BEST

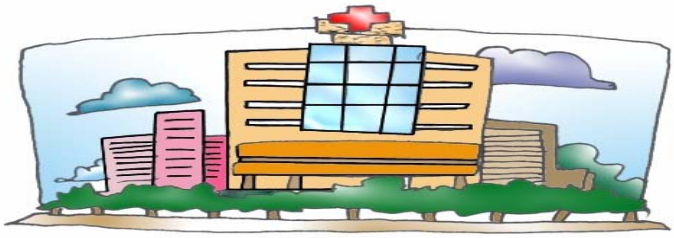
ENVIRONMENTAL

MANAGEMENT PRACTICES

MEDICAL FACILITIES

Table of Contents

Medical Facilities: Part of the Solution to Water Pollution



Whether your business is two blocks or 20 miles from the water, it has two connections to the Monterey Bay. Indoor drains such as sinks, toilets, and most floor drains convey wastewater through the sanitary sewer system to a treatment plant where the water is treated before it is discharged into the Bay. Outside your business, rainwater, wash water from buildings, road surfaces, vehicles, and equipment pick up oil, grease, cleaning compounds, pesticides, paint, garbage and other pollutants. Storm drains carry theses pollutants through the storm drain system directly into local creeks and the Bay. They are not filtered or treated in any way. Whether you pour something down the sanitary sewer drain or down a storm drain, it will eventually end up in the Bay.

In 1998, the Environmental Protection Agency (EPA) and the American Hospital Association (AHA) signed a Memorandum of Understanding (MOU). The MOU identified hospitals as having major waste volume reduction potential and as being major contributors to Persistent Bio-cumulative Toxins (PBTs). In the MOU, hospitals are encouraged to reduce waste volume by 50% and to virtually eliminate mercury by 2010.

The Regional Water Quality Control Plant (RWQCP) operated by the City of Palo Alto developed the majority of these pollution prevention guidelines, while working closely with local hospitals. Although these guidelines were intended to assist hospitals and other medical facilities to minimize pollutant loadings to the sewer, there are also cost saving and environmental stewardship measures described at length. Pollutants of concern from medical facilities can include the following:

- Cadmium
- Chromium
- Copper
- Formaldehyde
- Lead
- Mercury
- Nickel
- Phenolic Compounds
- Selenium
- Silver
- Solvents
- Zinc

These contaminants have extremely stringent discharge limits for the Monterey Bay and/or interfere with water treatment. This is why it is necessary to reduce pollution to the greatest extent possible (source reduction) before wastes enter the sewer.

With care and foresight, hospitals and medical facilities can significantly reduce the amounts of these pollutants in waste disposed to sinks or other drains. While the mass of pollutants from

medical facilities can be very large, hospital waste is often greatly diluted with domestic wastewater. In addition to source reduction, water conservation is also an important goal of a comprehensive water quality protection program. Most hospitals and medical facilities can reduce water consumption in many ways. A healthy Bay requires our best efforts in both pollutant source reduction and water conservation.

This document has been prepared to familiarize medical facility managers and employees with the best management practices for dealing with typical wastes generated in the industry. It also details the County of Santa Cruz Industrial Wastewater Pretreatment requirements specific to your facility. Use this document as a tool to ensure that your business is compliant, to save money on costly spill cleanups and waste disposal, and to train staff. Leave it in a visible location. If you have any questions about these pollution prevention guidelines, please call the County of Santa Cruz Environmental Compliance Division at 831.477.3907.

Radiology/X-Ray

Problem substances include silver (in spent processor solutions), chromium (in developer cleaners), and selenium (in some toners).

Since x-ray film has an especially high silver content, spent fixer from medical X-ray developing operations has been a major source of silver for the wastewater treatment plant. The County of Santa Cruz requires all commercial and industrial facilities, including hospitals and medical offices, to treat silver-containing wastes to remove the silver or have them hauled off-site as hazardous wastes. Most hospitals now have their wastes hauled off-site for recycling. X-ray processing can use more water than almost any other, non-domestic operation in a medical facility.

- In a large facility, centralized treatment of spent fixer reduces the amount of sampling required as well as the number of systems to be maintained-easily offsetting the increased effort required to collect and consolidate the waste.
- If processors are cleaned with a chromic acid solution such as Kodak's Liquid Developer System Cleaner, spent cleaning solutions and rinse water must also be disposed of as a hazardous waste. They must not be mixed with spent fix from which silver will be reclaimed.
- Spent photo chemicals containing selenium such as Kodak Rapid Selenium Toner must be disposed of as hazardous wastes. Never pour selenium-bearing solutions down a sink or drain!
- Newer, well-maintained equipment generally uses less water and smaller volumes of chemicals, with reduced carry-over of silver-bearing fixer into the rinse water.

Persons in charge of x-ray processing must be provided with the County of Santa Cruz Photoprocessing Facilities Best Management Practices pamphlet, which details the requirement for photoprocessing in Santa Cruz.

Physicians

Problem substances: mercury, selenium, and zinc.

Because mercury is acutely toxic in extremely small amounts, and because it is one of the metals that conventional wastewater treatment plants cannot completely remove from sewage, mercury's presence in wastewater from medical offices and hospitals is a serious problem for the health of the Bay. Mercury is unlikely to be eliminated from wastewater while medical facilities continue to use equipment containing mercury.

- Instruct staff to use the available alternatives to mercury thermometers, such as digital thermometers, electronic sensors, and temperature strips.

- Until you have eliminated all mercury-containing equipment from your office:
  - Make sure mercury spill cleanup kits are readily available in all areas where mercury-containing equipment is used.
  - Clean up all mercury spills properly and completely.
  - Do not send mercury thermometers home with patients.

- When possible, substitute Anderson tubes for Canter tubes. The Anderson tube contains no mercury and can be an acceptable substitute.

