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MONONGALIA GENERAL HOSPITAL
MORGANTOWN, WEST VIRGINIA

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I. SUMMARY

On June 4, 1990, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation from the Monongalia General Hospital, Morgantown, West Virginia. NIOSH was requested to evaluate worker exposures to glutaraldehyde when used as a cold disinfecting agent for semi-critical surgical equipment (i.e. endoscopes and bronchoscopes).

An initial site visit was conducted on July 11, 1990. During that site visit, locations using glutaraldehyde solutions were identified and work practices/controls observed. Four areas were identified where Sporicidin is used, the Cystoscope and Endoscope rooms located in the hospital's Main Operating suites and the Cystoscope and Special Procedures rooms of the Same Day Surgery Center. During August 6-10, 1990, November 13-15, 1990, and April 22-26, 1991, environmental evaluations were conducted where glutaraldehyde was being used.

None of the samples collected exceed the Occupational Safety and Health Administration (OSHA) Permissible Exposure Level (PEL) or the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Value (TLV) for a ceiling exposure concentration of 0.2 parts per million (ppm) glutaraldehyde. Exposure estimates for personal breathing zone and area air samples ranged from None Detected (ND) to a 0.08 ppm.

On the basis of the environmental sampling results, it is concluded that a health hazard does not exist from an inhalation exposure to glutaraldehyde for nurses and technicians who perform cold disinfecting and sterilizing procedures. However, a dermal hazard does exist to those personnel due to improper use and selection of personal protective equipment and poor work practices. Recommendations are included in this report.

KEYWORDS: SIC 8062 (General Medical and Surgical Hospitals); glutaraldehyde, disinfecting, sterilizing, eye, skin, and respiratory irritation.

II. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) received a management request for a health hazard evaluation in June 1990 from the Monongalia General Hospital, Morgantown, West Virginia. The request was submitted to evaluate employee exposures to a cold disinfecting solution containing 0.13% glutaraldehyde, i.e Sporicidin®. This solution is used on a daily basis for disinfecting semi-critical equipment (i.e. endoscopes and bronchoscope).

An initial walkthrough site visit was conducted on July 11, 1990. During the walkthrough, areas using the glutaraldehyde solutions were identified and work practices/controls observed. Four areas were identified using the Sporicidin®; the Cystoscope and Endoscope rooms located in the main hospital's operating suite and the Cystoscope and Special Procedures rooms located in the Same Day Surgery Center.

III. BACKGROUND

The Monongalia General Hospital is a public hospital serving Monongalia County, West Virginia. Sporicidin® is used in the main hospital's operating suites, particularly the Cystoscope and Endoscope rooms. In addition, the hospital operates a detached Same Day Surgery Center designed primarily for minor and elective surgical cases. Sporicidin® is use more extensively at the Same Day Surgery Center's Cystoscope and Special Procedures rooms due to the greater volume of patients seen at the center.

Sporicidin® is manufactured as a 2% glutaraldehyde product that when diluted with 1:16 parts water results in a 0.13% glutaraldehyde solution. Once activated, the solution is effective for thirty days and can be used for cold disinfection and sterilization. For cold disinfection against vegetative organisms, and pathogenic fungi and viruses, it is recommended that items be soaked for at least 10 minutes. However, Monongalia General has adopted a 20-minute soaking period. To sterilize against resistant pathogenic spores, the minimum recommended time is 12 hours.

Glutaraldehyde is used exclusively to disinfect endoscopes and bronchoscopes after surgical cases. The hospital has a number of both types of scopes available; and, depending on the case load, the scopes may be cleaned and disinfected at the end of the day. However, in many instances observed, the case load dictated that scopes be cleaned and disinfected between cases.

