Laboratory Self-Inspection: A Guide to Effective Safety & Health Auditing

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After reading this article, the reader should be able to understand basic principles of laboratory safety, which include manuals and records as well as physical inspection of the laboratory.

Generalist Exam 0201 questions and answer forms are located after the “Your Lab Focus” section, p. 143.

Safety inspections can be divided into: manuals and records; and physical inspections.

Proper safety requires a strong management team along with proper education and training.

Inspection of laboratories for safety and health issues is essential for the prevention of accidents and injuries. The development of checklists for use in auditing laboratories insures that pertinent areas of the laboratory safety and health plan are fully examined. A framework for conducting a typical laboratory inspection is suggested in this article, and potential checklist questions are presented based on safety and health issues common to a clinical laboratory setting.
Chemical Hygiene Plan Elements:

- Responsibilities of laboratory director and supervisors.
- Designation of a qualified chemical hygiene officer.
- Policies for all operations that involve hazardous chemicals.
- Criteria for the use of personal protective equipment and control devices.
- Criteria for exposure monitoring when permissible levels are exceeded.
- Provisions for medical consultations and examinations.
- A copy of the OSHA Laboratory Standard.
- Provision for training employees in the elements of CHP.

OSHA Substances of Special Interest

- Any substance that is regulated as a carcinogen by OSHA.
- Classified as “known to be carcinogenic” by the NTP.
- Listed as a group I carcinogen by the IARC.
- Has been classified as “reasonably anticipated to be carcinogenic” by the NTP.
- Listed as a group IIa or IIb carcinogen by the IARC. If it meets the toxicological criteria listed in the January 31, 1990 Federal Register, pages 3319–3320.

Hazardous Waste Reduction

- Acquisition constraints (eg, Purchase reagents in small quantities).
- Process changes (eg, Substitute less hazardous reagents for more hazardous ones).
- Recovery (eg, Silver recovery from darkroom fluids, heat recovery from the combustion of waste solvents).
- Recycling (eg, Distribution and reuse of xylene or formalin).
- Redistribution (eg, Relocating surplus or unwanted chemicals to laboratories that can use them).

Laboratory inspections should cover the general safety program for the entire laboratory and must be answered for all laboratory sections. A prepared checklist of general questions is a useful tool to ensure that all pertinent information is gathered during the inspection. Specific questions related to safety features peculiar to an individual section should also be developed and incorporated into the checklist for that section.

The safety inspection should be divided into 2 portions:

The first portion (Manuals and Records) relates to review of documentation. In order to conduct an effective document review, it is helpful if the laboratory staff gathers these documents together for review by the inspector. The second portion (Physical Inspection of the Laboratory) requires direct inspection of the various laboratory areas to observe environmental safety compliance and actual employee practices.

Manuals and Records

Safety procedures must be readily available to all personnel. A system to assure that all personnel have read the procedures, policies, and recommendations should be present, and it should form a portion of the orientation program for new personnel. Policies and procedures must also be established regarding the documentation of all laboratory accidents resulting in property damage or involving spillage of hazardous substances. All serious accidents resulting in fatalities or in the hospitalization of 5 or more employees must be reported to the Occupational Safety and Health Administration (OSHA) within 48 hours. Ideally, policies and procedures should require the reporting of any occupational injuries or illnesses that require medical treatment (more than first aid). When examining records for general safety some of these checklist questions may be helpful:

- Are safety policies and procedures posted or readily available to all personnel, and are these policies and procedures communicated to new employees before they start work?
- Have policies and procedures been developed regarding the documentation of all laboratory accidents resulting in property damage or involving spillage of hazardous substances?
- Have policies and procedures been developed regarding the reporting of occupational injuries or illnesses that require medical treatment (more than first aid)?
- Has an evaluation of these incident and accident reports been incorporated into the laboratory’s quality improvement program to avoid recurrence?

