Contents

Personal Health & Safety and Risk Mitigation as a Medical Student

Background: Healthcare providers, including medical students, have inherent risks including exposure to sharp instruments, contagious diseases, hazardous chemicals, toxins, and radiation. Additionally, some individuals may be at increased risk due to underlying acute or chronic medical conditions, pregnancy, trying to become pregnant, or breastfeeding. Strategies exist to mitigate these risks in healthcare and educational settings and are an important part of lifelong personal risk management as a healthcare professional.

Reporting Injuries/Exposures: While best practices and training are used to minimize and mitigate risks of injury in healthcare settings, accidents can still happen and should be reported as soon as feasible. The priority in any accident situation is to stabilize the injured person, which may involve special washing or management instructions which are posted for necessary locations, and then seeking medical attention appropriate for the injury (e.g., band-aid for a minor injury, Student Health services or personal provider at the individual's discretion, visiting urgent/emergency room, or call 911 for any life-threatening serious injury). Information about

Student Health, including hours, location and contact information is found https://www.umaryland.edu/studenthealth/student-health-center/.

Use the incident reporting form at

https://secure.ethicspoint.com/domain/en/report_information.asp?clientid=28588&override=yes&agreement=no&companyname=University%20of%20Maryland%2C%20Baltimore&violationtypeid=89798&locationid=-1

to report an injury event once the immediate clinical care need has been addressed. This report will alert Environmental Health and Safety (EHS), so they can address any unsafe conditions and track injuries.

ANATOMY LABORATORY:

Risks

Anatomy laboratories represent an environment with physical, chemical, and biosafety risks. Students should be aware of potential risks and be familiar with risk mitigation strategies. Compliance with all anatomy laboratory safety procedures and personal protective equipment (PPE) standards of the lab are a requirement of working within the anatomy laboratory. Failure to comply with all directed safety procedures can result in elevated risk of personal injury or may place others at risk of injury. Unsafe laboratory conduct may result in disciplinary action.

The primary risks in the anatomy laboratory are sharp instruments and formaldehyde exposure.

Sharps Injury: In the anatomy laboratories students will be working with sharp instruments (scalpels, scissors, probes, needles, etc.) that represent a risk of physical injury and biohazard exposure, i.e., a 'needle-stick' injury. The risk of infection from embalmed human tissue is exceedingly low to non-existent, however universal personal PPE precautions and compliance with safe sharps handling procedures are important in preventing injuries and are good practice for clinical settings where the automatic observance of biosafety precautions may prevent serious infectious exposure.

Chemical Hazard (Formaldehyde): Formaldehyde (including variants such as urea-formaldehyde and phenol-formaldehyde) are naturally occurring molecules present in some foods and are also formed during combustion reactions such as fire or cooking. Formaldehydes are also commonly used by industry including within many adhesives, resins, and some hair products. In the medical setting, formaldehydes and derivatives are used as tissue preservatives and microbial sterilizers. Formaldehydes are one of several factors contributing to the characteristic odor of the anatomy laboratory.

High concentrations of formaldehyde are hazardous to human health with a variety of possible reactions depending on route of administration and variation between individuals.

Formaldehyde is a known chemical hazard exhibiting potential carcinogen, teratogen, irritant, and chemical sensitizer properties. Allowable exposure limits for formaldehyde are established by the federal Occupational Safety and Health Administration (OSHA). OSHA established a permissible respiratory short term exposure limit (15 minutes) of 2.00 ppm (STEL) and a time-weighted average (over an 8-hour period) exposure limit of 0.75 ppm (TWA) in the Federal Code of Regulations 1910.1048. The UMSOM anatomy laboratories are monitored by independent testing on a regular basis to ensure student/faculty exposure is maintained below the OSHA limits. The most recent testing (November 2024 and January 2025) recorded an average STEL value of 0.06 ppm (range 0 ppm to 0.21ppm) and an average TWA value of 0.09ppm (range 0.062-0.153 ppm), both well under the OSHA permissible exposure limits.