Typically during the cleaning process, the scopes are first rinsed with water to remove heavy contamination. The inside of the scopes are cleaned with the aid of a suction pump which pulls the cleaning solution through the scope. After cleaning, the scopes are placed in an immersion bath of the glutaraldehyde solution and allowed to soak for 20 minutes. The immersion bath consists of a two gallon plastic basin which usually sits on a counter near a sink. The basin is kept covered with a loose fitting lid. The lid is removed during both the cleaning process and for retrieval of the instruments after the soaking period. According to a recent report[1], Sporicidin® has been deleted as a high level disinfectant because it loses its bacterial activity in the presence of an organic load (about 4% blood), is not effective against Aspergillus species after 30-minutes exposure time, and is unable to inactivate bacterial spores. Therefore, the hospital's Infection

Control Committee decided to implement the use of a full 2% glutaraldehyde solution for all cold disinfecting.

As a precaution, hospital officials instituted a limited use policy until NIOSH could evaluate employee exposures to the more concentrated glutaraldehyde solution.

IV. CHEMISTRY/TOXICOLOGY OF GLUTARALDEHYDE

The use of glutaraldehyde has expanded over the last twenty years and it is now used in a variety of different fields. It was originally developed as a quick acting sporicidal agent without the undesirable properties of formaldehyde. Today, glutaraldehyde is used primarily for disinfection or sterilization of medical, dental and hospital equipment.

NIOSH's National Occupational Exposure Survey (NOES 1981-82) determined that glutaraldehyde is being used not only in a variety of areas in the medical industry (e.g., inhalation therapy, dental, urology, gastrointestinal, ambulatory services, electron microscopy and cytochemistry) but also in photography, shoe repair, dyes, and tanning operations. The survey estimated that approximately 14,000 workers are potentially exposed to glutaraldehyde in the industries described.

Since 1982, glutaraldehyde has been marketed as a replacement for formaldehyde in dialysis reuse processes and it was estimated at the time that approximately 1 percent of hemodialysis operations in the United States have now begun to use glutaraldehyde for this procedure. The following information is an accumulation of studies and articles written on the chemistry and toxicology of glutaraldehyde.

1. Chemistry [2,3,4,5]

Products containing glutaraldehyde are most frequently available as 2%, 10%, 25% and 50% aqueous solutions, which have no flash points and are non-flammable. In general, glutaraldehyde is a saturated dialdehyde with the following formula: CHO-CH2-CH2-CH2-CHO, and its molecular weight is 100.13. In contrast to formaldehyde, which is a simple aldehyde, glutaraldehyde has two active carbonyl groups. Under proper conditions these two groups, either singly or together, undergo most of the typical aldehyde reactions to form acetals, cyanohydrins, oximes, and hydrazones. Through the crosslinking reaction, the carbonyl groups react with protein.

As a raw material, glutaraldehyde is synthesized and commercially available as an acidic aqueous solution. Aqueous solutions of glutaraldehyde are mildly acid in reaction and at an acid pH of approximately 3-4, glutaraldehyde solutions are stable for a period of many months. In this acid state they are not sporicidal. When rendered alkaline, however, the glutaraldehyde gradually undergoes polymerization. Above a pH of 9, the polymerization proceeds comparatively rapidly and eventually loses activity. In the pH range of 7.5 to 8.5 the polymerization reaction is slowed down considerably, so that full antimicrobial activity (i.e., sporicidal, bactericidal, viricidal, and fungicidal) is maintained for at least two weeks (14 days).

Most glutaraldehyde used in hospitals is a 2.0% concentration which has a two-component system that must be mixed together, or activated, prior to use for disinfection or sterilization. The activated solution that contains 2.0% glutaraldehyde is buffered to an alkaline pH of 7.5-8.5 as described above. To buffer this concentration of glutaraldehyde to the required alkaline range, the addition of 0.3 percent of sodium bicarbonate is necessary. Although other alkalinating agents may be employed, the alkali metal bicarbonates, such as sodium bicarbonate, have given best results. To provide greater utility to the activated or buffered glutaraldehyde solution, it has been convenient to add a surfactant to promote the wetting and rinsing of surfaces, sodium nitrite as a corrosion inhibitor, a peppermint oil odorant, and yellow and blue FD and D dyes, indicating that activation through mixing the two components has been completed. Before the addition of the buffer-dye combination, the inactivated glutaraldehyde solution is colorless; after the addition, the solution turns a characteristic fluorescent green. It should be noted that there are approximately eight different brands of this type of material on the market today and each of these may have slightly different chemical ingredients as well as percent concentrations.

