

# Guide to using germicidal UV

Part of the the  
Search, Treat, Prevent  
Comprehensive Approach for TB

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Created with the support of Interactive Research  
and Development (IRD) and The Global Fund

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# Introduction

Tuberculosis (TB) is an airborne disease that is both curable and preventable, but remains lethal, killing more than 1.4 million people in 2015.<sup>1</sup> TB can be spread by any untreated patient through the air. Although prevention from exposure alone will not turn the tide of the TB epidemic, we must protect people from exposure to TB bacteria. Any prevention must be situated within a comprehensive program to stop TB (such as the Search-Treat-Prevent approach) which includes actively searching for and treating people with TB infection (or so-called “latent” tuberculosis).

Germicidal UV (GUV)\* is an evidence-based,<sup>2</sup> safe, and cost-effective way to protect people from exposure to TB and mitigate the risk of its transmission. GUV is ideally combined with administrative transmission control approaches (like the [F-A-S-T approach](#)) to identify and sort infectious patients in healthcare settings. It can be implemented in resource-limited settings and as shown impact across a variety of climates, including those very cold and hot.<sup>3</sup>

The goal of this guide is to provide an overview to any person or program considering effective strategies for preventing the transmission of TB through GUV. It is intended to be used as a guide for individuals or programs that are trying to mitigate TB transmission in places and spaces where TB is likely to be transmitted, particularly healthcare facilities.

\*GUV has also been referred to as UVGI, which stands for ultra violet germicidal irradiation.

These types of facilities in the private and public sector may include:

- Outpatient healthcare facilities, such as doctor's offices
- Hospitals
- Laboratories
- Other high-risk indoor congregate settings, such as homeless shelters and prisons

The individuals or teams implementing and supporting GUV programs across a variety of settings may include:

- Healthcare providers including doctors, nurses, and healthcare workers
- Project managers
- Infrastructure directors
- Operations specialists
- Maintenance staff
- Patients or other occupants of a space

What is the difference between UVGI and GUV?  
UVGI and GUV refer to the same thing. UVGI stands for "ultra violet germicidal irradiation" whereas GUV stands for "germicidal ultra violet". GUV is preferred by some scientists and doctors since the word "irradiation" has strong associations with exposure to harmful materials that cause cancer, which is untrue of this safe technology.

# Search-Treat-Prevent

Making progress against the global TB epidemic will require a paradigm shift as called for by the Global Plan to End TB 2016 – 2020. It will require new strategies and a comprehensive approach tailored to each operational setting.

All settings should aim for a comprehensive approach that includes:



**Searching** for and diagnose everyone who is sick with TB

**Treating** people with TB promptly and effectively

**Preventing** future TB cases by preventing exposure and treating exposure of TB infection

This is called the Search-Treat-Prevent approach and it can be applied in all operational contexts. See the “Resources” section for more materials on this approach.

Protecting people against exposure to TB is an essential element of this comprehensive approach to elimination. GUV is a cost-effective way to protect people against such exposure and falls under the “Prevent” element of the Search-Treat-Prevent comprehensive approach.

# Basic Checklist

- Procure GUV lamp bulbs and fixtures from a reliable manufacturer
- Put GUV in rooms that have no ventilation or air coming from an outside source
- Install GUV in the upper area of a room
- Train all staff in a facility on GUV maintenance
- Clean GUV regularly and keep a record of cleanings
- Measure GUV regularly for effectiveness
- Replace GUV lamp bulbs regularly
- Post signs informing room occupants of GUV presence
- Dispose of GUV lamp bulbs properly

# Germicidal UV for TB

This guide focuses on airborne infection and TB transmission control by one means of providing clean air, GUV. There are other ways to clean air, such as through natural or mechanical ventilation systems, or use equipment to prevent transmission, such as through personal protective equipment. Information on these other means can be found in the “Resources” section.