Fire prevention and disaster preparedness are important parts of any laboratory safety program. Exit drills must be conducted to prepare employees to respond safely in case of fire or emergency. The purpose of an exit drill is to educate the occupants about the fire safety features and exits, and to test the efficiency, knowledge, and response of institutional personnel in implementing the facility’s emergency plan. All personnel must participate at least once a year, but a drill may involve only a subset of the personnel in attendance. Interruption of essential laboratory services is not required. In addition to exit drills, there must be documentation that fire extinguisher training has been provided to all personnel working in the laboratory. This training should include hands on operation of extinguishers that might be used in an actual fire. Effective checklist questions include:

- Are policies and procedures documented and adequate for internal and external disaster preparedness?
Is there a comprehensive, documented, and workable evacuation plan, including specific plans for any persons with disabilities?

Are exit drills conducted periodically?

Have personnel been instructed in the use of portable fire extinguishers?

Policies must specify that portable patient care electrical equipment is inspected before initial use, after repair or modification, and when a problem is suspected. Policies and procedures for the safe handling of electrical equipment must be documented and should be a part of new employee orientation.\(^3\)

Are policies and procedures documented and adequate for the safe handling of electrical equipment, and/or has corrective action been taken?

Are employees provided with electrical safety information prior to starting work?

Substance-related accidents and injuries are the most prevalent forms of laboratory mishap. It is essential that the laboratory establish a Chemical Hygiene Plan, or CHP, to inform employees of the hazards they are potentially exposed to on the job. An acceptable CHP must contain several key elements [T1]. Included on this plan should be any OSHA defined substances of special interest (select carcinogens) by National Toxicology Program (NTP), International Agency for Research on Cancer (IARC), and a number of other criteria [T2]. Also included on the plan should be special containment procedures for substances that are reproductive toxins or are acutely hazardous, storage and handling policies for all chemicals used in the laboratory, and prevailing regulations concerning hazardous waste minimization and disposal [T3].

In addition to the CHP, laboratory policies may also need to address procedures for adequate radiation safety, and control of bloodborne pathogens and/or other infectious materials (especially tuberculosis and anti-microbial drug resistant pathogens).

It is the responsibility of the laboratory director or designee to ensure that the laboratory has a documented CHP and other policies that includes these elements, and to define the safety procedures for all hazardous substances an employee may encounter in the laboratory. The laboratory must conduct an annual review and evaluation of the effectiveness of its CHP, and Federal, State or local statutes may mandate periodic review of other substance control policies.\(^4\) Checklist questions for substance control policy include:

- Does the laboratory have a CHP that defines the safety procedures for all hazardous chemicals used in the laboratory?
- Is there an annual review and evaluation of effectiveness of the laboratory’s CHP?
- Is there documentation that each of the chemicals in the laboratory has been evaluated for carcinogenic potential, reproductive toxicity, and acute toxicity; and does the policies and procedure manual define specific handling requirements for these chemicals?
- Is policy and procedure adequately documented for hazardous waste disposal?
- Is there a defined program to reduce the volume of hazardous waste that is generated by the laboratory?
- Is policy and procedure adequately documented for radiation safety?
- Is a program in place to control exposure to bloodborne pathogens, including an OSHA required Exposure Control Plan, and the use of universal precautions?
- Are policies and procedures documented to address engineering controls, spill prevention, personal hygiene, labeling, personal protective equipment, housekeeping, training, and medical surveillance for bloodborne pathogens?
- Is a program in place to control exposure to other biohazards that follow applicable OSHA and National Institutes of Health (NIH) recommendations, as well as those of the Centers for Disease Control (CDC)?

### Physical Inspection of the Laboratory

A random sampling of laboratory workers should be interviewed. The laboratory workers should be able to explain the laboratory safety policy and work procedures adequately, or be able to find this information in a reasonable amount of time. If safety procedures are posted in the laboratory, they should be on a bulletin board or otherwise in an area dedicated to this purpose. Non-safety related materials should not be posted in this area, and dated or superseded materials should not be present.

Employees should know how to exit the building in case of fire or other emergency, and should know where to gather once outside without having to consult the fire bill. Employees should be able to describe the use of fire extinguishers, fire blankets, fire pulls, and other fire safety equipment provided to them. If a first aid kit or first aid supplies are present, employees should be able to adequately explain how to use its contents. As a minimum, all laboratory workers should be CPR certified.