The majority of the 2% glutaraldehyde solution is used primarily as a cold disinfectant and sterilizer for hospital medical and dental work. In addition to the 2% solutions, the most frequently used are the 25 and 90% solutions which are used as intermediates and fixatives for tissues, and for crosslinking polyhydroxy materials and proteins.

2. Toxicology

The majority of research articles available on glutaraldehyde today concern its ability to disinfect and/or sterilize against spores, bacteria, virus and fungus. There have been no epidemiological research studies reported in the literature to date and there have been only a limited number of human toxicological findings which have been reported on glutaraldehyde. The following is an accumulation of the more important information on animal, as well as the human toxicity studies currently available.

a. Dermatological Effects

The Environmental Protection Agency in 1969, under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) established that glutaraldehyde was considered to be a moderate skin irritant based on information collected during animal studies at that time.[6]

In one study aqueous solutions of 2 percent activate glutaraldehyde produced faint yellow staining of the skin and hair on rabbits after the first application. The staining became more intense and turned to a golden brown over the six week period of application. Discoloration persisted up to 35 days after application ceased. A mild "rash" appeared during the early stages but disappeared despite continued application of the solution. In the same study, a 25 percent solution of glutaraldehyde produced a severe erythematous reaction with edema after one to two daily applications, with necrosis and eschar formation in seven to ten days.

Activated glutaraldehyde retains the skin sensitizing properties of pure glutaraldehyde.[7] One study reported that allergic contact dermatitis was found in radiologists and X-ray technicians from the handling of X-ray solutions containing glutaraldehyde. The authors concluded that all persons with hand dermatitis who handle X-ray films should have a patch test with one percent aqueous solution of glutaraldehyde.[8]

b. Respiratory Tract Effects

Glutaraldehyde has a pungent odor, an odor recognition threshold of 0.04 ppm by volume in air and an irritation response level of 0.3 ppm.[5]

In one study, activated glutaraldehyde versus pure glutaraldehyde increased the irritant effects to the upper respiratory tract of workers. Another study indicated that the vapor from pure glutaraldehyde was noticeable and considered irritating by some persons. The authors, therefore, concluded that glutaraldehyde should be kept covered whenever possible and used in a well-ventilated area in such a manner so as to prevent prolonged breathing of the vapor.[9]

c. Eye Effects

Studies on the effects of glutaraldehyde on the eyes of rabbits produced severe corneal opacity and irritation of the iris and conjunctiva. These reactions were not reversed during a seven-day observation period. In rinsed eyes, there was similar irritation of the conjunctiva which remained during the seven-day observation period. The cornea and iris showed less irritation, which was partially reduced during the seven-day observation period.[10]

d. Mutagenic and Teratogenic Effects

In the most recent publication of the Registry of Toxic Effects of Chemical Substances (RTECS), 1983-84 three studies were cited in which glutaraldehyde was evaluated for possible mutagenic and teratogenic effects in animals. The study on mutagenic research on chickens showed that glutaraldehyde at 8% did not produce DNA damage.[11]

The second study referenced stated that glutaraldehyde did not produce teratogenic effects. The study did illustrate, however, that glutaraldehyde administered to mice at 50 gm/kg produced central nervous system, musculoskeletal and craniofacial damage (including nose and tongue). It was also determined in this study that glutaraldehyde at 8 gm/kg produced fetotoxicity (i.e., stunted fetus).