- Whenever possible, prescribe non-metallic shampoos and medications. Physicians' prescription practices can help improve water quality in the Bay. When patients use dandruff shampoos containing selenium, this extremely toxic heavy metal is rinsed to the sewer. Wastewater treatment cannot remove enough selenium to protect the Bay. Zinc ointments prescribed for diaper rash and other dermatology applications contribute to water pollution in similar ways, entering the sewer when babies are bathed or when the diapers are washed. Evaluate drug ingredients for metals, and prescribe non-metallic alternatives when feasible.

Nursing and Patient Care

Problem substances include mercury, phenolics, and pharmaceutical products.

While most of the wastewater sent to the sanitary sewer from patient care areas is very similar to household wastewater, potential concerns include disinfection supplies, medicines and other pharmaceutical products, and spills from mercury-containing equipment such as thermometers and blood pressure cuffs. Because mercury is acutely toxic in extremely small amounts, and because it is one of the metals that conventional wastewater treatment plants cannot completely remove from sewage, mercury's presence in medical facility wastewater is a serious problem for the health of the Bay. Mercury is unlikely to be eliminated from wastewater while medical facilities continue to use equipment containing mercury.

- Use some of the available alternatives to mercury thermometers, such as electronic sensors, digital thermometers, and temperature strips.
- Mercury spill cleanup kits should be available in all areas where mercury-containing equipment, such as thermometers and blood pressure cuffs, are used.
- Make sure the individual designated by the environmental health and safety department - cleans up all mercury spills. If your facility does not have such a person, instruct all employees in the proper handling and management (usually recycling) of mercury.
- Do not send mercury thermometers home with patients.
- Blood pressure cuffs with electronic sensors are available. Replace the mercury containing devices where appropriate.
- When possible, substitute Anderson tubes for Canter tubes. The Anderson tube contains no mercury and can be an acceptable substitute.

Equipment Containing Mercury

Because mercury is acutely toxic in extremely small amounts, and because it is one of the metals that conventional wastewater treatment plants cannot completely remove from sewage, mercury's presence in medical facility wastewater is a serious problem for the health of the Bay. Mercury is unlikely to be eliminated from wastewater while medical facilities continue to use equipment containing mercury.

- Whenever possible, replace mercury-containing equipment with equipment that does not contain mercury.
- Use some of the many available alternatives to mercury thermometers, including alcohol (red) and digital thermometers for equipment such as lab ovens and water baths.
- Make sure mercury spill cleanup kits are available in all areas where mercury-containing equipment is used.
- Make sure the individual designated by the hospital's environmental health and safety department cleans up all mercury spills. If your facility does not have such a person, instruct all employees in the proper handling and disposal (usually recycling) of mercury.

Central Sterilization

Problem substances include cold sterilants and caustic cleaners.

Of the wide range of sterilizing processes used by hospitals and other medical facilities, those of most concern to the County of Santa Cruz are certain cold sterilants (glutaraldehyde, formaldehyde, and phenols), and institutional dishwashers using caustic cleaners. Other processes (ethylene oxide chambers, for instance) may be of interest to agencies concerned with air quality.

- Cold sterilizing solutions containing glutaraldehyde or formaldehyde have been commonly discharged to the sanitary sewer in the past. Use of these chemicals should be minimized or eliminated where possible. Spent solutions must be treated as hazardous waste using a neutralizer such as Formalex, or collected and properly disposed. Activated glutaraldehyde solutions lose their toxicity when held for a period of time (usually 14 to 21 days). Alternative sterilization methods are nearly always possible.
- Sonic sterilization may be used alone or in conjunction with solutions. This alternative may be used with less toxic solutions that don't pose a threat to the environment if disposed to the sanitary sewer.
- Alternative liquid sterilants include, among others, formulations of per-acetic acid, acetic acid and hydrogen peroxide (Renalin, Actril, Steris, etc.). These products are currently being used primarily on dialysis equipment, but may have other uses. Chemicals in the spent solutions do not pose a problem for the water treatment plant if they are disposed of properly.
- Steam sterilization (autoclaving) produces little or no chemical waste. However, without cooling water recirculators or sensors to keep cooling water use to a minimum, autoclaves can be one of the hospital's largest water users. Water-saving modifications to autoclaves easily pay for themselves with savings from water and sewer bills.
- Large industrial-type dishwashers may be used for sterilization as well as cleaning. These commonly use hot water, steam, and caustic cleaners. Water and chemical use should be minimized where practical. Concentrated caustic cleaning chemicals should be stored in secondary containment to prevent concentrated spills from reaching the sanitary sewer.
- The sterilizing gas ethylene oxide (EtO) is normally applied to equipment held in a sterilizing chamber. Use of EtO requires air emissions control devices. The wastewater from emission control scrubbers that convert the EtO to an ethylene glycol solution may be discharged to the sanitary sewer.
- Other proposed alternative sterilization methods include gas phase hydrogen peroxide, electron beam, gas plasma, and microwave. Although none of these appear to pose significant risks related to the sanitary sewer or wastewater disposal, they are not yet widely available.

Hemodialysis

Problem substances include formaldehyde and disinfectants.

Disinfection of dialysis equipment and the associated reverse osmosis (RO) systems used to purify dialysis water can cause water pollution problems if formaldehyde-based disinfectants are used and discharged to the sanitary sewer.

- A solution of peracetic acid, acetic acid and hydrogen peroxide (such as Renalin, Steris, or Actril) can be substituted for formaldehyde-based disinfectants. These products yield

decomposition products that are easily handled by a wastewater treatment plant's biological treatment processes. Since formaldehyde is a suspected carcinogen, use of a substitute may have other significant benefits for both patients and technicians.