Respiratory: Inhalation of formaldehyde at or above OSHA safe short-term exposure levels of 2 ppm can cause irritation to the mouth, nose and throat including inflammation, runny nose, or burning sensations. Exposure above 25 ppm may lead to pulmonary edema and acute respiratory distress. Exposures greater than 100 ppm are immediately dangerous to health and life-threatening. In sensitized individuals, inhalation exposure at concentrations as low as 0.1 ppm may cause respiratory reactions such as asthma, bronchitis, or chest tightening.

Oral: Ingestion of high concentrations of formaldehyde can cause irritation of the mouth, throat, and stomach leading to nausea, vomiting, convulsions, coma, and death. There are no high concentration solutions present within the anatomy laboratory.

Skin: Acute contact with high concentration formalin causes white discoloration, burning sensation, dryness, and scaling of the skin. Formaldehyde is also a contact sensitizer, with repeated dermal exposure potentially sensitizing some individuals to developing allergic dermatitis, tingling, or numbness of the exposed skin even at relatively low concentrations.

Eyes: Concentrations at 3 to 5 ppm or via direct contact may cause eye irritation including burning sensations, blurry vision, and potential loss of vision at higher concentrations. Eye exposure can have delayed effect, not appearing until minutes to hours after initial contact. Some brands of soft/disposable contact lenses are capable of absorbing formaldehyde and, if used, should be washed after exposure.

Fetal/Infant exposure: Formaldehyde has carcinogenic and teratogenic effects in animal models when high blood concentrations are reached. Absorbed formaldehyde is also eliminated more slowly from fetal than maternal tissues in animal models. OSHA has not established separate exposure limits for individuals who are pregnant or breastfeeding, however epidemiology data on formaldehyde exposure to individuals within these categories is sparse and precautionary enhanced protective measures may be warranted.

<u>Chemical Hazard (phenol):</u> Phenol is an aromatic organic compound used in many products including plastics, disinfectants, mouthwashes, and can be found in the environment. In the medical setting, phenols are used in tissue preservatives, disinfectants and in various solvents.

Trace elements of phenol are present in the embalming fluids and wetting agent in the anatomy laboratory. Phenol compounds even at very low concentrations exhibit a strong, sweet, tarry odor and these are another of the other compounds contributing to the aroma of the anatomy laboratory.

High concentrations of phenol are hazardous to human health with a variety of possible reactions depending on route of administration. Phenol exposure can occur via absorbtion through the skin, inhalation or ingestion. Exposure can cause caustic-like burning, eye damage, respiratory irritation, pulmonary edema, and internal injury to organs including liver, kidney and neuronal tissues.

Exposure limits for phenol are set by OSHA in the Federal Code of Regulations 1910.1000 Table Z-1 consisting of a maximum of 5 ppm TWA. There is no STEL. The most recent testing (November 2024) reported phenol levels below the detection threshold of the instrumentation registering a constant 0.00 ppm TWA value.

Risk Mitigation

All workplace and educational settings contain risks that can be mitigated with awareness (this document), training (provided prior to or at each setting), and personal protective equipment suitable for the specific hazards within each environment.

Sharps injury: All students are required to watch the training videos and documents on safe sharps handling prior to the first anatomy lab session in which scalpels and/or needles are in use. These safety briefings are linked in the pre-reading/viewing materials with each laboratory session. Additionally, faculty observe sharps handling throughout laboratory sessions and will intervene to direct safe handling procedures as required.

Formaldehyde exposure: The respiratory environment, i.e., air quality, is maintained by the building air handling infrastructure at a level determined as safe by OSHA. Contact protection is achieved within the laboratory wearing personal protective equipment and following procedures as laid out below in the 'standard anatomy laboratory PPE and procedures' section.

