

# Engineering Controls for Tuberculosis: Upper-Room Ultraviolet Germicidal Irradiation Guidelines

## Peer Reviewers' Comments

### Specific Questions

*1. Is the guideline provided for average UVGI intensity (30-50  $\mu\text{W}/\text{cm}^2$ ) in the upper-room air appropriate? Would it be better to use a minimum average intensity (e.g., 30  $\mu\text{W}/\text{cm}^2$ )? Would some other guideline be more useful?*

In general, the reviewers thought it was useful to have a specific guideline for upper-room average UVGI intensity. There were some reservations since the range was derived primarily from one set of experiments at the University of Colorado. One reviewer suggested it may be best to have just one number (e.g., 30  $\mu\text{W}/\text{cm}^2$ ) rather than a range. Additional research was suggested to better define the UVGI intensity that is needed.

*2. Is the guideline for installing louvered fixtures that provide 0.17 UV-C watts per each  $\text{ft}^2$  in a room appropriate? Is the guideline of 0.085 UV-C watts per  $\text{ft}^2$  for fixtures without louvers in rooms with 9 ft or higher ceilings appropriate?*

Although there were some reservations by reviewers that this number was also derived from just one set of experiments at the University of Colorado, it was generally accepted as useful. One reviewer suggested that the volume of air in the upper room (rather than floor space) would be a better way to estimate the fixtures needed for UVGI systems.

*3. Other than the information provided in the draft document, what other methods are available for obtaining "spot measurements" of the upper-air UVGI intensity when the UVGI system is composed of multiple fixtures?*

Several good research projects were noted by reviewers.

*4. Is it appropriate to provide a guideline that states UV lamps should be replaced when the lamps start to emit approximately 70% of their original output? What is the best way to measure the output of the UV lamps in a fixture?*

There was agreement among the reviewers that "relamping" should be done as recommended by manufacturers or at least on a yearly basis.

*5. Under "air mixing guidelines" it is stated in the draft that fans should be used to continually mix the air if there is any question about vertical air mixing between the upper and lower portion of a room. Will the use of mixing fans have any affect on other infection control issues?*

It was suggested by a reviewer that mixing fans may affect the designed airflow within an infection isolation room.

## General Comments

In brief, the reviewers provided considerable general comments. Writing and editorial mistakes were noted and comments provided to help clarify the document.

The NIOSH/CDC recommended exposure limit (REL) was first published in 1973. Based on the REL, the maximum recommended exposure to UVGI is  $6 \text{ mJ/cm}^2$  at 254 nm for a daily 8-hr work shift. This corresponds to a maximum recommended exposure for eight hours to UVGI at a wavelength of 254 nm of  $0.2 \mu\text{W/cm}^2$ . Based on this, upper-room UVGI system designers have used  $0.2 \mu\text{W/cm}^2$  as the maximum lower (occupied) room irradiance at any time in order to limit the irradiance level in the lower room to the 8-hr REL. Some reviewers jointly noted this limits the radiation level in the upper-room thereby decreasing the potential effectiveness of the system. Therefore, they thought it appropriate that the only figure that should be quoted in the document is  $6 \text{ mJ/cm}^2$  for an 8-hour exposure.