- The RO system used for water filtration may also be disinfected with similar products. RO units can be made compatible with peracetic acid disinfectants through pretreatment to remove any iron, which may react with the oxidizing solution and form holes in the membrane. (Some rubber or metal system components may also need to be replaced.)
- Use of peracetic acid disinfectants with the small membrane cartridges and in the dialysis equipment itself can also reduce the volume of hazardous waste generated. Older machines must be modified to use peracetic acid disinfectants but newer machines should be compatible. Equipment that can be heat-disinfected may be available in the near future.
- Any dialysis unit that is still using formaldehyde for disinfection should collect all waste solutions and dispose of them as hazardous waste.

Laboratories

The numerous laboratory operations in hospitals and other medical facilities are significant potential sources of pollutant discharges to the sanitary sewer. Many lab waste solutions contain significant concentrations of metals and other chemicals, making it practically impossible to list all of the reagents and test kits containing pollutants of concern that could be used in your facility.

- Laboratory personnel must know the constituents of each reagent used, as well as the proper disposal method. Products that are not suitable for discharge to the sewer must be collected for disposal as hazardous waste.
- Managers should review the chemical contents of all reagents periodically. In many instances a problem solution can be used in smaller quantities, or replaced with less harmful alternatives (see the Waste Minimization section of this booklet).
- When determining whether a waste solution meets discharge concentration limits or requires disposal as hazardous waste, remember that the solution to pollution is not dilution!
- Segregate wastes appropriately-for both storage and disposal, according to your facility's health and safety guidelines or your agreement with a hazardous waste hauler.

Common laboratories found in medical facilities include the following: chemistry, hematology, pathology/histology, microbiology, immunodiagnosis, and gross pathology and necropsy. The following pages detail best management practices specific to those particular laboratory activities.

Best Management Practices For Laboratories

As part of a comprehensive program to reduce amounts of metals and chemical contaminants reaching the waters of the Monterey Bay, this document has been prepared for laboratories. Careful management of chemicals and waste liquids will have a measurable impact on the quality of your waste streams. The sanitary sewer flows to the City of Santa Cruz Wastewater Treatment Facility, which has limited capacity to remove chemical contaminants from sewage. Since the storm drain system flows directly to creeks and the Bay with no treatment, it is also important to protect storm drains from chemicals and other pollutants. In a sense, all of the BMPs in this booklet are intended to provide "drain protection" - which is water quality protection. Never hold or store chemicals in sinks. Install lips around all sinks, especially cup sinks on countertops and under hoods. Block floor drains in areas where chemicals are used or stored. Maintain sufficient and readily available stocks of materials required for spill cleanup (absorbents, drain plugs, acid base neutralization kits, etc.).

Drain Protection Safety Showers

Use one of three methods to keep spilled chemicals from reaching safety shower drains:

1. Install a temporary plug that opens automatically when the safety shower is turned on.
2. Eliminate the drain.
3. Protect the safety shower drain from lab spills with a sump. The capacity of the sump must be greater than the volume of the largest chemical container used or stored in the lab, or the sump must be double-contained. The sump may be covered by a grate to reduce hazards to people in the area. When an earthquake or accident occurs, the following practices should help prevent breakage or spills leading to discharge of chemicals to the sewer. Reduce spills by storing glassware and other containers on textured rubber mats.

Container Security/Secondary Containment

- Reduce bottle breakage by ordering chemicals in plastic coated bottles whenever possible.
- Always use plastic or insulated holders for solvent bottles.
- Never store chemicals above sinks on shelves or in cabinets. Store in approved chemical cabinets or on low shelves.
- Always latch doors on chemical storage cabinets.
- Secure chemicals stored on shelves or in cabinets behind barriers if secondary containment is not feasible. Barriers should be at least l/5 the height of the tallest container.
- Segregate incompatible chemicals to prevent mixing in case of an accidental spill. Use separate storage cabinets and closets or physical barriers such as independent secondary containment, berming, or trenching.
- Secondary containment for all regulated chemicals should prevent leaks or spills from reaching the sewer or storm drain system. The secondary containment vessel or area (e.g. a tray, canister, or bermed area) should be impervious to the liquid being contained and large enough to hold at least 110 percent of the capacity of the primary container. Secondary containment must not drain to any sewer.
- Keep countertop chemical containers, such as squirt bottles and small flasks, in trays of appropriate capacity, or within bermed areas away from sinks and drains.
- Use secondary containment for all liquid chemicals stored on shelves or countertops, or in cabinets.
- Keep secondary containment dry at all times.
- Again, never use a sink as secondary containment.

Waste Minimization for Laboratories

- Reducing use of chemicals reduces chemical waste. Basic waste minimization techniques include product substitution, reduced product usage and storage, recycling/reuse of chemicals, modified operations, and water conservation.
- Substitute chemicals with less toxic alternatives.
- Use the minimum amounts of chemicals required by each experiment or process – to minimize disposal volume at end of procedure.
- Order minimum amounts of chemicals to reduce waste and leftover materials in case procedures are changed, expiration dates pass, or spills occur.
- Use a last in, first to use chemical stocking scheme to avoid generating expired or off-spec chemicals.

Training

- All lab workers and employees should understand the importance of utilizing Best Management Practices for water quality protection. Training for new employees and refresher training for all staff are critically important.
- Keep your lab's Spill Response Plan updated and available to employees at all times.
- Train all lab workers in proper chemical handling, storage, disposal, and water conservation practices.

Wastewater Disposal

To protect water quality in the Bay, all wastewater discharged to the sanitary sewer must be in compliance with local, state and federal regulations. Discharge of substances may be prohibited due to pH, temperature, explosivity, radioactivity, etc., as specified in the District's sewer use ordinance. See your company's health and safety officer for guidelines on discharging reagents and chemicals that may be acceptable to your wastewater treatment authority. Hazardous wastes, as defined by the California Code of Regulations, Title 22, shall not be disposed of via the sanitary sewer. Rinsate from chemical bottles and containers that have been in contact with a hazardous material is a hazardous waste. During triple rinsing, collect all such rinsate in appropriate waste containers with no discharge to the sewer, and dispose of it as a hazardous waste. Many types of equipment used routinely in the process of conducting experiments may generate wastes which should not be discharged to the sanitary sewer. Do not use aspirators connected to a sink if you are vacuum-distilling or filtering chemicals that should not go down the drain. (Such aspirators also waste water.) Use a rotary evaporator with a contained vacuum system and a dry ice condenser to intercept solvents. Make sure all chemical containers are properly labeled. Keep Materials Safety Data Sheets (MSDS) on file for all chemicals.