The third study showed that glutaraldehyde acted as an antimitotic and fixative substance to the eggs of a non-mammalian test species (Pleurodele) when they were treated with a .050 M solution.

e. Other Research

The results of two studies demonstrated an increased irritation from glutaraldehyde when the dialdehyde is activated. In one study mice were exposed at 8 and 33 ppm (33 and 133 mg/m^3) of alkalinized glutaraldehyde for 24 hours. The animals reacted with distinctly nervous behavior, panting and washing of the face and limbs, with symptoms disappearing after a few hours. Half of each group were sacrificed immediately postexposure, and the rest one day later. Lungs and kidneys showed no histopathologic damage, but the livers of the mice exposed at 33 ppm showed definite signs of toxic hepatitis, possibly still reversible, since it was present to a somewhat lesser degree in the animals autopsied one day post-exposure.[5]

In a second study, simulating a complete cold-sterilizing procedure lasting twelve minutes, the integrated sample of activated, 2% aqueous solution resulted in 0.38 ppm (1.33 mg/m^3) of glutaraldehyde measured at the operator's breathing zone. Although some irritation had been felt throughout this procedure, it was not until the end of the operation, when the equipment being sterilized was air-hose dried, that severe eye, plus nose and throat irritation were felt by the operator and the investigators, who also experienced sudden headache.[5]

A NIOSH investigation concluded that a health hazard existed at a hospital where glutaraldehyde was used in small animal research studies, and as a sterilant and disinfectant of respiratory therapy equipment. Glutaraldehyde concentrations in 8 personal breathing zone samples ranged from none detected to 1.5 mg/m^3. Six of these exceeded the ACGIH TLV of 0.7 mg/m^3. Medical questionnaires revealed that 9 of 11 exposed workers reported irritative symptoms compatible with exposure to glutaraldehyde. Eye and throat irritation were the most prevalent symptoms.[12]

In summary, the current literature illustrates that glutaraldehyde is a relatively strong irritant to the nose and a severe irritant to the eye. It can produce staining and may be slightly irritating to the skin. It also may cause skin sensitization (allergic contact dermatitis) from occasional or incidental occupational exposures.

Furthermore, it appears that the relatively strong irritant effect of pure glutaraldehyde on the eyes, nasal passages, upper respiratory tract and skin are slightly enhanced when the dialdehyde is activated. Finally, recent information suggests that glutaraldehyde is not mutagenic or teratogenic, but is fetotoxic.

V. EVALUATION CRITERIA

As a guide to the evaluation of the hazard posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is

important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary source of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and Recommendations, 2) the American Conference of Governmental Industrial Hygienist's (ACGIH) Threshold Limit Values (TLVs)[13],and 3) the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Levels (PELs)[14].

In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

The OSHA permissible exposure limit (PEL) for glutaraldehyde is 0.2 ppm ceiling (C). The ceiling "C" designation refers to a concentration that should not be exceeded even instantaneously during any part of the work day. Both the NIOSH Recommended Exposure Level (REL) and the ACGIH Threshold Limit Value (TLV) for glutaraldehyde has been established at 0.2 ppm (C).

VI. EVALUATION DESIGN AND METHODS

Fifty three personal breathing zone and area air samples were collected on August 6-10, 1990 using a solid sorbent (washed XAD-2, Supelco ORBO 23) to trap glutaraldehyde vapor. Samples were collected by drawing air through the collection media at a flowrate of 100 cubic centimeters per minute (cc/min) using calibrated sampling pumps. Sampling times varied from less than 60 to 385 minutes.

Analysis consisted of desorbing the trapped glutaraldehyde from each sample tube with 1.0 milliliters of toluene. The oxazolidine derivative of glutaraldehyde was then analyzed by using a Hewlett-Packard, Model 5890, gas chromatograph equipped with a flame ionization detector (GC/FID). The limit of detection (LOD) for that method was 2.0 micrograms per sample (ug/sample) and the limit of quantitification (LOQ) was 6.0 micrograms/sample (NIOSH Method 2532).[15] The Limit of Detection (LOD) is defined

as the smallest amount of analyte which can be distinguished from background instrument noise. The Limit of Quantitification is defined as the mass of analyte equal to ten times the standard error of the calibration graph.

