Just the Facts
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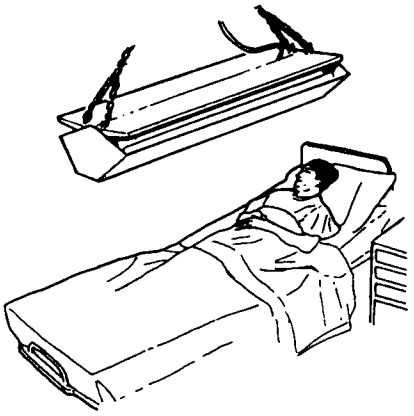
U.S. Army Center for Health Promotion and Preventive Medicine

Use of Germicidal Ultraviolet Lamps to Prevent Tuberculosis Transmission in Medical Facilities



- **Healthcare Facilities**
- **Information/Guidance**
- **TB Prevention by UV Light**

The use of germicidal ultraviolet (UV) lamps (wavelengths of 100-290 nanometers [nm]) to prevent tuberculosis (TB) transmission in medical facilities is controversial. Because of recent renewed interest in overhead UV lamps, the operators of an increasing number of high risk facilities are choosing this intervention to provide needed additional protection. Ultraviolet lamps are low pressure mercury vapor lamps that emit UV and visible radiation. Over 95 percent of the radiant energy is emitted at a wavelength of 253.7 nm, which is near the optimum for inactivating microorganisms.

The two most common types of UV installation are wall- or ceiling-mounted room fixtures for disinfecting the air within a room and irradiation units for disinfecting air in supply ducts. Wall- or ceiling-mounted fixtures act by disinfecting upper room air, and their effectiveness depends in part upon the mixing of the lower portion of the room to within the range of the UV radiation from the fixtures. These fixtures are most likely to be effective in locations where ceilings are high, but some protection may be afforded in areas with ceilings as low as 8 feet. To be maximally effective, lamps should be left on day and night.

Installing UV lamps in ventilation ducts may be beneficial in facilities that recirculate the air. Ultraviolet exposure of air in ducts can be direct and more intense than the radiation from room fixtures and may be effective in disinfecting exhaust air. Duct installations provide no protection against TB transmission to any person in the room with an infectious patient. As with high efficiency particulate air (HEPA) filters, UV installations in ducts may be used in general use areas but should not be used to recirculate air from a TB isolation room back into the general circulation.

The main concern about UV lamps is safety. Short-term overexposure to UV irradiation can cause keratoconjunctivitis and erythema of the skin. However, with proper installation and maintenance, the risk of short-term overexposure is low. Long-term exposure to UV irradiation is associated with increased risk of basal cell carcinoma of the skin and with cataracts of the eyes. To prevent overexposure of healthcare facility personnel and patients, UV lamp configurations should meet applicable safety guidelines.

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For settings in which the risk of TB transmission is high, UV lamps have been used to supplement ventilation. The decision to use UV lamps should be made on a case-by-case basis. Ultraviolet lamps are not recommended for use in small rooms or booths where nebulizing devices will be used.

Users of UV lamps should be aware that environmental factors (such as ventilation design and operation and restrictions on lamp use in order to control occupant exposure) may limit the ability of UV lamps to inactivate airborne microorganisms and thus to protect people from airborne infectious agents.

Proponents of UV lamps for air disinfection cite epidemiological studies in classrooms, military housing, and hospitals as evidence that UV lamps reduce acute respiratory infections. Prevention of TB through the use of UV lamps has been reported in studies on animals housed within a hospital's air exhaust system. However, experiments have not shown that UV lamps furnish the same protection as good ventilation.

There are reports that UV irradiation for aerosol disinfection has been impressive in the laboratory, but considerably less effective in practical applications. Among the possible explanations are:

- Lower sensitivity to 254-nm radiation for ambient airborne microorganisms than for laboratory-generated aerosols.
- The difficulty of achieving microbicidal irradiance levels in occupied rooms without overexposing people.
- The difficulty of obtaining adequate exposure times given the effects on aerosol movement by natural and mechanical ventilation.

Within a room, air mixing is affected by the locations of supply air diffusers and exhaust air grilles, supply air temperature, open windows and doors, and ventilation system operation.

To maximize air disinfection it is desirable to use the highest achievable level of room irradiation. However, 254-nm radiation can damage plants, fade paints and fabrics, and accelerate the deterioration of some materials. Short wavelength ultraviolet radiation (UVR) (between 200 and 300 nm) is absorbed by the outer layers of the skin and the eyes.

In light of the exposure to 254-nm radiation that National Institute for Occupational Safety and Health (NIOSH) investigators measured in healthcare facilities, NIOSH recommended that UV lamps not be used indiscriminately and that worker exposure to these sources be reduced to the lowest feasible level. If UV lamps are installed, an experienced person should measure occupant exposure, instruct the workers on how to recognize the symptoms of overexposure, and train the staff members who will maintain the lamps. Infection control experts recommend using all available precautions for preventing the transmission of TB. Ultraviolet lamp users should evaluate carefully the benefit that they can expect to derive from this intervention. Do not overlook other environmental control measures such as exhaust and dilution ventilation and air cleaners.

Attempts to deactivate viruses with UV light and chemical spray have not proved to be reliable or effective enough to be recommended by most codes as the primary infection control measure for viruses or bacteria. Isolation rooms with appropriate ventilation-pressure relationships is the primary infection control method used to prevent the spread of airborne viruses in the hospital environment.