Experiments and Equipment Guidelines for Renovation and New Construction

Do not build chemical storage shelves or cabinets over sinks. Install house vacuum systems that have dry-seal or non-contact water pumps. Pumps that use contact water may discharge solvents to the sanitary sewer, causing the facility to be in violation of discharge limits. If a safety shower will drain to a laboratory floor drain, construct the drain in an appropriately sized sump with a standpipe to ensure that spilled chemicals do not go down the drain, but water from the shower itself can. Check with the local building code to determine whether such sumps must be double-contained. When plumbing new construction, segregate laboratory waste from sanitary waste with separate piping. Provide a sampling port on the laboratory waste line. Consider installing holding tank(s), with sampling ports, to allow for capture, testing, and release of laboratory rinse water and/or accidental spills. Multiple tanks with separate drains may be necessary to segregate incompatible chemicals. Select sinks with lips. And don't forget water conservation!

Water Conservation

Structural measures such as those listed below can make a reduce water use significantly. Well-trained lab workers use their ingenuity to save water on the job. Install water-saving devices (such as flow restrictors) on sinks and rinse tanks. Reduce rinse times if possible (without affecting product quality). Recycle water - for example, to air scrubbers and cooling towers. Eliminate one-pass water-cooling systems.

Chemistry Labs

Problem substances include mercury, copper, chromium, and cyanide.

These days most lab chemistry analyses are run on automated systems or other instrumentation that use very small volumes of samples and reagents. Advantages of such systems over "test tube scale" procedures include waste minimization as well as increased productivity. With several methods usually available for any one parameter, careful choice of methods can reduce or eliminate many waste problems.

Lab managers and analysts should be aware of the available options and choose the one that produces the best results with the least amount of waste.

Hematology Labs

Problem substances include cyanide, formaldehyde, chloroform and other solvents, xylenes, mercury, copper, chromium, zinc, and low-level radioactive wastes.

- Cyanide-containing cell lysing solutions are common reagents in many blood tests. Cell sorter/counting instruments using these solutions generate a waste solution that is just below the hospital's discharge limit for cyanide and acceptable for discharge.
- The manual iron-cyanide test yields a concentrated cyanide solution that should be collected, stored in secondary containment segregated from all acidic solutions, and disposed of as hazardous waste.

Chemistry and Hematology Labs

Several other waste streams common to both hematology and chemistry labs should be reviewed and possibly collected for disposal:

- Bouin's solution, used for washing bone marrow cells and as a preservative, contains formaldehyde. Concentrated formaldehyde solutions like Bouin's solution are hazardous wastes. They must be collected and disposed of properly whenever concentrations exceed the hospital's discharge limit.
- All waste solvents should be collected for disposal as hazardous waste. These include chloroform and methylene chloride (used to extract blood and urine samples for GC analysis), as well as solvents used for TLC analysis. Minimize extraction sample sizes to reduce the quantity of solvents used. Investigate less hazardous solvents and methods.
- Waste from atomic absorption (AA) standards for heavy metals should be collected and disposed of as hazardous waste. Produce standards only as needed.
- Minimize use of xylenes for extractions and be sure to collect any waste. Terpene-based solvents (Hemo-D) may be substituted for xylenes used for slide cleaning in some applications.
- Analysis of chloride by ion-selective electrode (ISE) is preferable to the calorimetric method. Calorimetric analysis uses a mercury reagent, and generates a highly toxic waste stream for which collection and disposal may be difficult and expensive.

- All solutions from the titrametric method commonly used for analysis of chloride in sweat are hazardous and must be collected for disposal as hazardous waste.
- At least one albumin method uses a highly concentrated chromium reagent. This solution exceeds the hospital's discharge limit for chromium, and should be collected for disposal as hazardous waste.
- At least one total protein method uses a concentrated copper reagent. The solution exceeds the hospital's discharge limit for copper, and should be collected for disposal as hazardous waste.
- At least one preservative for stool samples contains a concentrated copper solution. This should not be discharged to the sanitary sewer.
- Some glucose tests contain zinc. Other types are available and should be utilized whenever possible.

Pathology/Histology

Problem substances include mercury, glutaraldehyde, formaldehyde, alcohols, xylene, and other solvents.

The most common hazardous materials found in pathology and histology labs are preservatives and fixatives used to prepare specimens.

- Waste glutaraldehyde, formaldehyde, alcohols, xylene, and other solvents should be collected and disposed of as hazardous waste.
- Activated glutaraldehyde solutions lose their toxicity when held for a period of time (usually 14 to 21 days). After that time they may be acceptable for discharge to the sanitary sewer, as long as all other laws and regulations are satisfied.
- Two common tissue fixatives, Zanker's solution and B5, are especially problematic because they contain high levels of mercury. These solutions are extremely hazardous and should be used only in the smallest possible volumes, with all wastes rinsed to hazardous waste containment-never to a sink. While Zanker's may be the solution of choice in a few instances, lab managers should discourage its use whenever possible. Expending the additional time and care necessary to obtain excellent specimens using other (non-metallic) fixatives will improve water quality and reduce disposal costs.

Microbiology

Problem substances include reagents containing heavy metals (such as copper and silver) and solvents.

- All staining supplies should be stored in secondary containment.
- Both waste and contaminated rinsate volumes can be reduced if slides are stained with a few drops of solution rather than a dipping bath.
- If stains contain hazardous or metal ingredients, rinse slides and containers to a hazardous waste container.

