PRIMARY SOURCES OF GLUTARALDEHYDE EXPOSURE

Glutaraldehyde-based agents are used to disinfect medical equipment that cannot be subjected to steam sterilization, specifically heat-sensitive, lensed devices typically requiring high-level disinfection between patient uses. Trade names for glutaraldehyde-based products include, but are not limited to, Cidex®, Sonacide®, Sporicidin®, Hospex®, and Omnicide®.

DEFINITIONS:

Sterilant: Physical or chemical agent(s) or process which completely eliminates or destroys all forms of life, particularly microorganisms.

Disinfectant: An agent that destroys pathogens by physical or chemical means. Disinfection processes do not ensure the same margin of safety associated with sterilization processes and can vary in their extent of microorganism elimination. This variation leads to subcategories, the first of which is high-level disinfection.

High-Level Disinfection: A process utilizing a sterilant under less than sterilizing conditions. The process kills all forms of microbial life except for large numbers of bacterial spores.

Disinfection activities range from simple soaking of small instruments to automated processing of complex lensed instruments, such as endoscopes. Exposure to glutaraldehyde as a high-level disinfectant occurs primarily during the following activities:
- Activating and pouring glutaraldehyde solution into or out of a cleaning container system (e.g., soaking basin in manual disinfecting operations and reservoir in automated processors);
- Opening the cleaning container system to immerse instruments to be disinfected;
- Agitating glutaraldehyde solution;
- Handling of soaked instruments;
- Removing instruments from the container system;
- Rinsing the channels of instruments containing residual glutaraldehyde solution;
- Flushing out instrument parts with a syringe;
- Drying instrument interiors with compressed air;
- Disposing of “spent” glutaraldehyde solutions to the sanitary sewer;
- Performing maintenance procedures, such as filter or hose changes on automated processors that have not been pre-rinsed with water.

RECOMMENDED EXPOSURE CONTROLS

A variety of engineering controls, facility design considerations, and work practices are available to minimize exposure to glutaraldehyde during its use as a disinfectant and sterilant. In good industrial hygiene practice such methods are to be used to control employee exposure, and if they prove to be insufficient to protect employees, respirators and other personal protective equipment are to be used. Employees required by their employer to wear respirators must receive training and a medical evaluation to determine their fitness to use the equipment. Fit testing of the respirator is also required. Employees whose employers do not require them to wear respirators but who choose to do so must obtain certain information concerning the safe use of respirators.
Respirators protect only the user, so others in the area may be overexposed to glutaraldehyde vapor if it is not adequately controlled at the source of the release.

Other forms of personal protective equipment (PPE), including gloves, safety eyewear, and isolation gowns, lab coats, or aprons (plus sleeve protectors) should be worn and may be required whenever there is the potential for skin or eye contact with glutaraldehyde. Such PPE should always be used in combination with effective engineering controls.

Studies have documented the effectiveness of controls in reducing exposure to glutaraldehyde in disinfecting. The changes that appeared to have the most impact on reducing mixing exposures were the addition of a waste pump and new filters in the hood.

ENGINEERING CONTROLS

The goal of engineering controls is to keep glutaraldehyde vapor from entering the workspace and the employee’s breathing zone by containing and removing it at the source of release. The primary sources of employee exposure to glutaraldehyde during disinfection/sterilant activities include pouring glutaraldehyde solutions into container systems, opening soaking basins or reservoirs, and handling instruments containing residual glutaraldehyde. Engineering controls tailored for these exposure sources include ventilation: general exhaust ventilation, local exhaust systems (such as laboratory chemical hoods), process automation, and isolation (e.g., basins with tight-fitting covers, dedicated centralized storage and use areas).

GENERAL ROOM VENTILATION

The American National Standards Institute, Inc., in collaboration with the Association for the Advancement of Medical Instrumentation, recommends that rooms where glutaraldehyde
disinfection/ sterilization is performed be large enough to ensure adequate dilution of vapor and have a minimum air exchange rate of 10 air exchanges per hour. Some agencies recommend even higher air exchange rates (e.g., 15 air exchanges per hour), to ensure dilution of vapor.