TB is most likely to be transmitted in crowded, poorly ventilated settings, including inside homes, prisons, or healthcare facilities where people are sick with TB. GUV is appropriate for any space where TB is likely to be spread, but requires that the staff and occupants of a space understand how to appropriately use GUV. TB is most likely to be transmitted in healthcare settings and therefore this guide focuses on healthcare examples.

Is GUV exposure harmful to humans? Can GUV cause cancer?

There are no long-term negative effects of being around GUV. GUV rays can cause minor irritation in the eyes and skin, which is why it is important to install these fixtures correctly. Correctly installed GUV fixtures focus the exposure of UV rays on the upper part of rooms where there is no risk of exposing human eyes or skin. Regardless of how GUV is installed, it cannot cause cancer.

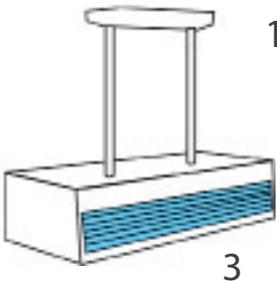
# Installing UV

Within healthcare facilities, particularly in locations with a high burden of TB, there are several areas that are places for TB to be transmitted:

- Waiting rooms
- Exam rooms
- Consultation rooms
- Corridors
- Inpatient treatment rooms
- X-ray rooms
- Operating theaters
- Bronchoscopy rooms
- Sputum induction areas

GUV is especially important where there are likely unsuspected TB cases, such as outside of TB wards where space occupants may be unknowingly spreading the disease. It is also important that GUV be installed in places where there is not already clean air circulating. For example, avoid installing GUV outdoors, where there is already a supply of fresh air.

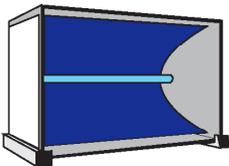
## Common UV Fixture Types



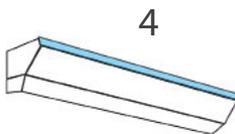
1



2



3



4

1 Rectangular louvered ceiling-mounted fixture

2 Round louvered ceiling-mounted fixture

3 Kira© wall-mounted fixture with parabolic reflector

4 Upwards-facing wall-mounted fixture

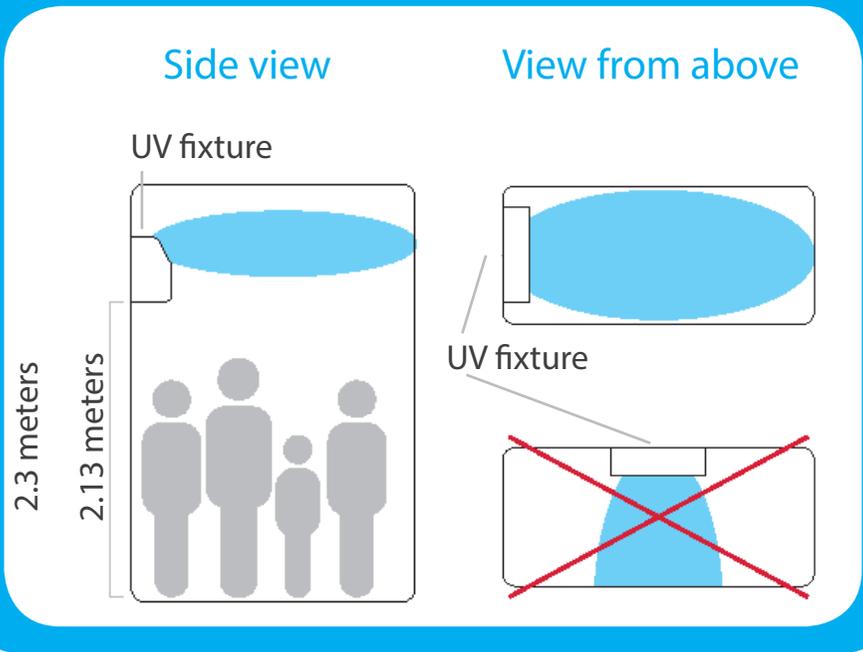
Ensure the GUV fixture model procured has been tested by an independent laboratory, as not all fixtures produce the same output.