Because of the high LOQ reported from that analysis, it was determined that short term exposures, in this case occurring less than 30 minutes, at the OSHA Permissible Exposure Level could not be determined. Therefore, it was decided that additional samples needed to be collected to assess glutaraldehyde exposures.

On November 13-15, 1990, an additional 35 personal breathing zone and area air samples were collected and again analyzed according to NIOSH Method 2532. Samples were collected using the washed XAD-2 collection media at a flowrate of 50 cc/min using calibrated sampling pumps. Sampling times varied from less than 20 to 389 minutes. In addition, specially prepared laboratory quality control or "spiked" samples consisting of 27 to 140 micrograms of glutaraldehyde were also submitted along with the field samples for analysis.

Results reported for that batch of samples showed an LOD of 6.0 micrograms/sample and a LOQ of 18 micrograms/sample, higher than the first batch of samples collected in August. The analysis did accurately report the spiked values, however, the amount of glutaraldehyde placed on the samples were substantially higher than what would be expected to be found at the hospital. Due to the floating LOD and LOQ reported with NIOSH Method 2532, it was decided that an alternative method would be needed to assess exposures occurring at or below the OSHA PEL (0.2 ppm ceiling concentration).

On April 22-26, 1991, area glutaraldehyde samples were again collected at the hospital. Sampling was limited to the Special Procedures Room at the Same Day Surgery Center. This was because of the high volume of patient load, the rapid turnover times, and between case disinfecting of surgical equipment using glutaraldehyde. And also, it was observed that most of the cleaning and disinfecting was accomplished in the Special Procedures Room and the potential for exposure was higher there than in other areas which intermittently used glutaraldehyde.

During this visit, glutaraldehyde samples were collected using three methods: 1) OSHA Method 64; 2) NIOSH Method 2531; and 3) a modification to the NIOSH 2531.

1) OSHA Method 64

Fourteen area air samples were collected using OSHA Method 64. Those samples were collected on 37 millimeter glass fiber filters treated with 5% Dinitrophenylhydrazine hydrochloride (DNPH) at a flowrate of 1.0 liter per minute (lpm). Sampling times ranged from less than 30 to 264 minutes.

Each sample was desorbed in 2.0 ml of acetonitrile and analyzed by high pressure liquid chromatography (HPLC) equipped with a diode-array detector. The LOD for this method was 0.1 micrograms per sample and the LOQ was 0.3 micrograms per sample, Therefore these conditions were sufficient for determining short term exposures at or below the OSHA PEL.

2) NIOSH Method 2531

Fourteen area samples were collected using NIOSH Method 2531. Those samples were collected on washed XAD-2 tubes treated with 5% Dinitrophenylhydrazine hydrochloride (DNPH). Samples were collected at a flowrate of 400 cc/min for 30 to 264 minutes. Analysis of the samples was the same as used in the OSHA 64 samples except that 3.0 milliliter of acetonitrile was used to desorb the samples. The LOD and LOQ reported for this method were 0.3 and 0.9 micrograms per sample; respectively; therefore, these conditions should have also been sufficient for determining short term exposures at or below the OSHA PEL.

3) NIOSH Method 2531 (Modified)

Finally, fourteen additional area samples were collected using a modified NIOSH Method 2531. The modification was that the washed XAD-2 tubes treated with 5% Dinitrophenylhydrazine hydrochloride (DNPH) was packed in 13 millimeter diameter glass tubes. This was done in an effort to increase the flow rate through the media and reduce the pressure resistance on the sampling pump. Samples were collected at a flowrate of 1.0 liter per minute for sampling times of 30 to 264 minutes. Analysis was similar as described for OSHA method 64 and NIOSH Method 2531. The reported LOD and LOQ for this method were 0.3 and 0.9 micrograms per sample, respectively. Again, the LOD and LOQ was sufficient for determining exposures at or below the OSHA PEL.