There are no national standards that apply specifically to glutaraldehyde usage areas; however, local codes may apply. The air exchange rate recommended by ANSI/AAMI is consistent with the American Institute of Architects’ guidelines for healthcare facilities.

LOCAL EXHAUST VENTILATION

ANSI/AAMI recommends that local exhaust ventilation also be installed at the point of release of glutaraldehyde vapors. The healthcare facility must ensure that the ventilation system is operating properly and is not obstructed or disturbed by drafts from sources such as fans, supply air diffusers, open windows and doors, and heavily traveled aisles.

Local exhaust ventilation located at the level of vapor discharge is the preferred method of reducing glutaraldehyde vapor concentrations because it captures and removes vapor at the source before it can escape into the general work environment. Local exhaust ventilation systems for glutaraldehyde-based activities may include a local exhaust hood (such as a laboratory fume hood), the associated ductwork and fan, or a self-contained, freestanding, recirculating exhaust ventilation system (i.e., ductless fume hood).

LOCAL EXHAUST HOOD

The purpose of a local exhaust hood is to capture glutaraldehyde vapor during processing and conduct it into the exhaust system (via the hood). The capture and control of glutaraldehyde vapor is achieved by the inward airflow created by the exhaust hood. The minimum hood-induced air velocity necessary to capture and convey glutaraldehyde vapor into the hood is called
the “capture velocity.” A minimum capture velocity of at least 100 feet per minute is recommended to prevent exposure to glutaraldehyde vapor. Once glutaraldehyde vapor is collected inside a suitable exhaust hood, it is transported through a duct system and then discharged to the outside via a fan.

DUCTLESS FUME HOODS

Ductless fume hoods are ventilated enclosures that have their own exhaust fan that draws air out of the hood, passes it through an air cleaning filter and then discharges the cleaned exhaust air back into the workplace. Ductless fume hoods are “recirculating” exhaust systems used for contaminant control and use a variety of filters for air cleaning purposes, depending on the air contaminant(s). For glutaraldehyde, a filter containing activated charcoal or other suitable sorbent material must be used to effectively capture vapors. Because the collection efficiency of these filters decreases over time, a preventive maintenance program in accordance with the manufacturer’s recommendations must be implemented to ensure optimum performance of the system and effective employee protection.

Ductless fume hoods may also come equipped with a variety of features as specified in the American National Standards for Recirculation of Air from Industrial Process Exhaust Systems. These safety features are designed to prevent inadvertent exposure in the workplace and include continuous monitoring devices equipped with alarms to alert operators to potential filter break through, and backup air cleaning devices.

TRANSFER PROCEDURES

Reducing the release of glutaraldehyde vapor during transfer operations can be accomplished by the use of automated and enclosed equipment. For example, the transfer of glutaraldehyde from
drums into process containers can be automated using pumps and closed transfer lines. Such automated equipment can help employees avoid glutaraldehyde exposure.

The use of a “safety nozzle” for pouring reduces the potential for splashing and “glugging” during initial pouring of glutaraldehyde solutions. When using a “safety nozzle,” be aware that droplets may remain inside the nozzle and take care to avoid spraying droplets into the atmosphere when removing (unscrewing) it from one container and screwing it onto another container.

AUTOMATED DISINFECTION
The use of automated processing equipment to disinfect instruments can significantly reduce the glutaraldehyde exposures of employees performing disinfection procedures, as well as of other employees and non-employees in the vicinity. However, exposure is still possible, especially when poor work practices are used or the equipment is poorly designed or improperly installed. The ANSI/AAMI standard contains detailed guidelines for the purchase and installation of automated equipment, which is now widely used in healthcare facilities that perform high-volume disinfection.