GUV can be used in a variety of ways within a healthcare setting, such as sterilizing equipment. To be used as a means of disinfecting air, GUV lights should be placed in appropriate fixtures and placed in the upper room (over the head of room occupants and not at eye level). These fixtures focus UV beams on the upper area of the room, preventing the minor irritation that can occur to eyes and skin when exposed to GUV.

### Where in a space should GUV fixtures be installed?

GUV fixtures emit light in the shape of an oval, with the precise area of effectiveness varying between fixture manufacturers. Each GUV fixture should be installed in the way that allows the rays to reach a maximal amount of space.

If installing GUV fixtures in a corridor, for example, the GUV fixtures should be installed at the ends of the corridor rather than along the sides.



It is essential that the installation of GUV fixtures be combined with an air mixing device. Examples of air mixing devices include:

- Ceiling fans
- Standing fans
- Air conditioners
- Ventilated heat systems
- Ventilated air conditioning systems, such as central air

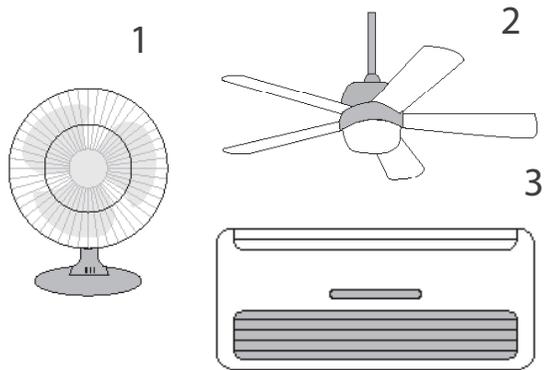
These air mixing devices must direct air into the area of the room where the GUV lamp is located in order for the air to pass through the UV rays.

### Free-standing Air Mixing Devices

1 Table fan

2 Ceiling fan

3 Air conditioner



Lastly, before installing GUV, ensure that there are staff to support its maintenance. In order for GUV to be successful, staff should be trained on the basics of GUV, potential hazards, and maintenance. GUV can be a scary and intimidating thing to people who are unfamiliar with it – make sure staff understand why GUV has been installed and how it works so that they can explain it to other occupants, such as patients.

# Maintenace and considerations for GUV

Before installing GUV, you may want to consider:

## Cost

- Is there money available for:
  - A GUV fixture?
  - One GUV lamp bulb per fixture as well as back-ups?
  - Cleaning supplies for the GUV fixture, according to manufacturer guidelines?
  - Staff members to dedicate time to GUV maintenance?
  - Electricity costs?
- Will there be future financing for new GUV lamp bulbs and maintenance staff?

## Average costs for material GUV supplies per fixture (excluding shipping costs)

Item	Cost
GUV fixture	US\$120
GUV bulb	US\$40
Back-up GUV bulb	US\$40
Cleaning supplies	US\$2
Total	US\$202

## Expertise

- Is there a GUV expert (someone who has experience installing GUV in other facilities) available to:
  - Select the location of GUV fixtures?
  - Install GUV fixtures?
  - Regularly measure the effectiveness of GUV fixtures?
  - Train staff on GUV maintenance?

## Staffing

- Who will be in charge of:
- Routine inspection of GUV fixtures?
  - Cleaning GUV fixtures?
  - Procuring new bulbs?
  - Installing new bulbs?
  - Training new staff on GUV basics, hazards, and maintenance?
  - Tracking performance of GUV?
  - Alerting program administrators of any problems with the GUV fixtures, such as a broken bulb?
- How will the people performing these duties communicate with one another?

## Location

- How often does the GUV fixture need to be cleaned based on the space's type of use?
- Where will signage be placed?

What is a routine inspection of a GUV filter?