VII. RESULTS

Only the results for the samples collected during the April survey in the Special Procedures Room of the Same Day Surgery Center will be reported, because of the problems previously described with the analytical method.

During the week of April 22-26, 1991, forty two (42) area samples were collected for glutaraldehyde. Samples were collected according to three different methods of analysis. All samples were collected in close proximity to the working location of the nurse cleaning and disinfecting the scopes. Those area samples are expected to represent "worst case" conditions, with personal sampling result expected to be equal or less than the area results.

For each cleaning operation, three sets of samples were collected using the methods previously described. No exposure estimate exceeded the OSHA or ACGIH exposure criteria for glutaraldehyde. Sample concentrations ranged from None Detected (ND) to 0.08 ppm. Table 1 shows the results of that analysis.

VIII. RECOMMENDATIONS

In observing work practices at the Monongalia General Hospital, it appeared that skin adsorption may be a significant means of occupational exposure to glutaraldehyde. Signs posted in operating rooms instructed employees to wear gloves and goggles PRN (whenever necessary). The only gloves available to the employees were latex surgical gloves. Goggles and face shields were available but were not observed being used.

Scopes placed in the soaking basins of glutaraldehyde were manipulated, sometimes above head level, to fit in the soaking basin. This practice typicality resulted in some splashing and often glutaraldehyde would run down the arms of the employee. Also, it was observed that the small syringe and hose used to flush the glutaraldehyde through the scope occasionally would come loose and splash the employee.

These poor work practices could result in a significant skin adsorption of glutaraldehyde. A combination of both glutaraldehyde's low odor threshold (0.04 ppm) and the poor work practices observed could explain the increase in employee health complaints. It also appeared that changing to the more concentrated 2% glutaraldehyde solution increased the frequency of complaints. The most frequently heard complaints during this study were headaches, respiratory irritation, skin rashes, and some finger tingling when working with the glutaraldehyde solution.

Based on the survey results and work practice observations, the following recommendations are offered:

1. Even though the airborne exposure levels are below criteria, employees may still be suffering from the odor of the glutaraldehyde itself or possibly the mint oil added to mask the chemical odor. In either case, if complaints continue, it is recommended that the hospital investigate the feasibility of local exhaust ventilation to control the odors from permeating through the work areas. This is particularly important since the operating rooms should be on a positive pressure ventilation system. The design of a control system should require a face velocity of at least 100 feet per minute, with airflow directed toward the back of the hood away from the operator's breathing zone. This system will require an appropriate amount of filtered and tempered replacement air in order to work properly. This system should be designed by professionals with laboratory ventilation experience.

2. If possible, substitution of materials less hazardous is an excellent way to avoid exposures/contact to the employees and should be investigated for the operations evaluated in this study. If not feasible, then alternative methods other than hand cleaning instruments should be investigated. Some suggestions for alternative methods would be the procurement of sufficient scopes to allow all to be gas sterilized. The use of a portable cleaning system, similar to a typical dishwasher except that glutaraldehyde is used, could reduce or even eliminate employee contact with glutaraldehyde.

3. Personal protective clothing/equipment should be mandatory, not PRN, when handling glutaraldehyde, and a written program on proper use and protective equipment is recommended. Employees who work with glutaraldehyde should be required to wear protective gloves, goggles, impervious aprons and lab coats for the extent of the process. The ACGIH recommends a variety of different materials be used when working with aldehydes. These include butyl rubber and neoprene rubber (described as an excellent barrier with >8 hour break-through). The rubber materials described above should be considered when selecting the appropriate aprons and gloves.

4. Emergency eye wash stations should be installed in all areas which use the glutaraldehyde solution. Skin contact should be avoided and the solution promptly washed off if skin contact is made.

5. The training and education of employees regarding safe work practices is essential to reducing and/or eliminating chemical exposures. Therefore, each employee should be instructed on the potential hazards associated with glutaraldehyde, proper use of personal protective clothing, work practices and avoidance of confined space exposures. Most of this information, as well as recommended personal protective equipment can be found on the Material Safety Data Sheet (MSDS) supplied with the chemical.