Immunodiagnosis

Problem substances include copper sulfate solutions and mercury.

- Some slide preparation solutions contain heavy metals and should be collected for offsite disposal. For example, copper sulfate solutions should not be discarded or rinsed into the sewer.
- Thimerisol, which contains mercury, is used as a preservative in some buffer solutions. Alternatives to Thimerisol are available for some applications. Sodium azide is one example that does not cause water pollution problems at levels used for immunodiagnosis.

Gross Pathology and Necropsy

Problem substances include formaldehyde solutions, glutaraldehyde, alcohols, rinses from silver staining, Zanker's solution, and zinc sulfate.

- All formaldehyde solutions and specimens stored in free solutions should be stored properly in secondary containment, on secured shelving, and away from sinks.
- Waste solutions containing metals, including rinses from silver staining and Zanker's fixing (solution contains mercury and chromium), should be collected and managed as a hazardous waste.
- All waste solutions containing concentrations of metals or formaldehyde above the discharge limits for those substances must be collected and disposed of as hazardous waste.
- Formaldehyde, glutaraldehyde, and alcohols, which are used in large quantities in pathology and necropsy work, should be stored properly and collected for proper disposal.
- Activated glutaraldehyde solutions lose their toxicity when held for a period of time (usually 14 to 21 days). After that time they may be acceptable for discharge to the sanitary sewer, as long as all other laws and regulations are satisfied.
- Use of Zanker's solution and zinc sulfate for fixing can be eliminated in most cases. While Zanker's may be the solution of choice in a few instances, managers should discourage its use whenever possible. Expending the additional time and care necessary to obtain excellent specimens using other (non-metallic) fixatives will improve water quality and reduce disposal costs.

Pharmacy

Problem substances include silver, selenium, zinc, and other metals.

Most pharmacies dispense commercially prepared medicines rather than compounding prescriptions on site. Medical products may contain significant amounts of metals that should not reach the sewer.

If pharmacists at your facility have occasion to recommend over-the-counter medications to patients, they should consider suggesting less toxic substitutes for hazardous formulations. Some products to avoid include selenium-containing dandruff shampoos and zinc ointments.

Silver Solutions and Ointments

Concentrated silver nitrate solutions are prepared in pharmacies for use to treat burns. Solutions with silver concentrations above 5 ppm must be collected and disposed of as hazardous waste.

Chemicals Storage and Disposal

- Pharmacy personnel should inventory chemical stores periodically and properly dispose of all chemicals that are no longer used, including expired medicines.
- No pollutant-containing products should be discarded to the sanitary sewer. Substances to be aware of include hazardous wastes and all products containing silver, cadmium, chromium, copper, cyanide, lead, mercury, nickel, selenium and zinc.
- Keep bottled chemicals in secured storage, on low shelves (never over sinks) or in storage cabinets with latching doors. Follow Fire Department regulations.
- Store acids separately from bases, and flammables separately from oxidizers.
- Make sure all chemical containers are clearly labeled.
- Provide secondary containment for all hazardous materials and waste storage.
- Prevent bottle breakage and spills by using trays with lips or other specialized carrying containers when transferring chemical bottles between storage areas and labs.

Compounding

- Any compounding done in the pharmacy should also follow the guidelines in the Laboratories section of this document.
- Prepare only minimum amounts and collect all waste.
- Pour or mix liquid chemicals within a tray or other secondary containment, so that spills will not reach a drain.
- When compounding powders, clean up “dust” using dry cleanup methods as soon as possible, so that chemicals will not reach the sewer during routine wet cleaning operations.

Expired Pharmaceuticals

The easiest manner to dispose of expired pharmaceuticals is to return them to the manufacturer. Most pharmaceutical companies have a take-back program for expired meds. If no such program exists for a medication, determine if the medication is considered a toxin, biological hazard, or

cytotoxic drug. Review RCRA to identify hazardous pharmaceuticals. It may need special handling. Follow the guidelines below. Never dispose of medications via the sanitary sewer. It is no longer acceptable to flush unwanted medication down the toilet.

Disposal Of Prescription Drugs:
Check prescription drugs periodically for expiration. Remove expired drugs from stock. Check package insert or Material Safety Data Sheets (MSDS) for any special disposal requirements. Document how expired drugs are disposed of after removal from stock (e.g., biohazard bag, returned to pharmaceutical rep, etc.).

Disposal Of Hazardous Drugs:
Special handling may be required for toxins, biological and cytotoxic drugs. As above, check the MSDS and have proper disposal containers available. Write a policy for disposal of these hazardous substances. Appoint one staff person to have overall responsibility for ensuring proper disposal of expired medications. It may be necessary to incinerate certain medications.

Infectious Waste

Infectious or "red bag" biohazardous waste is usually sterilized and then landfilled or recycled, or incinerated. In any case, the cost of infectious waste disposal is high. Wastewater produced by incinerator scrubbers can contain significant amounts of metals. One partial solution to both of these problems is to minimize the amount of infectious waste generated throughout the hospital or medical facility.

- Educate all employees about the nature of appropriate red bag waste and the cost of its disposal. A large portion of this waste is often non-infectious paper products or other office trash. Workers may place these materials in the infectious waste receptacle because it is more convenient, or because the user is unaware that these items can be discarded as normal trash.
- Red bag waste containers should only be placed where they need to be. Remove all red bag containers from the following areas: in hallways, besides washing sinks, at nurse's desks, on anesthesia carts, beside dialysis stations during machine set up or in restrooms.
- Encourage the segregation of non-infectious waste. Inclusion of such items as batteries, X-ray film, electronics, thermometers, hazardous waste, and packaging (often with metal-containing pigments) with infectious waste contributes significantly to metals loading in the waste stream.