A staff member should be responsible every day for ensuring that the GUV fixture is on and working properly. Record of this inspection should be kept in a log.

## Cleaning GUV fixtures

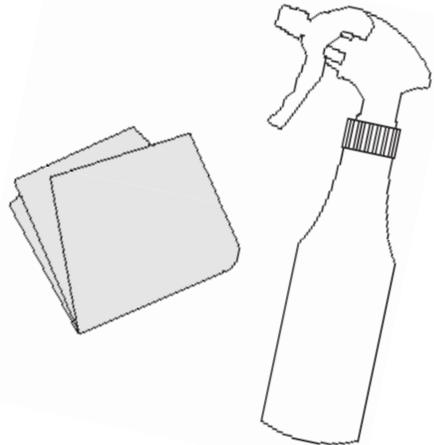
In order for GUV fixtures to work properly, they must be cleaned regularly. Cleaning requires both the proper cleaning equipment, as well as a person who is designated to clean the fixture.

Prior to cleaning, the GUV fixture should be turned off to prevent the light from coming into contact with the skin and eyes of the person cleaning it, as well as to prevent heat burns from a hot bulb. The person cleaning the fixture should be aware of how to use GUV safely, how to clean the fixture, how often cleaning should occur. It is recommended that this cleaning be performed by dedicated facility staff, such as the regular cleaning person.

The required equipment is:

- Cleaning fluid
- A clean, soft cloth, such as a microfiber cloth or even an old t-shirt

To clean the fixture, the bulb and fixture should be wiped clean of dust. If using a louvered fixture, all louvers should also be cleaned. Some spaces may get dusty faster than others and it is important to adjust the cleaning schedule accordingly. For spaces such as laundry, kitchens, dining, and dormitory areas, this should happen every 3 months. GUV fixtures in other areas can be cleaned on an annual basis.



The basic maintenance of GUV includes:

- Leaving GUV lamp bulbs on 24 hours a day in high-risk areas and turning lamps off at facility closure times in low-risk areas
- Cleaning fixtures regularly
- Replacing GUV lamp bulbs on an annual basis, or according to lamp bulb producer guidelines
- Measuring GUV fixtures regularly to ensure they are functioning properly

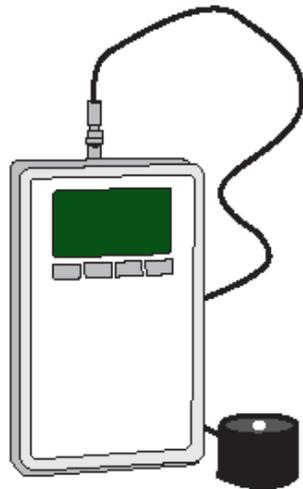
# Measuring GUV

The effectiveness of GUV and the safety of fixtures at eye level are measured using a type of radiometer. This type of radiometer is commonly known as a UVGI meter.

Before taking measurements, GUV fixtures should be cleaned and potential interferences, such as fluorescent lights and sunlight, should be blocked. UVGI meters should be held 1 meter away from the geometric center of the fixture with the face of the sensor parallel to the fixture's louvers. Additional measurements should be taken slightly above, below, to the left, and to the right of geometric center. The person performing the measurement should ensure their eyes are protected during this process.

Periodically, radiometers should be calibrated. This can be done by the factory from which the radiometer was ordered, and done in advance of the time when the radiometer is needed.

GUV performance should first be measured 3 to 4 days after its initial installation and then every 6 months until replacement. If a lamp has a 30% or more decline in the rays it emits, its bulb should be replaced even if it is before the scheduled replacement date.



# FAQs

How often should GUV fixtures be cleaned?

GUV fixtures should be regularly cleaned, with a staff member clearly designated to perform this duty. For spaces such as laundry, kitchens, dining, and dormitory areas, this should happen every 3 months. GUV fixtures in other areas can be cleaned on an annual basis.

Is GUV cost-effective?