Persons at Increased Risk: Some individuals may be at elevated risk including, but not limited to:

- Students who have acute or chronic medical conditions where personal healthcare providers recommend enhanced protection
- Those previously sensitized to formaldehyde
- Anyone experiencing respiratory or contact symptoms when in the anatomy laboratories
- Those who are pregnant, trying to become pregnant, or breastfeeding.

Individuals within any of these elevated risk categories should consult with their personal providers regarding potential risks and possible enhanced risk mitigation strategies. This document and discussion with the anatomy laboratory director are good sources of information to take to your provider for options that may be suitable for specific student situations. Students may also wish to consult with the UMB Educational Support and Disability Services for potential accommodations. While there is currently no evidence in the literature to suggest that exposure to the chemical environment of the gross anatomy laboratory following the exposure limits established by OSHA is associated with an increased risk for individuals trying to become pregnant, who are pregnant, developing fetuses, or while breastfeeding, a lack of evidence does not necessarily mean that an elevated risk does not exist and these individuals should also consult with providers and consider seeking accommodations if needed.

Standard anatomy laboratory PPE and procedures

All students must wear the standard PPE and follow standard procedures described here and during the laboratory orientation session. Gloves, face shields/eyewear and washing stations are in the anatomy laboratory and will be introduced during the laboratory orientation session.

Attire: The only acceptable personal attire in the anatomy labs are scrubs, which may be of any standard medical style and must be provided by the student. Footwear must be provided by the student and cover the entire foot, with shoes or sneakers permitted. Open-toed shoes or sandals are prohibited in the laboratory. Changing rooms are available near student lockers within the building.

Eyewear: Face shields or protective eyeglasses must be always worn when working with donors or solutions that contain formaldehyde or phenol. Face shields are provided by UMSOM in the anatomy laboratory, with several alternative styles of eye protection available if the standard style is uncomfortable or does not fit. Training videos on how to assemble different types of face shields are linked to within the pre-readings for the first laboratory session.

Gloves: A pair of disposable gloves must be worn any time donors or items contaminated with embalming fluid are handled. UMSOM provides powderless Nitrile gloves in the anatomy laboratory. Compared to latex gloves, nitrile is less porous, more puncture resistant, and less allergenic. However, many types of gloves including both latex and nitrile contain manufacturing rubber accelerator chemicals to which some individuals may be allergic. Contact allergen responses can be mitigated with enhanced PPE (see below).

Handwash: At the conclusion of a session in the anatomy laboratories, students must wash hands and forearms with soap and water at one of the handwash stations within the lab.

Enhanced anatomy laboratory PPE (in addition to the standard PPE)

Individuals at elevated risk may be recommended by the faculty or their personal medical provider to use enhanced PPE. The enhanced PPE below is in addition to all the standard PPE

above (i.e., the standard and enhanced are worn together). Students with recommendations for enhanced PPE should see the anatomy laboratory course director to receive the additional materials and procedures on how to utilize them correctly.

Gloves: Individuals who are contact sensitized to formaldehydes may experience tingling or numbness of their fingers even when wearing Nitrile gloves, as traces of formaldehyde can slowly penetrate synthetic (Nitrile) or natural (latex) polymer gloves. Those with contact allergies to nitrile or to the accelerants used in manufacturing gloves may experience itching or redness of their hands. To provide enhanced contact protection, individuals in risk categories or with contact allergies should first coat their hands with a commercial industrial protective barrier cream and then wear Nitrile gloves.

Industrial barrier creams create a thin protective layer on hands, guarding the skin under the glove from direct contact with the sensitizing or irritating agent in the gloves. UMSOM provides several types of industrial barrier cream for use in the anatomy laboratory for individuals needing enhanced protection.

Individuals with highly sensitive contact allergic reactions, potentially to the barrier creams themselves, may need consultation with the Division of Occupational and Environmental Medicine (OEM) to explore personalized approaches in cases where the usual enhanced mitigations prove ineffective. Contact OSA to organize an OEM consultation.