MOBILE DISINFECTING STATIONS
Mobile disinfecting soaking stations designed specifically for manual high-level disinfecting provide an enclosed area for sterilizing trays, protecting employees from splashes and spills, and controlling exposure to vapor from glutaraldehyde and other disinfectants. Mobile disinfecting stations utilize ductless fume hoods for vapor control and may have different types of filters available depending on the disinfectant to be used.
FACILITY DESIGN
The healthcare facility should designate central areas for disinfection and sterilization using glutaraldehyde so that specific controls can be utilized. Specific engineering controls are more difficult to implement in facilities that permit the widespread use of glutaraldehyde throughout the site. The centralized location should be large enough to permit freedom of movement (a crowded work space creates the potential for spills), and have limited access. Posting warning signs at the entrance to the centralized location and limiting access to only trained personnel designated to perform operations involving the use of glutaraldehyde will contribute to reducing exposure at the facility.

RECOMMENDED WORK PRACTICES
Poor work practices can contribute significantly to an employee’s glutaraldehyde exposure. The healthcare facility should evaluate each glutaraldehyde-using operation and observe employees’ work practices to determine all potential sources of exposure. Developing procedures for safe work practices may be useful for training and communication purposes. These procedures should emphasize prevention of employee contact with glutaraldehyde solution or vapors. Only trained, designated personnel should be responsible for handling glutaraldehyde. The following sections provide general recommendations for safe work practices addressing the transportation, storage, use, spill control, cleanup, and disposal of glutaraldehyde. Individual facilities should tailor their work practices to the specific glutaraldehyde operations in place at their work sites.

TRANSPORTATION AND STORAGE OF GLUTARALDEHYDE

- Transport glutaraldehyde solution only in closed containers with tight-fitting lids to minimize the potential for spills
- Designate centralized locations for using glutaraldehyde to reduce the potential for spills during transport.
- Store unused glutaraldehyde solutions in tightly covered containers in a cool, secured, and properly labeled area.
- Dispose of outdated solutions properly.

USE AND HANDLING PROCEDURES

- When transferring glutaraldehyde to soaking basins and reservoirs, pour the liquid carefully and minimize splashing.
- Minimize splashing and agitation of glutaraldehyde solutions by careful placement and removal of instruments (NSW Health Department, 1993).
- When transferring and pouring glutaraldehyde solutions, use safety nozzles designed with a flexible spout and shut-off valve, when available.
- Keep covers on soaking basins closed as much as possible and use appropriately-sized, tight-fitting lids for containers.
- Use appropriately-sized soaking basins designed to minimize surface area (e.g., narrow, deep container).
- Keep automatic washer doors closed at all times except when necessary for loading or unloading of instruments to be disinfected.
- Rinse soaked instruments under gently running water as close as possible to the soaking tray or washer to contain solution and minimize dripping on other surfaces (NSW Health Department, 1993).
• Use adequate ventilation if using compressed air to dry instruments rinsed with ethyl or isopropyl alcohol rinses. See discussion on Engineering Controls at page 19 in this section.

• Use glutaraldehyde only in designated areas where traffic and ventilation can be controlled.

• Ensure that the ventilation system is operating prior to handling glutaraldehyde solutions. (Consult your facilities department for help on how to check the operation of your ventilation system.) NOTE: The odor threshold of glutaraldehyde has been reported to be 0.04 parts per million (ppm), and odor detection is a potential indicator that the engineering controls are inadequate. However, you cannot always rely on odor detection because some formulations may contain a perfume to mask the odor of glutaraldehyde. Additionally, individuals vary in their ability to detect odors; thus, the lack of an odor does not necessarily mean that exposures are adequately controlled.

• Follow recommended ACGIH procedures for proper use of laboratory hoods.

• Close workroom doors to ensure the effectiveness of any available general dilution ventilation.

• Do not store food, eat, drink, smoke, or apply cosmetics in any area where glutaraldehyde is stored or used.

