Hazard Alert for Ultraviolet Germicidal Lamps Used in Biosafety Cabinets

FACT SHEET 24-015-0316

Introduction: Biosafety cabinets used in medical and biological research allow workers to safely work with contaminated objects. Some of these cabinets use ultraviolet (UV) germicidal lamps to disinfect contaminated objects and surfaces. An example of such a biosafety cabinet with germicidal lamp is shown in Figure 1. These lamps pose an eye and skin hazard, but can be used safely when workers take appropriate precautions.

What is UV radiation? UV radiation, like visible light, is a type of electromagnetic radiation. UV radiation is present in sunlight, in mercury vapor lamps, in welding and cutting arcs, in tanning lamps, and other types of lamps.

How is the UV radiation in germicidal lamps different from the UV radiation in sunlight? The solar UV radiation that reaches the Earth is mainly in the UV-A and UV-B range (UV-A: 315 nm – 400 nm, UV-B: 280 nm – 315 nm). UV germicidal lamps emit mainly at 254 nm in the UV-C range (UV-C: 100 nm – 280 nm), which is not visible, and also some visible blue and violet light. The most widely used UV germicidal lamps are "ozone free" low pressure mercury vapor lamps.

What is the hazard from the UV germicidal lamps used in biosafety cabinets? The UV-C radiation from germicidal lamps can cause a corneal swelling (i.e., photokeratitis, also known as "welder's flash"). The feeling can range from a minor "foreign body" sensation to significant pain. It may also cause skin erythema, more commonly known as "sunburn." Though painful, these symptoms are usually gone within 24-48 hours with no lasting effects afterward.

Biosafety cabinets not only use powerful UV lamps, but they use reflective metal surfaces to increase the scattered UV radiation inside the cabinet. This makes the germicidal lamp more effective, but also increases the hazard. Older cabinet designs include UV-blocking panels that only provide partial protection from direct and scattered UV radiation (see Figure 2). More modern designs include a protective sash that completely blocks the UV radiation, and the germicidal lamp will not operate unless the sash is closed.

Figure 1. Biosafety cabinet with operating UV germicidal lamp. Direct and reflected exposures can be hazardous.

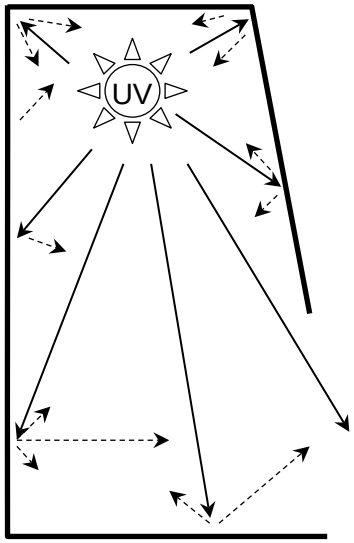

Figure 2. Schematic diagram showing the hazard from direct and scattered UV radiation for older designs of biosafety cabinets.

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Finally, the UV germicidal lamps used in biosafety cabinets look like common fluorescent lamps, and emit small amounts of visible light. They are usually not very bright to look at, and this lulls workers into complacency and increases the risk for injury. Again, the hazardous UV radiation is not visible.

Can UV-C radiation increase my long-term risk for skin cancer or cataract? In theory? Yes. But is it a realistic risk compared to the UV radiation from sunlight? No.

UV-C radiation is considered a cancer risk for the same reasons that it is an effective germicidal agent. But, UV-C radiation doesn't penetrate the skin and eye tissues nearly as deeply as the UV-A and UV-B radiation in sunlight. Daily solar UV radiation exposure poses a much greater risk.

The International Agency for Research on Cancer and the International Commission on Illumination both maintain that the main source of UV-related risk for skin cancer and cataract is outdoor sunlight.

What control measures are recommended?
Engineering controls are preferred. These should include:

(1) Ensuring that only "ozone free" UV lamps are used.
(2) Labels to identify the activation switch for the UV germicidal lamp.
(3) Prominent warning labels on the biosafety cabinet to identify the hazard and inform workers.
(4) For cabinets without a protective sash, temporary warning signs should be in place while disinfection is in progress and exposures are possible.
(5) Dispose of UV germicidal lamps in the same manner as workplace fluorescent lamps.

Administrative controls should include:

(1) Standing operating procedures (SOPs) should be developed that explain the hazards, outline the control measures, and provide methods to report accidents or defective equipment.
(2) Education and training. All workers who might gain access to the lamps should be informed regarding the hazard and trained in the SOPs.
(3) Authorized access only. For cabinets without a protective sash, ensure that no one is present in the room while the lamp is operating. If workers must be present during this time, then contact the Army's Nonionizing Radiation Program to evaluate the UV hazard in the vicinity of the cabinet.

Personal protective equipment is recommended when exposures near the lamp cannot be avoided:

(1) To protect the eyes, use UV-protective face shields or wraparound goggles. Protective eyewear using common plastics and glass will provide adequate protection.
(2) To protect the skin, use face shields, gloves (e.g., work gloves, nitrile gloves), and clothing with tightly-woven fabrics.

Where can I get additional information, or report a suspected overexposure? In the event of a known or suspected overexposure, contact the following as soon as possible after getting the accident victim immediate medical attention:

(1) Your installation radiation safety officer.
(2) The Army's NRP at DSN 584-3932; commercial (410) 436-3932.
(3) The Army's Tri-Service Vision Conservation and Readiness Program at DSN 584-2714; commercial (410) 436-2714.