An inspector should ask to see the Materials Safety Data Sheet (MSDS) for any hazardous materials used in the laboratory. A MSDS should be present for each hazardous material present, and they should be organized so that the staff can readily access them.\(^5\) The staff should be able to find specific safety and health information on any MSDS that they possess in a reasonable amount of time. Evaluation questions for staff knowledge are:

- Are safety policies and procedures posted in a readily accessible manner?
- Are personnel knowledgeable in the laboratory safety policies and procedures?
- Are employees competent to provide first aid if required?
- Are employees familiar with evacuation procedures?
- Are personnel knowledgeable in the use of fire safety equipment?
- Is MSDS information available to laboratory employees?
- Are employees able to read a MSDS?

An inspector needs to ensure that a Ground Fault Interrupt (GFI) is present on outlets used to connect laboratory equipment.
equipment, that outlets are installed at least every 3 feet on laboratory benches, and that power strips are not “daisy chained” together. An inspector also needs to examine equipment electrical cords for frayed insulation or missing ground plugs. An examination of laboratory glassware should search for cracks or other signs of fatigue (especially if it is to be used under vacuum or extreme temperature). Inspections should ensure that centrifuges are equipped with either an automatic stop or interlock, or that they are posted with a clear warning not to open until the mechanism stops spinning. Inspections should ensure that hot plates and heating mantles have a functional warning light to indicate that they are on. An inspector needs to inspect flammable, corrosive, and hazardous materials storage areas for chemical compatibility and ensure that employees are familiar with the instructions for every piece of equipment that they are expected to use. An inspection needs to ensure that glassware is not stored above waist height on open shelves, and that heavy pieces of equipment are not stored where they can drop on a laboratory worker’s head. An inspection needs to ensure that all compressed gas cylinders are secured by means of a strap at the top and bottom and equipped with a safety collar or a cap when not in use. An inspector needs to inspect chemical containers to ensure that labels indicate, at a minimum, the contents and whether it is hazard. An inspector needs to ensure that containers are designed and constructed to be compatible with their contents. An inspector should observe the employees handling chemicals and make sure that chemicals are decanted so as to minimize spillage.

An inspector needs to ensure a grounding strap is used whenever pouring large quantities of flammable material from a conductive container, such as a metal drum. The following checklist questions cover inspection of the facility:

- Are chemicals handled safely?
- Are electrical hazards present in the laboratory?
- Is laboratory equipment safe to operate?
- Are laboratory equipment handled and stored safely?
- Are chemicals stored safely?

An inspector should observe employees performing operations that may require special procedures, such as phlebotomy and tissue fixing, and note if policies and procedures are being followed. An inspection should also note if gloves and any other required protective clothing are properly utilized. Extremely toxic, infectious, carcinogenic, or mutagenic materials should only be handled under negative pressure. All laboratory hoods and biosafety cabinets should be inspected to ensure that these units have been performance tested during the previous year, that they are functioning properly, and that employees are familiar with their operation.

If respirators are used to protect laboratory workers from hazardous airborne contaminants, each employee must have a physician’s written opinion, stating that they are physically able to wear the respirator provided without serious health effects. Employees must be trained to use any respirator provided to them and must be fit tested prior to working in areas where respirators will be required. This examination must be repeated annually,6 or more frequently if deemed necessary by the laboratory safety manager. The laboratory safety manager should maintain a log of all laboratory workers who were fit tested in the previous year. Checklist questions for employee practice include:

- Are special procedures defined in the chemical hygiene plan, and if so, are the employees following them?
- Are the employees wearing all personal protective equipment, and following recommended procedures whenever required by laboratory policy?
- Are employees using respiratory protection, and are they medically qualified, properly trained, and adequately fit tested?
- Is process control ventilation used where required, and is it both adequate and functioning properly?

After an inspection, the laboratory safety officer should track any noted deficiencies, and the responsible parties should be assigned the task of correcting them. Adherence to a rigorous program of laboratory safety inspections can identify and prevent problems before they occur. In addition to protecting the health of laboratory workers, such a program can substantially reduce lost time and increase productivity.

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