• Clean up small glutaraldehyde spills and releases immediately. In the case of large spills or delayed response, employees should be encouraged to close doors, alert others and activate the HazMat spill response team.
ALTERNATIVES TO GLUTARALDEHYDE FOR HIGH-LEVEL DISINFECTION

When an alternative to glutaraldehyde is available which is at least as effective as a Food and Drug Administration’s (FDA) approved high-level disinfectant, consideration should be given to whether the alternative is safer for employees. Prior to selecting a specific glutaraldehyde alternative, in addition to process and product considerations, consideration should be given to the following: the toxicity of the glutaraldehyde alternative (e.g., there may be limited knowledge regarding the potential health effects of the alternative); disposal, ventilation, personal protective equipment (PPE) and air monitoring requirements.

Healthcare facilities that would like to eliminate or reduce their dependence on glutaraldehyde as a high-level disinfectant have two options: (1) use a different (drop-in) liquid chemical disinfectant (e.g., Cidex OPA, Compliance, Sporox II, and Sterilox); or (2) invest in new enclosed equipment technologies that do not utilize glutaraldehyde (e.g., Sterrad and Steris) (Sustainable Hospitals, 2001). Current alternatives to glutaraldehyde for high-level disinfection and/or sterilization can be found on the FDA’s website at www.fda.gov.cdrh/ode/germlab.html. Material Safety Data Sheets (MSDSs) for each product can be obtained directly from the manufacturer.

SELECTION AND USE OF PERSONAL PROTECTIVE EQUIPMENT

Employees must wear personal protective equipment (PPE) designed to protect skin and eyes from contact with glutaraldehyde solutions. Contact with clothing should also be prevented. The healthcare facility should develop and implement a written program outlining the facility’s policies and procedures for PPE selection and use, including a hazard assessment and written
certification that the hazard assessment has been performed to determine the nature of the hazards requiring PPE.

SKIN PROTECTION

Employers must select and require employees to use appropriate hand protection when employees' hands are exposed to potential skin absorption of substances such as glutaraldehyde. Gloves impervious to glutaraldehyde are required to be worn to prevent contact with glutaraldehyde solutions. Elbow-length gloves or protective sleeves made of glutaraldehyde-impervious material should be worn to protect the hands and forearms. The gloves used will depend on the type of work to be done, the duration of contact, and the concentration of glutaraldehyde. Among the chemical-protective materials, butyl rubber, nitrile and Viton® are the most impervious to 50% glutaraldehyde solutions and have been shown to provide full shift protection against glutaraldehyde permeation. For shorter exposures, gloves made of polyethylene and styrene-butadiene/styrene-isoprene copolymers (i.e., Allergard Synthetic Surgical Gloves) provide protection for several hours with dilute (2% to 3.4%) glutaraldehyde solutions (Jordan et al., 1996; Ansell Healthcare, 2003).

Latex examination gloves may not provide adequate skin protection against glutaraldehyde. Although one author reports a breakthrough time of 45 minutes with latex examination gloves and standard 2% to 3.4% glutaraldehyde solutions, other materials are available that provide a greater margin of safety. Therefore, latex gloves are not recommended for use with glutaraldehyde.

Polyvinyl chloride (PVC) and neoprene gloves do not provide adequate protection and should not be used with glutaraldehyde solutions because they may retain or absorb glutaraldehyde.
If the required hazard assessment indicates a need for additional protection for skin and clothing, it can be provided through the use of isolation gowns, lab coats, or aprons (plus sleeve protectors) that are made of glutaraldehyde-impervious material such as polyethylene-coated, spun-bond polypropylene. Protective clothing that has become saturated should be removed quickly and laundered prior to reuse. If skin contact with glutaraldehyde occurs, the skin should be washed thoroughly with soap and water for at least 15 minutes.

EYE PROTECTION
Splash-proof goggles or safety glasses with full face shields must be worn wherever there is potential for glutaraldehyde solution to contact the eyes. Suitable emergency eyewash equipment must be immediately available for quick drenching or flushing of the eyes (for at least 15 minutes) in all glutaraldehyde usage locations. It is recommended that emergency eyewash units be accessible and located within a 10 second travel time of all affected areas. For additional details, consult American National Standard: Emergency Eyewash and Shower Equipment. If an eyewash and a shower are required, a combination unit should be considered.