Respiratory: Regular face coverings (cloth or surgical masks, KN95, N95, etc.) are ineffective at preventing penetration of formaldehyde through the mask, and thus are not suitable for enhanced respiratory protection. For enhanced protection, chemical filter devices (aka respirators) are worn. Chemical respirators remove embalming chemicals from inspired air by passage of the air through absorbing filters in the respirator cartridges.

UMSOM will provide a chemical respirator and cartridges. Students must be fit-tested for the respirators by Environmental Health and Safety (EHS), a process that requires advance scheduling. Students needing respirators should contact the anatomy laboratory course director as far in advance as possible to collect respirators and receive fit testing prior to starting or continuing within the anatomy lab. Contact OSA to organize an EHS consultation.

For most students, one set of filter cartridges will last through the entire academic year. Filter cartridges should be replaced after each study year, i.e., new filters for the MS1 and the MS2 semester. Filter effective duration is estimated at ~100 laboratory exposure hours per filter set. Following a typical study schedule that consists of approximately 45 scheduled laboratory hours, plus up to 55 hours self-study time. Students exceeding 100 laboratory exposure hours in the semester, or who start to detect the laboratory odor through the filter, should request a new filter from the anatomy laboratory course director. Students are responsible for storing and maintaining the respirator according to the manufacturer's instruction sheet. Storing the respirator in a large zip-lock bag between laboratory sessions will help keep it clean during storage in lockers and extend the filter life.

HEALTHCARE SETTINGS:

Students should be aware of a variety of potential hazards when working in the healthcare setting. For pre-clerkship students, the opportunities for injury or illness are more limited than for students in clinical rotations, who are engaged in additional entrustable hands-on care.

In general, all students should follow posted signage and direction of clinical staff in all clinical settings regarding potential risk and risk mitigation including the use of Personal Protective Equipment. Personal Protective Equipment is available to students at all clinical sites. Questions regarding risk, risk mitigation, or access to Personal Protective Equipment may be directed to supervising residents and attendings as well as nurse managers at the clinical site. Concerns can be brought to SOM Office of Student Affairs and/or reported through UMMS Safe or at the VA through the Joint Patient Safety Reporting System.

Following are some of the common risks, along with management and mitigation information.

1. Contagious diseases
    a. Immunizations against infectious pathogens are a key strategy in infection prevention, particularly for healthcare workers. Students are required to follow the UMB Immunization Policy (https://www.umaryland.edu/studenthealth/immunization-requirements/) which includes immunization requirements based on Maryland law and the public health recommendations from the Centers for Disease Control and Prevention. Clinical sites may require additional immunizations, such as COVID and Influenza. Students may receive vaccinations at UMB Campus Health. Compliance with the immunization policy is monitored through Student Health; and students may request medical or religious accommodations through them. Non-compliance may result in a disruption of coursework or rotations.
    b. Handwashing and other infection prevention measures. Hand hygiene is an essential strategy in reducing infectious risk in the clinical setting and should be performed before and after every patient encounter. Personal Protective Equipment is also used in specific settings to reduce risk of infection. Patients known to have communicable infections will generally be identified with

instructions related to prevention of transmission. Follow the posted instructions and direction of clinical staff about personal protective gear, which may include need for gowns, respirators, gloves, etc. These decisions are made based on Infection Control Plan protocols, related to how the given infection is spread (e.g., by contact, by breathing aerosols, etc.) Learn more about UMMC Infection Prevention protocols (https://www.umms.org/bwmc/patients-visitors/for-patients/infection-prevention).