For more information on minimizing infectious waste, visit http://www.cabq.gov/p2/Synop01.pdf

Radiation Therapy and Radioactive Waste

Problems include wastes containing lead, cadmium, other metals, and low-level radioactive waste.

Radioactive waste results from the use of tracers and other radioactive diagnostic and treatment procedures.

- Each facility's radiation safety officer must follow all Nuclear Regulatory Commission (NRC) regulations concerning the disposal and storage of radioactive materials and waste. Limited amounts of some substances are acceptable for disposal in the sanitary sewer. In California the radiation program is handled by the Department of Health Services (DHS), Radiological Health Branch.
- For more information about applicable regulations, call DHS at (916) 323-2759.

Lead Shielding

Lead shielding used to protect patients during radiation therapy is normally either machined from lead blocks or poured in molds.

- All machining waste (from sawing, filing, and washing operations) must be collected and disposed of as hazardous waste.
- Molded shields are made from low-melting temperature lead alloys such as Cerrabend, which contains bismuth, tin, and cadmium. Because of the metal content, any wastes from washing, filing, or other working of the casts should be collected and disposed of as hazardous waste.

Clean Water Practices for Medical Facility Administration

Effective planning for water quality protection involves numerous departments and operations.

Personnel/Management Structure

- All large and small medical facilities should have at least one employee with specific responsibility for developing and implementing environmental programs. In hospitals and other large facilities this may be a full-time job for one or more persons.
- An environmental coordinating committee that includes interested members of affected departments or groups can provide invaluable feedback and information on many programs and strategies that cross departmental boundaries.
- Internal environmental audits should be conducted regularly by in-house staff or consultants.

Training

- Personnel in all departments should be trained for awareness of their roles in pollution prevention and waste minimization.
- Environmental concerns should be prominently featured in training for new employees, annual safety training, and other related meetings. Specific requirements for work groups such as nursing, housekeeping, laboratory, and radiology should be addressed regularly.
- Posters, fliers, and labeling should be used to remind employees about pollution prevention strategies. For example, post signs above sinks stating that hazardous chemicals must not be disposed to the sewer. Label instruments and processes that use problem materials so that the user is aware of his/her responsibilities.

Procurement/Central Receiving

- When ordering materials or equipment, consider pollution prevention and potential problems for waste disposal.
- A centralized receiving department can implement proper labeling of hazardous materials with use and disposal cautions, and also initiate a tracking program for problem substances.
- Careful inventory control using a first-in/ first-used scheme can reduce excess purchasing and unnecessary duplication in various inventories, as well as the amount of outdated or unneeded materials which must be disposed of as hazardous waste.

Contracting

The County of Santa Cruz recommends incorporating environmental protection standards into maintenance and construction contracts whenever possible.

- Construction contractors should protect storm drams from dirt, saw-cut slurry, and spills of all kinds. Paints and solvents must not be discharged to sewers or storm drains. Make sure contractors clean up their materials and work areas at the end of the day, especially during wet weather.
- Make sure cooling system maintenance firms use only those treatment chemicals allowed in the Sewer Use Ordinance. Wastewater and cleaning solutions must meet discharge standards.
- Require grounds maintenance, landscaping, and cleaning firms to eliminate storm drain discharges and protect paved surfaces from potential runoff contamination.

Facilities

Medical facilities present some special concerns for pollution prevention:

- Plumbing
- Laundry
- Recirculating Hot Water Systems
- Water Purification Systems
- Vacuum Pumps
- Dehumidifiers and Air Conditioners
- Water Softening
- Limestone Sumps
- Cleaning and Maintenance Products

In many respects, facilities operations and maintenance activities are the same for hospitals and medical centers as for any large business or industry.

Plumbing

Mercury from inappropriate spill cleanup practices and broken equipment often finds its way to sewer lines and sumps, where it settles at low points such as sumps and traps. The slow dissolution of the mercury in a sump, trap, or pipe can release enough metal to cause discharge violations for mercury years after poor disposal practices have been corrected.

Whenever sewer lines, traps, or sumps are moved or cleaned, caution should be taken to avoid spilling the contents in case mercury is present. Non-water contents must be handled as hazardous waste unless proven otherwise.

Laundry

While the operation of hospital laundry facilities is tightly regulated for health concerns by the Joint Commission of Accredited Healthcare Organizations (JCAHO), discharge to the sewer is currently regulated only by local agencies such as the Santa Cruz County Sanitation District.

- Make sure no hazardous materials enter the laundry (e.g. thermometers, rags used to clean up hazardous materials spills).
- Reduce water use by recycling gray water and using water-efficient equipment such as tunnel washers and other automated systems.
- Wastewater discharged from laundry facilities may contain significant amounts of metals as well as organics. The majority of these pollutants come from laundered materials rather than laundry chemicals. While the District does not currently require treatment of hospital laundry wastewater before it is discharged to the sewer, several “pretreatment” options (used by laundries in other settings) are available. Depending on the levels of contaminants attributable to laundry wastewater, pretreatment may be required by the District.
- Store laundry chemicals properly in secondary containment, with incompatible substances separated from each other.

Water Purification Systems

The municipal water supply may contain dissolved solids that are unacceptable for some medical uses. These salts are commonly removed in treatment systems using ion exchange resins and/or reverse osmosis (RO). Deionized (DI) water is used to make up laboratory reagents and to prepare dialysis solutions.

- Chemicals used for cleaning and disinfection of DI and RO systems should be stored properly in secondary containment, with acids and bases separated, on secured shelving and away from sinks.
- Disinfection of RO and DI should be accomplished without the use of formaldehyde. Sodium hypochlorite, bromine, and per-acetic acid disinfectants are appropriate substitutes. RO systems may be made compatible with peracetic acid disinfectants such as Renalin and Actril. To do so, the RO membrane may need to be pretreated to remove any iron, which reacts with the oxidizing solution and may form holes in the membrane (Some rubber or metal system components may also need to be replaced).