RESPIRATORY PROTECTION
Respirators should not be used as a substitute for installing effective engineering controls. When effective engineering controls are not feasible, or while they are being implemented, appropriate respirators may be used to control employee exposure to glutaraldehyde vapor.

All personnel who may be required to wear a respirator for routine or emergency use must be included in a written respiratory protection program that meets the requirements of OSHA’s Respiratory Protection standard. Such a program must have written site-specific procedures for
- Selecting, using, and maintaining respirators;
- Medical evaluations;
- Fit testing; employee training; and
- Routine program evaluation.

Employers must select appropriate respirators based on an exposure assessment or a reasonable estimate of employee exposures to glutaraldehyde vapor during routine and/or emergency work procedures. For protection against exposures to glutaraldehyde vapor during routine procedures, employers may provide air-purifying respirators (i.e., a half-face or full-face air-purifying respirator with organic vapor cartridges), or air-supplying respirators.

If air-purifying respirators are provided, employers must implement a change-out schedule for air-purifying canisters and cartridges to ensure that they are changed before the end of their service life. Change-out schedules must be developed by consulting the respirator manufacturer cartridge or canister test data and evaluating workplace conditions such as estimated glutaraldehyde concentrations, temperature, relative humidity, and employee breathing rate. Cartridge or canister service life calculation formulas are also available on the OSHA website, www.osha.gov.

Air-supplied respirators should be used when exposures may be reasonably anticipated to be higher and for unknown exposures, such as emergency spill situations.

All respirators used must be certified by the National Institute for Occupational Safety and Health (NIOSH) and must be appropriate for use with glutaraldehyde. The disposable air-
purifying particulate respirators (filtering face-pieces) are not effective against organic vapors and must not be used for glutaraldehyde protection.

Employees who voluntarily choose to wear respirators, but who are not required by their employers or OSHA to wear a respirator must still receive OSHA information. See OSHA’s Respiratory Protection standard for further details regarding the requirements for employee use of respirators.

EMPLOYEE INFORMATION AND TRAINING

All employers with glutaraldehyde solutions or other hazardous chemicals in their workplaces must develop and implement a written hazard communication program that meets the requirements of OSHA’s Hazard Communication standard. Such a program must include provisions for employee access to material safety data sheets (MSDSs), container labeling, and training for all potentially exposed individuals.

Employees who use, handle, or may have potential exposure (e.g., accidental or possible) to glutaraldehyde solutions must be provided information and training prior to their initial work assignment. Employees must be provided information regarding the requirements of the Hazard Communication standard; operations in their work area where glutaraldehyde solutions (and other hazardous chemicals) are present, plus the location and availability of the written hazard communication program and material safety data sheets (MSDSs).

Employee training must include, at a minimum, the following elements:

- Methods and observations that may be used to detect the presence or release of glutaraldehyde in the workplace;
The physical and health hazards of glutaraldehyde;

- The measures employees can take to protect themselves, including specific procedures the employer has implemented to protect employees from exposure to glutaraldehyde, such as appropriate work practices, emergency procedures, and personal protective equipment; and

- An explanation of the material safety data sheet, the employer’s labeling system, and how employees can obtain and use the appropriate hazard information.

EXPOSURE MONITORING

Workplace exposure monitoring should be conducted to ensure a safe work environment and to compare monitoring results with recommended occupational exposure limits for glutaraldehyde. Monitoring should be conducted after initiating use of glutaraldehyde solutions; whenever there is a significant change in protocol, work practices, caseload, or workplace ventilation systems; and after major equipment (e.g., endoscope washers or other auto-mated equipment) repairs. Exposure monitoring should also be conducted if employees have complaints or symptoms of glutaraldehyde exposure.