c. Bloodborne Pathogens (BBP). BBP include HIV, Hepatitis B and Hepatitis C – these can be transmitted in a healthcare setting via injury with a contaminated sharp implement (e.g., needlestick) or via splash from potentially infected material to the mucous membranes. There is separate training on BBP during Practice of Medicine I and Practice of Medicine III: Introduction to Clerkships. . Any exposure event should be reported promptly to the UMB Student Health Blood Borne Pathogens Exposure Hotline at 667-214-1886. While each clinical site has an exposure hotline, students should use the UMB Student Health BBPE Hotline to avoid out of pocket costs associated with testing. Experts from the hotline will review the exposure event and make recommendations regarding post-exposure prophylaxis (medication to help prevent infection). Post-exposure prophylaxis is most effective if started within a couple of hours of exposure. More information regarding BBPEs and reporting (https://www.umaryland.edu/studenthealth/urgent-needs/blood-borne-pathogens-exposure/).

d. Tuberculosis. Baseline TB testing is required upon entry, followed by annual TB symptom screening. For students, this is provided by Student Health and the baseline TB test can be scheduled via the link at https://www.umfpi.org/immed-care-covid-d.

    i. If you have a positive tuberculosis skin test or blood test (IGRA) at baseline, this usually indicates latent tuberculosis, for which treatment may be indicated. Student Health will address this with you.

    ii. Note that post-exposure testing may also be needed in the unlikely event that you are exposed to someone with active TB and were not adequately protected (this typically happens only if the TB is initially not recognized). Student Health would coordinate this follow-up testing. If you learn of such an exposure, please report this to Student Health for follow-up.

2. Respiratory protection

    a. Respirator use may be required in the clinical setting to prevent against certain disease spread through the respiratory route such as Pulmonary Tuberculosis, COVID, among others. All students are fit-tested for an N95 respirator annually and will receive training on respiratory protection. Fit testing is coordinated through the Office of Student Affairs in conjunction with UMB Environmental Health Services. Medical clearance (OSHA Form) is required prior to fit testing and is performed at UMB Student Health. N95 respirators are available for

student use at each clinical site. If you are unable to access appropriate Personal Protective Equipment, including an N95, please contact the Office of Student Affairs immediately for assistance.

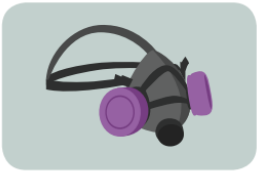
b. Types of respirators and indications
    i. N-95 respirators are considered filtering facepiece respirators. They are the type you will most commonly use in healthcare settings. They are only useful for filtering out particles, so would not be helpful with exposure to vapors (such as formaldehyde). They require a tight face seal to work, so are not effective if facial hair is present. There are several different brands and sizes, and it may take a few tries to get the right one for your face. Fit testing is used to make sure you have one that will protect you. People with asthma or other respiratory conditions may find it difficult to use these. Follow instructions at your clinical site about disposal or storage options.

Filtering Facepiece Respirators are disposable half facepiece respirators that filter out particles such as dusts, mists, and fumes. They do NOT provide protection against gases and vapors.

    ii. For those who cannot use an N-95, a powered air-purifying respirator (PAPR) may be an alternative. This filters air through a battery-powered pack and delivers the filtered air to your face via a tube connected to a hood. A PAPR can be used for many types of hazards, with the appropriate filter (different filters for different hazards including vapors such as formaldehyde are available).

Powered Air-Purifying Respirators (PAPRs) have a battery-powered blower that pulls air through attached filters, canisters, or cartridges. They provide protection against gases, vapors, or particles, when equipped with the appropriate cartridge, canister, or filter. Loose-fitting PAPRs do not require fit testing and can be used with facial hair.

    iii. An elastomeric half-face respirator can be fitted with different types of cartridges, for filtering particles, vapors, gases, fumes. This needs to be fit-tested. It has been used for infectious disease protection when N-95 respirators were scarce, and for pathogens needing a higher level of protection, like Ebola (which you will not be expected to deal with).



Elastomeric Half Facepiece Respirators are reusable and have replaceable cartridges or filters. They cover the nose and mouth and provide protection against gases, vapors, or particles when equipped with the appropriate cartridge or filter.