6. Air monitoring in all use locations should be performed periodically and records kept of the results. This is especially important if there are any modifications in the operation; that is location or process changes and/or increase in the use of glutaraldehyde.

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1. Monongalia General Hospital
2. OSHA, Region III

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

Table 1.
Glutaraldehyde Sampling Results
Monongalia General Hospital
Morgantown, West Virginia
April 22-26, 1991

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Job Description	Sample Method	Sample Duration (minutes)	Volume (liters)	Glutaraldehyde (ppm)
1. Mixing solution, cleaning 2 scopes. (4/22/91)	OSHA 64	65	65	0.03
	OSHA 64	65	65	0.02
	NIOSH 2531	65	26	0.006
	NIOSH 2531	65	26	0.007
	NIOSH 2531 (m)	65	65	0.02
	NIOSH 2531 (m)	65	65	0.009
2. Cleaning, soaking 2 scopes (4/22/91)	OSHA 64	90	90	0.06
	OSHA 64	90	90	0.06
	NIOSH 2531	90	36	0.02
	NIOSH 2531	90	36	0.02
	NIOSH 2531 (m)	90	90	0.05
	NIOSH 2531 (m)	90	90	0.02
3. Long term samples near soaking basin (4/23/91)	OSHA 64	264	264	0.01
	OSHA 64	264	264	0.01
	NIOSH 2531	264	105	0.008
	NIOSH 2531	264	105	0.006
	NIOSH 2531 (m)	264	264	0.005
	NIOSH 2531 (m)	254	264	0.005

Table 1 (continued).
Glutaraldehyde Sampling Results
Monongalia General Hospital
Morgantown, West Virginia
April 22-26, 1991

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Job Description	Sample Method	Sample Duration (minutes)	Volume (liters)	Glutaraldehyde (ppm)
4. Cleaning and soaking one scope. (4/23/91)	OSHA 64	31	31	0.01
	NIOSH 2531	31	12.4	0.02
	NIOSH 2531 (m)	31	31	0.01
5. Cleaning and soaking one scope. (4/23/91)	OSHA 64	36	36	ND
	NIOSH 2531	31	14.4	ND
	NIOSH 2531 (m)	31	36	ND
6. Cleaning, soaking 2 scopes (4/26/91)	OSHA 64	24	24	0.08
	OSHA 64	24	24	0.07
	NIOSH 2531	24	9.6	0.06
	NIOSH 2531	24	9.6	0.07
	NIOSH 2531 (m)	24	24	0.06
	NIOSH 2531 (m)	24	24	0.05
7. Collected with #6, but near breathing zone.	OSHA 64	20	20	0.06
	NIOSH 2531	20	8	0.05
	NIOSH 2531 (m)	20	20	0.03

Table 1 (continued).
Glutaraldehyde Sampling Results
Monongalia General Hospital
Morgantown, West Virginia
April 22-26, 1991

HETA 90-296

Job Description	Sample Method	Sample Duration (minutes)	Volume (liters)	Glutaraldehyde (ppm)
8. Cleaning, soaking 2 scopes (4/26/91)	OSHA 64	27	27	0.03
	OSHA 64	27	27	0.02
	NIOSH 2531	27	10.8	0.02
	NIOSH 2531	27	10.8	0.03
	NIOSH 2531 (m)	27	27	0.009
	NIOSH 2531 (m)	27	27	0.001
9. Near breathing zone while cleaning 2 scopes	OSHA 64	27	27	0.05
	NIOSH 2531	27	10.8	0.04
	NIOSH 2531 (m)	27	27	0.04

Notes:
All samples collected in the Special Procedures Room of the Same Day Surgery Center.
ND = Not Detected
(m) = Modified method using 13 millimeter diameter sorbent tubes at 1.0 liters per minute.