Monitoring should be conducted in all glutaraldehyde use areas as well as in the breathing zone of each employee using or handling glutaraldehyde solutions. Special attention should be given to short-term tasks that may have elevated exposures such as pouring, mixing or otherwise agitating glutaraldehyde solutions.

Several air sampling methods are available for monitoring glutaraldehyde exposures. These methods include active and passive sampling techniques as well as the use of a direct-reading instrument. Active air sampling uses battery-powered personal sampling pumps and treated
filters or sorbent tubes for sample collection. Passive sampling uses small, lightweight, easy-to-use badge assemblies that rely on natural air movement rather than pumps for sample collection. After sampling, the filters or sorbent tubes and passive monitors should be sent to a laboratory for analysis. A direct-reading, handheld, easy-to-use, portable instrument called the “glutaraldehyde meter” may also be used to compare monitoring results with recommended glutaraldehyde exposure limits, as well as to determine concentrations resulting from spills and other emergencies.

Accredited laboratories have demonstrated their ability to meet performance standards and are preferred. The OSHA website at www.osha.gov/dts/ltc/methods/organic/org064/org064.html and NIOSH at www.cdc.gov/niosh/nmam/pdfs/2532.pdf may be consulted for additional information regarding validated sampling and analytical methods for glutaraldehyde. In addition, the American Industrial Hygiene Association (www.aiha.org) may be consulted for a listing of consultants and accredited industrial hygiene laboratories.

Active air sampling methods require sampling expertise and special sampling supplies and should be performed by an industrial hygienist or other qualified professional trained in industrial hygiene air sampling strategies and techniques. Passive monitors and the glutaraldehyde meter do not necessarily require sampling expertise and can be used by healthcare personnel to evaluate workplace exposures. Proper use of passive monitors may be determined by consulting the manufacturer’s instructions and/or the laboratory that will conduct the analyses. Proper use and maintenance of the glutaraldehyde meter may be determined by consulting the equipment manufacturer (e.g., MSA or PPM Technology).
Active sampling methods are more sensitive and reliable than passive monitors/badges and the glutaraldemeter. Quantitative limits of detection (LOD) for the active methods are in the range of 0.44 ppb (parts per billion), while the reliable LOD for passive methods and the glutaraldemeter are in the range of 20-100 ppb.

DISPOSAL OF GLUTARALDEHYDE SOLUTIONS
Dispose of glutaraldehyde solutions in accordance with local, state, and federal regulations. Check with your local Publicly Owned Treatment Works (POTW) to determine if glutaraldehyde solutions can be disposed of in the sanitary sewer system. Some POTWs may prohibit the disposal of glutaraldehyde solutions in the sanitary sewer system or may require neutralization prior to disposal. If there are no disposal restrictions, glutaraldehyde solutions may be disposed of (along with copious amounts of cold water) into a drain connected to the sanitary sewer system. Do not discard glutaraldehyde solutions (including neutralized solutions) into septic systems. Unlike municipal sewage treatment systems, septic systems are not diluted by other waste streams. Consequently, glutaraldehyde concentrations entering the system may be higher and have an adverse effect on the microorganisms that are necessary for proper functioning of the septic system. Dispose of empty glutaraldehyde containers according to product label instructions.

SPILL CONTROL AND CLEANUP PROCEDURES
All glutaraldehyde spills have the potential to create vapor concentrations that exceed recommended exposure limits. Consequently, a suitable plan of action with procedures for handling glutaraldehyde spills should be developed and implemented by knowledgeable and responsible individuals at the facility. In the development of this plan, consideration should be
given to the physical characteristics of the area(s) where glutaraldehyde solutions are used (e.g.,
type and effectiveness of ventilation, room size and temperature) as well as the quantity and
concentration(s) of the solution(s). The spill control plan should incorporate the following key
elements:

- Designation of individuals responsible for managing spill cleanup;
- Evacuation procedures for nonessential personnel, if necessary;
- Medical treatment procedures for exposed individuals;
- Site-specific reporting requirements (e.g., site safety and health personnel);
- Cleanup procedures, the location of spill control supplies, and required personal
  protective equipment;
- Location and availability of material safety data sheets (MSDSs) for glutaraldehyde-
  based sterilants/disinfectants and manufacturer recommendations for emergency
  response;
- Employee training requirements;
- Air exchange rate(s) within the areas of use and procedures to prevent the dispersal of
  glutaraldehyde vapor to other areas of the facility through the general ventilation system;
  and
- Respiratory protection program requirements pertaining to glutaraldehyde.