Recirculating Hot Water Systems

Hospitals and other large medical facilities normally employ some method of disinfection (in addition to that provided in the local drinking water supply) in order to combat infectious agents, such as *Legionella*, within the system. Additional chlorination and water temperature maintained within the system above "household" levels (either constantly or intermittently) are two common strategies. Unfortunately, both of these methods may lead to increased corrosion of copper and lead in plumbing. This may be the hospital waste stream's largest source of copper.

- Disinfection systems that use electrolysis to introduce copper and silver ions into the water should be avoided because of the added metals loading to wastewater. The District has banned their use.
- Additional corrosion prevention measures may be necessary, such as reduced or intermittent chlorination, lowered or intermittent high temperatures, protective magnesium anodes, alternate piping materials, slower recirculating rates, pH adjustment, and chemical controls such as addition of sodium bicarbonate.

Vacuum Pumps

- Vacuum pump oil must be disposed of as a hazardous waste.
- Water seal pumps should not be used since they can entrain solvents in the seal wastewater. Mechanical pumps *without* water seals are preferable for water pollution prevention. These pumps do not require a connection to the sanitary sewer.
- Use of water aspirators has been banned by the District. They should be replaced with non-water systems. Water aspirators can introduce chemicals into wastewater and needlessly waste large amounts of water.
- Cold traps on vacuum lines can be used to capture volatile chemicals; however, they are rarely adequate for keeping all solvents out of pump seal water and pump oil.
- Do not use single-pass cooling water for vacuum pumps. Some single-pass cooling systems waste as much as ten gallons of water per minute. Single-pass pumps should be replaced or retrofitted to recirculating cooling water systems. Savings in water and sewer use fees can quickly pay for such modifications.

Dehumidifiers and Air Conditioners

Condensate from dehumidifiers and air conditioners may be contaminated with small amounts of dirt, corroded metals, and oil.

- All such condensate flows should be reused when possible (in cooling towers, for example).
- If necessary, condensate drain lines should be re-plumbed to facilitate recycling of the condensate or discharge of the condensate to the sanitary sewer.
- New drainage lines must be plumbed to the sanitary sewer, *never* to the storm drain system.

Water Softening

Common water softeners exchange sodium for calcium and magnesium in the water supply, and add considerable salt loading (dissolved solids) to wastewater. A growing number of sewage treatment plants have banned water softeners for this reason. High dissolved solids content in the District's effluent may limit uses of reclaimed wastewater.

Medical facilities should soften water only where absolutely necessary, such as for hemodialysis.

Limestone Sumps

Acidic wastewater from laboratory areas may need to be neutralized before discharge to the sanitary sewer. Limestone neutralization sumps are common in older construction. Water passes through a basin filled with limestone chips, where the limestone neutralizes any acids.

- The pH of waste water from laboratory areas can be controlled in the lab with a combination of proper training and collection or neutralization of acids and bases. Therefore a limestone sump is often unnecessary.
- Limestone sumps are valuable sampling points for determining the effectiveness of a laboratory's pollution control efforts. Unfortunately, they can also be collection points for sediments (including elemental mercury). Limestone and sediments must ultimately be discarded as hazardous waste.
- If a neutralization system is necessary, an appropriate equilibration tank or neutralization basin should be installed.

Cleaning and Maintenance Products

Cleaning and maintenance products may contain pollutants such as metals, solvents, and tri-butyl tin.

- If possible, eliminate use of the following problem products: Floor waxes or wax strippers that contain zinc, toilet cleaning and disinfection products containing tri-butyl tin, carpet and upholstery cleaners that contain tri-butyl tin
- Do not use cooling water system additives that contain copper, chromium, or tri-butyl tin.
- Paint and paint strippers contain solvents and metals that should not be disposed of into the sewer or storm drain system. Paint extra paint out of brushes. Brushes used for water-based paint can be rinsed in a sink. Solvents and thinners used with oil-based paints should be filtered and reused. Extra paints, solvents, and paint residue that cannot be reused or recycled must be managed as hazardous waste. Chemical paint-stripping waste is always hazardous.
- Use of copper-based root control products is banned in the District service area. Mechanical root removal is the appropriate alternative.
- Maintain pools, spas, and fountains without use of copper-based algaecides.

Housekeeping

Problem materials include phenolic disinfectants and infectious waste.

Phenolic Disinfectants

Housekeeping includes normal cleaning operations as well as disinfection of critical areas. Many hospitals have found that phenolics, which are hazardous materials that must be regulated if discharged to the sewer, are not necessary for adequate disinfection. Phenolic compounds are toxic and may bioaccumulate in the environment; a wastewater treatment plant biological treatment system may not completely remove them from sewage.

- Eliminate use of phenolic disinfectants wherever possible. Consider substituting quaternary amine disinfectants, which have been shown by many infection control departments to be suitable. (Quaternary amine disinfectants are also hazardous, but pose fewer problems for the wastewater treatment plant).
- If phenols are used, keep concentrations to the minimum recommended by the manufacturer. Use pumps or auto-feed systems that supply the appropriate dose when preparing a solution; prepare only the amount to be used. Measures may need to be taken to ensure that personnel do not override these controls in an effort to make the solutions stronger than necessary.
- Store both types of concentrated disinfectants (and all hazardous chemicals) in secondary containment to avoid spills.
- Never discharge concentrated disinfectant solutions to the sanitary sewer.