Yes, when employed correctly, GUV is very cost effective compared to mechanical ventilation systems and room air purifiers. GUV is an ideal way to clean air and prevent TB transmission in places where natural ventilation is not an option due to climate or air quality concerns.

Are GUV lamps the same as other UV lamps, such as black light and growth lamps?

No. UV rays come in different wavelengths and these types are categorized by letters. GUV lamps use UV-C rays.

Are UV rays visible to the human eye?

No, UV rays are not visible to the human eye. However, GUV lamp bulbs are colored blue to let people know that it is not a regular lamp.

Does blue light coming from the GUV fixture mean it is working?

GUV lamps can continue to put out light even after they are no longer putting out UV light. This means that just because a UV lamp looks like it's working, it may not be providing germicidal protection.

Can GUV be used alone to prevent TB transmission?  
GUV fixtures must be installed with something that can move and mix the air in a space. GUV and TB transmission prevention are essential, but must be implemented with efforts to search for and treat TB cases as part of a comprehensive approach to eliminating TB.

Does GUV work in high humidity conditions?  
While humidity is shown in experiments to make it difficult to kill organisms, GUV is not affected significantly by high humidity.

What qualification makes someone a GUV expert?  
There is no standard qualification in GUV. However, there are certificates and trainings available. An expert qualified in GUV should have experience in installing GUV previously in other facilities and be willing to provide references.

How can old GUV bulbs be safely disposed of?  
GUV bulbs contain mercury which is safe if enclosed inside the bulb, but if a bulb is broken, is dangerous to humans, soil, and water supply. GUV bulbs should be disposed of following each facility's waste management policy, or if there is none, then according to state, territory, or national laws. An appropriate hard-shell bin should be used instead of a plastic bag should be used for a bulb, which can include sharp edges if broken.

# Resources

End TB Transmission Initiative. Maintenance of Upper-Room Germicidal Ultraviolet (GUV) Air Disinfection Systems for TB Transmission Control (2017): <http://www.stoptb.org/wg/ett/>

USAID. TB Care II Project Resources: <http://tbcare2.org/resources/infection-control>

US Center for Disease Control and National Institute for Occupational Safety and Health. Environmental control for Tuberculosis: Basic Upper-Room Ultraviolet Germicidal Irradiation Guidelines for Healthcare Settings (2009): <https://www.cdc.gov/niosh/docs/2009-105/default.html>.

US Center for Disease Control and USAID. Implementing the WHO Policy on TB Infection Control in Health-Care Facilities, Congregate Settings and Households: A framework to plan, implement and scale-up TB infection control activities at country, facility and community level (2009): [http://www.stoptb.org/wg/tb\\_hiv/assets/documents/TBICImplementationFramework1288971813.pdf](http://www.stoptb.org/wg/tb_hiv/assets/documents/TBICImplementationFramework1288971813.pdf)

World Health Organization. WHO Policy on TB Infection Control in Health-Care Facilities, Congregate Settings and Households (2009): [http://apps.who.int/iris/bitstream/10665/44148/1/9789241598323\\_eng.pdf](http://apps.who.int/iris/bitstream/10665/44148/1/9789241598323_eng.pdf)

Zero TB Initiative. A Guide to the Search, Treat, Prevent Comprehensive Approach for TB (2017): <http://www.advanceaccessanddelivery.org/s/Getting-to-Zero-STP-Pamphlet-March-2017.pdf>

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1. WHO. Global tuberculosis report 2016. Geneva, Switzerland: World Health Organization, 2016.
2. Riley RL, Nordell EA (1992) Clearing the air: the theory and application of ultraviolet air disinfection. *Am Rev Respir Dis* 139:1286–1294
3. Dr. Grigory Volchenkov, "Evaluation of Environmental Control: Effectiveness and Cost," Course Material: Building Design and Engineering Approaches to Airborne Infection Control, August 2016, Harvard Medical School, Boston MA.



[www.zerotbinitiative.org](http://www.zerotbinitiative.org)



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