GENERAL PROCEDURES

All spills should be cleaned up immediately, regardless of size. All necessary spill cleanup
equipment (e.g., sponges, towels, absorbent mats/wipes, spill pillows, mop and bucket, plastic
dust-pan and trash bags) and personal protective equipment (i.e., eye, hand, body and respiratory
protection) should be readily available. Whether or not a spill can be cleaned up safely without the use of neutralizing chemicals and/or a respirator will depend on a number of factors such as the glutaraldehyde concentration, the amount spilled, the temperature of the room, the solution, and the effectiveness of the ventilation in the spill area. Any spill larger than a drip or a splash may need to be neutralized; and, when vapor concentrations are unknown, air-supplied or atmosphere-supplying respirators are appropriate.

NEUTRALIZING CHEMICALS
Before using any type of glutaraldehyde-based product, review the manufacturer’s recommendations for spill cleanup. Several chemicals can be used to lower the glutaraldehyde concentration in solutions and/or the ambient vapor level during a spill. Examples include: household ammonia, ammonium carbonate powder, dibasic ammonium phosphate, and sodium bisulfite. Glycine is also used as a neutralizer, and may be less hazardous than others. There are also commercially available products for this purpose, including powders, solutions, and salts.

DRIPS AND SPLASHES
A reusable or disposable sponge, towel, or mop may be used to quickly clean up small spills. Glutaraldehyde solutions can also be neutralized with an appropriate chemical agent before wiping up with a sponge, towel, or mop. Cleanup supplies should be thoroughly rinsed with large amounts of water prior to reuse. Rinse water and disposable cleanup supplies should be discarded according to applicable regulations as well as the procedures outlined in the facility spill control plan.
Drips and splashes may also be cleaned up with commercially available spill control kits that contain mats/wipes to absorb and neutralize small spills. The absorbed medium should be disposed of according to local, state and Federal regulations.

LARGE SPILLS

Any glutaraldehyde spill larger than small drips or splashes should be cleaned up by properly trained and equipped spill response personnel. Certain larger spills of glutaraldehyde are covered by the requirements of OSHA’s Hazardous Waste Operations and Emergency Response standard.

Pre-planning for spills is a critical piece of the facility exposure control plan. Personnel should understand the necessity to evacuate until the spill is cleaned up and the worksite is safe for reentry of employees. Appropriate spill-response equipment placed outside the affected area for access after the area is evacuated will facilitate compliance with the emergency spill response plan. Supplied air respirators are an important component of a spill-response kit. Appropriate training on the use of the respirators is an important piece of the pre-spill planning, so that spill responders are adequately equipped and trained.

Large spills should be contained and neutralized or contained and collected for disposal. Once contained, spills may be neutralized with an appropriate chemical agent such as sodium bisulfite (2-3 parts [by weight] per part of glutaraldehyde solution) with a contact time of 5 minutes at room temperature, using a mop or other tool to thoroughly blend in the deactivation compound. A less hazardous neutralizer, glycine, can be used in a ratio of 25 grams per gallon of 2.4% glutaraldehyde solution to neutralize in 5 minutes. Depending on the size of the spill and site conditions, heat and vapor may be liberated by the reaction with the neutralizing chemicals.
Commercially available spill pillows and booms may also be used to easily contain, absorb, and/or neutralize large glutaraldehyde spills.

