staff
- OSHA requirements
- The circumstances when the patient(s), visitors and staff should be evacuated from the area before cleanup
- How to determine when a room is "clean enough" to re-occupy
- Type of flooring (linoleum, carpet, etc.)
- Determination of the type of equipment to be used for the size and type of spill
- Manufacturer's instructions for the equipment to be used
- Ultimate waste disposal, which may depend on the cleanup method
- Preparation of an incident report that describes the spill, the cleanup method used, unusual circumstances, and follow up
- Mercury spills during a medical procedure

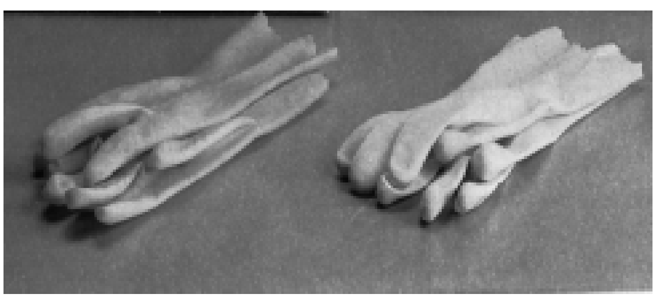
(See also the section on Hospital Employee Health and Safety and *Appendix P*.)



Storage Areas

Mercury-containing products not in use must be stored in nonbreakable containers with tight-fitting lids. The containers must be clearly labeled as to their contents. Rooms where mercury-containing items are stored should be tested periodically using a mercury vapor sniffer.

Even after most uses of mercury have been discontinued in the hospital, mercury-containing products may still be in storage from past uses. All hospital units should check storage areas for old, damaged or outdated equipment. (See *Appendix A* and *Appendix B* for lists of possible mercury-containing products in the hospital.) If mercury-containing products are found, contact the hazardous waste management coordinator. After the removal of the mercury-containing products, the areas should be checked with the mercury vapor sniffer.



Hospital Employee Health and Safety

A major concern with the use of mercury-containing products is the possible exposure of hospital employees to mercury vapor during a maintenance procedure, such as servicing mercury-containing equipment. Understand the properties and hazards of mercury. Check with your health and safety officer prior to doing such work to ensure that you are following correct procedures for:

- Ventilation
- Protective clothing and equipment
- Work habits, such as smoking, eating or drinking in the area and wearing jewelry (mercury readily combines with gold)
- Handling and recycling or disposal of mercury
- Follow-up monitoring

Conduct periodic training for all employees who may come into contact with mercury-containing products. Include new and temporary employees, employees at offsite locations, and contractors.

(See also the section on Spills.)