Hazardous Materials Management

Problem substances: hazardous materials, hazardous wastes, cleaning products, and all other chemicals

- **No hazardous materials or waste may be discharged to the sanitary sewer or storm drain!**
- Keep a record of disposal of hazardous waste to their final resting place. You are liable for these wastes after they leave your facility.
- All hazardous materials and wastes should be labeled and stored according to federal, state, and local regulatory requirements. Chemical storage practices should follow County of Santa Cruz Environmental Health Department regulations.
- It is essential to segregate non-compatible materials and provide secondary containment, which keeps spilled materials from spreading.
- Floor drains should be eliminated in all areas where hazardous materials are handled or stored.
- Material Safety Data Sheets (MSDSs) should be readily available for all of the materials used, and accessible to all staff. Each product's use and its MSDS should be evaluated regularly to ensure that the material is handled properly and that alternative, less toxic chemicals are considered when possible. However, it is important to remember that MSDSs do not list all ingredients. Some substances that pose significant environmental problems (e.g. copper or zinc) may be omitted from MSDSs or supplier literature. If you suspect that a chemical may contain a hazardous constituent, check with the supplier. If there is any doubt, dispose of spent materials as hazardous waste until the question has been resolved.

- Each waste stream must be characterized and profiled to ensure proper handling and disposition.
- Label containers, instruments, and processes that hold or use problem materials so that each user is aware of his or her responsibility for proper use and disposal.
- Keep bottled chemicals in secured storage, on low shelves (never over sinks) or in storage cabinets with latching doors. Follow Fire Department regulations and County of Santa Cruz Environmental Health Department regulations.
- Prevent bottle breakage and spills by using trays with lips or other specialized carrying containers (carboys) to transfer chemical bottles between storage areas and labs.
- **Check all containers on a regular basis for potential holes and leaks.** Leaks on steel drums can appear as rusted out spots or indentations initially. If a leak is discovered, place drip pans or absorbent material under the leak and then attempt to repair the leak immediately. Keep lids, bungs, and tops secured on waste barrels and containers at all times, excepting when adding waste to containers or dispensing product.
- In areas where hazardous materials are stored, make sure there are adequate spill cleanup materials (see the section on Spill Prevention, Control, and Response). Hazardous waste containers must be labeled and stored according to hazardous waste regulations. For more information on Best Management Practices for Hazardous Materials Storage, contact the County of Santa Cruz Environmental Health Services Department at 831.454.2022.

Waste Minimization

A pollution prevention workshop was held in the City of Albuquerque, New Mexico for Medical Facilities. The workshop focused predominantly on waste minimization. To view the synopsis, visit http://www.cabq.gov/p2/Synop01.pdf .

Hospital waste is typically 5% hazardous, 10% biohazardous, and 85% solid waste. All waste streams can be costly to dispose and/or treat.

Minimizing waste can save hospitals a great amount of money, while also saving the public cost of managing these wastes. The potential for a 50% reduction in wastes exists for hospitals lacking in waste minimization efforts. That results in a cost savings of 50% of total waste disposal costs. The person who discovers and implements this cost saving advantage will likely receive more than a pat on the back.

Begin the waste minimization process by gaining a full understanding of your facility's waste. Review all documentation of waste programs: hazardous waste manifests, solid waste invoices, universal waste disposal, biohazardous waste manifests. If no documentation exists, contact vendors. Attempt to quantify your waste streams in units/month. Be sure and use the same units. Convert liquid volume to weight so that all wastes are recorded in pounds or tons. Graph the data in tons of waste/month for each waste stream and, if possible, include the cost of disposal. This is your baseline waste generation data.

Next, begin analyzing how waste is generated. Begin in the purchasing department and end in the waste collection areas. Are wastes being appropriately classified? Are solid wastes being disposed of as hazardous or biohazardous? Ask hospital staff where they dispose of certain items. Are batteries being recycled? Are expired pharmaceuticals being sent back to vendors? Are there recycle bins present to an extent so as to promote recycling? Are there non-hazardous alternatives to large volume hazardous waste streams? There are many other questions that can lead to waste minimization opportunities.

Waste management is generally decentralized in hospitals since each waste stream can present its own challenges. Gather all persons responsible for waste generation and management within the facility in a meeting room. Label the group the Waste Minimization Committee. Show the group the baseline waste data you put together. Together with the group, brainstorm on potential waste minimization ideas for the various waste streams, explaining the cost savings involved.

Once waste minimization opportunities have been identified by this group, discuss feasibility of the ideas. Assign a responsible individual and a target implementation date for each idea that is deemed feasible.

After waste minimization concepts have been implemented, gather another years' worth of data. Demonstrate the reduction in waste from your baseline data and calculate the cost savings. Present the data to upper management along with your request for a raise!

For a template Waste Minimization Program, contact the Environmental Programs Coordinator at 831.477.3907.

Tried and True Waste Minimization Concepts

Listed below are some of the waste minimization concepts that have been know to be effective at medical facilities:

- Used battery collection and recycle
- Fluorescent tube collection and recycle
- Alcohol distillation units for alcohol recovery
- Solvent distillation units for solvent recovery
- Formalin filtration for formalin reuse
- Silver recovery for radiology
- Tyvek garment recycling
- Composting of food waste and leaf and yard waste
- Recharge laser jet cartridges for computer printers
- Replace oil-based paints with water-based paints
- Replace solvent parts washing fluid with water-based parts washing fluid
- Substitute Anderson tubes for Canter tubes
- Substitute paracetic acid/acidic acid solutions for formaldehyde

Useful Tools

To prevent purchasing products linked to Persistent Bioaccumulative Toxic substances (PBTs), use the Health Care Environmental Purchasing Tool (HCEPT) for screening. The tool is located at the following website: http://www.ahrmm.org/info/HCEPT/index.html .

Another site that was generated by medical professionals for medical professionals is www.h2e-online.org . Likewise, the website www.sustainablehospitals.org will be helpful. This website provides alternative products.

After the MOU was developed between the EPA and AHA, the California EPA and the Department of Toxic Substances Control (DTSC) put together a Pollution Prevention Guide for Hospitals (excluding medical wastes) in May 1998. Contact the DTSC at 510.540.3964 for a copy. Request Document Number 413. Included in this DTSC guide are a self-audit tool and several case studies for implementation of waste minimization concepts.