After the glutaraldehyde solution is removed, the spill area and the cleanup supplies/tools should be thoroughly rinsed with large amounts of cold water. Rinse water, disposable cleanup supplies and absorbent medium (if used) should be disposed of according to applicable regulations and the procedures outlined in the facility spill control plan.

Health effects of glutaraldehyde exposure include:

- Short term (acute) effects: Contact with glutaraldehyde liquid and vapor can severely irritate the eyes, and at higher concentrations burns the skin. Breathing glutaraldehyde can irritate the nose, throat, and respiratory tract, causing coughing and wheezing, nausea, headaches, drowsiness, nosebleeds, and dizziness.

- Long-term (chronic) effects: Glutaraldehyde is a sensitizer. This means some workers will become very sensitive to glutaraldehyde and have strong reactions if they are exposed to even small amounts. Workers may get sudden asthma attacks with difficult breathing, wheezing, coughing, and tightness in the chest. Prolonged exposure can cause a skin allergy and chronic eczema, and afterwards, exposure to small amounts produces severe itching and skin rashes. It has been implicated as a possible cause of occupational asthma.

POSSIBLE SOLUTIONS

Limit exposure to glutaraldehyde through work practice, engineering controls, and personal protective equipment (PPE) including:
• Make sure that rooms in which glutaraldehyde is to be used are well ventilated and large enough to ensure adequate dilution of vapor, with a minimum air exchange rate of 10 air changes per hour.

• Ideally, install local exhaust ventilation such as properly functioning laboratory fume hoods (capture velocity of at least 100 feet per minute) to control vapor.

• Keep glutaraldehyde baths under a fume hood where possible.

• Use only enough glutaraldehyde to perform the required disinfecting procedure.

• Store glutaraldehyde in closed containers in well ventilated areas. Air-tight containers are available. Post signs to remind staff to replace lids after using product.

• Use specially designed, mobile, compact, disinfectant soaking stations to facilitate sterilization of heat sensitive equipment such as endoscopes, or GI scopes. These soaking stations provide an enclosed area for sterilizing trays, and remove fumes from glutaraldehyde and other disinfectants.

Use appropriate PPE including:

• Use gloves that are impervious to glutaraldehyde such as those made of Butyl Rubber, Nitrile, and Viton®, which have been shown to provide full shift protection from glutaraldehyde.

• For shorter exposures, you can use gloves made of polyethylene. Do not use Neoprene and PVC gloves because they do not provide adequate protection against glutaraldehyde and may actually absorb it.

• Do not use latex surgical exam gloves for skin protection against glutaraldehyde, except in situations where only short-term, incidental contact is expected.
- Wear lab coats, aprons, or gowns made of appropriate materials such as polypropylene to provide additional protection.
- Wear splash-proof goggles and/or full face shields when working with glutaraldehyde to protect eyes.
- All employees who may be exposed to above the ceiling threshold limit value (TLV) of 0.05 ppm, should use appropriate respirators for glutaraldehyde vapor during routine or emergency work. Respirator requirements are found in the OSHA respiratory protection standard.
- Provide eye wash fountains for immediate emergency use.
- Use eye wash fountains and emergency showers if there is skin contact with glutaraldehyde. Flush area with water for at least 15 minutes to remove chemical.
- Change into clean clothes, if clothing becomes contaminated.
- Clean up spills immediately.
- Do not eat, drink, or smoke in any area where glutaraldehyde is handled or stored.
- Use a vacuum or wet method to reduce dust while cleaning up pure glutaraldehyde. Do not dry sweep.
- Use less toxic products if feasible and available, or other processes for sterilization.
- Automate the transfer of pure glutaraldehyde or pump liquid glutaraldehyde from drums or other storage containers to appropriate containers and operations, avoiding exposure to glutaraldehyde by keeping it in a contained process.

The OSHA Hazard Communication Standard requires employers to ensure that the hazards of all chemicals are evaluated and that this information is transmitted to the employees by means of a
hazards communication program which includes labeling, material safety data sheets, and employee training.