3. Risk identification and mitigation
    a. Healthcare activities
        i. Radiation exposure. Most healthcare workers are not exposed to enough radiation to warrant monitoring. However, for those who are working near radiation, including X-rays, more than in passing, monitoring via a

badge may be needed. Individuals are required to obtain and wear radiation badges to monitor exposure if they:

- •Operate fluoroscopic x-ray units or work in areas where fluoroscopic x-ray units are used
- • Operate therapeutic x-ray units
- • Engage in interventional radiology activities
- • Engage in interventional cardiology activities
- • Administer radiopharmaceuticals to patients (e.g., radiation oncology rotations)
- • Work in research labs with certain radioactive materials, as indicated by license conditions

If you think you are in a situation where this applies to you, and you have not been given a badge, instructions, and training please contact our Radiation Safety Officer, Nick Wellnitz (nwellnitz@umaryland.edu)

ii. Chemotherapy exposure. There are many hazardous drugs used in the hospital wards and in some practices treating cancer. Some of these can be absorbed through the skin. The risk also relates to spills in administering, local contamination and excretion. Follow signage and pay attention to instructions related to glove use and handwashing.

b. Research activities. As a student, you may be involved with laboratory or clinical research with a variety of potential hazards. There will usually be detailed instructions about safety, and sometimes special training. If you do not receive this training or if you still have questions, please contact EHS.

i. Chemical hazards – The Chemical Safety Officer is Simone Houng (simone.houng@umaryland.edu).

ii. Radiation hazards – The Radiation Safety Officer is Nick Wellnitz (nwellnitz@umaryland.edu).

iii. Animal work hazards – The Lab Animal Exposure Risk Assessment Program manager is Dr. Sammy Almashat (salmashat@som.umaryland.edu).

iv. Biological hazards – The Biosafety Officer is Matt Fischer (matthew.fischer@umaryland.edu).

4. Helping with health concerns. Your primary resource for help with health concerns will be Student Health. Additional resources are Dr. Marianne Cloeren (mcloeren@som.umaryland.edu), who is a specialist in Occupational and Environmental Medicine, and Steve Deck (sdeck@umaryland.edu), who is the Director of Public and Occupational Health. Concerns that arise from time to time have included:
   a. Symptoms related to school activities (e.g., formaldehyde in anatomy)
   b. Exposure event other than BBP (addressed above)
   c. Safety concerns in pregnant individuals.
5. International travel. Students traveling internationally for a UMB-sponsored project Should work with the UMB Center for Global Engagement (https://www.umaryland.edu/global/) regarding unique personal safety risks associated

with international travel. Additional resources can be found at UMSOM Global Health (https://www.medschool.umaryland.edu/osa/Global-Health/).

AVAILBLE RESOURCES:

Personal Providers – Students should consult with their personal providers regarding unique risks to them in the healthcare setting and the anatomy laboratory. This consultation may include a discussion of potential risk/exposures as well as risk mitigation strategies. Your provider may also assist in identifying suitability to wear enhanced PPE if needed. Students also have access to healthcare and health consultation through the UMB Student Health.

Anatomy Program Director – An important resource in the Anatomy Laboratory for any student who wishes to review risks and risk mitigation strategies is the program Director. The Director is knowledgeable about identifying specific standard or enhanced PPE effectiveness in the anatomy labs and assisting on access to supplies/resources provided by UMSOM.

Office of Student Affairs – OSA Deans are available to provide guidance and advice to students, review policies and procedures, and serve as student advocates.

UMB Educational Support and Disability Services – Works with and supports students with disabilities, acute and chronic medical conditions, and pregnancy. Accommodations may be requested through ESDS.

Occupational Safety and Health Administration – Additional information on both healthcare and other workplace related risks and mitigation is available at the federal Occupational Safety and Health Administration website (https://www.osha.gov/)