

# Sputum Induction



# SPUTUM INDUCTION

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This section of the manual provides practice-based guidance on conducting sputum induction safely. It addresses the following issues:

- **Safe sputum induction for a person with suspected or known infectious TB**
- **Administrative controls, including signage and a sample sputum induction procedure**

For a complete review and discussion of early identification of persons with suspected or known infectious TB in a variety of healthcare settings, refer to the Appendix for TB triage tools and the Resources section for a list of additional materials and suggested reading.

## About Sputum Induction

Sputum induction is used to obtain sputum for diagnostic purposes when patients are unable to spontaneously expectorate a specimen. The procedure uses sterile water or hypertonic saline to irritate the airway, increase secretions, promote coughing, and produce a specimen. The CDC and OSHA both classify sputum induction as a high-risk procedure when performed on a person with suspected or known infectious TB. This procedure induces coughing, resulting in a greater likelihood that infectious droplet nuclei are expelled into room air. Because of this increased risk, it is recommended that sputum induction be performed on persons with suspected or confirmed infectious TB only if absolutely necessary to obtain/confirm a TB diagnosis. All appropriate precautions must be used whenever sputum induction is performed.

Elements that are essential for a safe sputum induction program include:

- A triage program to identify persons with suspected or known infectious TB prior to sputum induction
- A written sputum induction procedure that includes TB infection control instructions
- Employee training on safe and effective sputum induction procedures
- Appropriate signage for high-risk procedure rooms
- Environmental controls meeting OSHA requirements and CDC recommendations, which may include use of the following:
  - Local Exhaust Ventilation (LEV, see page 78 for definition)
  - Airborne infection isolation precautions
  - Supplementary UVGI
- Monitoring and maintenance programs for environmental controls
- A respiratory protection program

Effective TB control programs are based on a hierarchy of control measures. In the order of priority, the three levels of the hierarchy are: administrative controls, environmental controls, and respiratory protection for employees.

## Administrative Controls for Sputum Induction

Administrative controls, the first level of the hierarchy, are designed to reduce the risk of exposure to persons with infectious TB. These controls include policies and procedures for early identification, evaluation, isolation, and treatment of patients likely to have TB. Administrative controls essential to safe sputum induction on high-risk patients include:

- Educating employees about TB and the risk of *M. tuberculosis* transmission during sputum induction
- Developing a sputum induction policy and procedure that includes patient care measures and staff safety issues, and is easily followed by staff
- Identifying persons likely to have TB prior to the sputum induction procedure
- Implementing work control practices for sputum induction
- Monitoring compliance with and evaluating sputum induction procedures on a periodic basis.

## Educating Staff

A system should be developed to inform staff of new or updated policies and procedures; education should be provided as necessary. One simple way of documenting that staff have read a new policy is to post it in a staff-only area and require that staff initial the posted copy after reading it. After a 30-day posting, the document is placed in a binder that remains available to staff. The information should also be included in department-specific orientations for new employees who will be assisting in sputum induction.

Product sales representatives will often train facility staff when equipment such as a local exhaust hood or booth has been purchased from their company. After the initial training session, a brief review of important safety issues can be presented periodically at staff meetings.

## Providing a Written Sputum Induction Procedure

High-risk procedures such as sputum induction must have up-to-date, understandable written procedures for staff to follow. One copy should be filed in the policy and procedure manual. A second, simplified set of instructions should be posted within view of the employee performing the sputum induction. These instructions can be placed on the door of the sputum induction room or attached to the sputum induction hood.

A written procedure should include safety measures such as identifying person with suspected or known infectious TB, using a respirator correctly, placing cautionary door signage, and verifying negative room pressure. The following are suggested topics to include in a sputum induction procedure:

*Early identification of patients who have TB is especially important prior to high-risk procedures such as sputum induction.*

- Patient instructions and education
- Instructions for operating sputum induction equipment
- Instructions for confirming room negative pressure or properly functioning hood or booth
- Instructions for safe use of UVGI, if applicable
- Specimen handling instructions
- Use of respirators by staff
- Use of other personal protective equipment such as gloves and face shields
- Cleaning and disinfection requirements for room/equipment
- Instructions for placing signage during procedure
- Instructions for assuring adequate removal of airborne contaminants between patients

See “Performing Sputum Induction” on page 82 for highlights of a sputum induction procedure.

## **Early Identification of a Suspect TB Patient**

Early identification of patients who have TB is especially important prior to high-risk procedures such as sputum induction. All facilities should have written criteria and a protocol in place to rapidly identify and implement precautions for suspected infectious TB patients. In out-patient settings or emergency departments, efforts to identify infectious TB patients should begin as soon as the patient enters the facility and approaches the admission or registration desk. In both in-patient and out-patient settings, the following patient’s warrant additional screening or action:

- Patients presenting with TB symptoms (e.g., cough, fever, night sweats, fatigue, weight loss, hemoptysis)
- Patients who have risk factors for TB (e.g., HIV infection, birth in country where TB is endemic, homelessness, injection drug use, recent incarceration, recent exposure to an infectious TB case, a new positive TST, or a history of TB infection or disease).

Cal/OSHA requires that healthcare facilities develop criteria to identify individuals who are “suspect” TB cases. These criteria must include identification of the following individuals:

- Any person who is known, or with reasonable diligence should be known, by the employer to be infected with TB and has signs or symptoms of pulmonary or laryngeal TB
- Any person who has a positive AFB smear, or any other positive test result, obtained for the purpose of diagnosing pulmonary or laryngeal TB
- Any person who meets the facility’s criteria for identification based only on signs and symptoms when TST and laboratory-generated information are not available.

A person with suspected or known infectious TB waiting for a sputum induction procedure should wear a surgical mask when not in an AIIR or complete enclosure. The purpose of the mask is to block aerosols produced by coughing, talking, and breathing. A surgical mask on a cooperative patient may provide adequate short-term protection. A mask is not effective for extended periods of time, however, and should be changed if damp.

All patients having sputum induced for diagnostic purposes should first be screened for TB. If the minimum criteria for a suspected infectious TB case are met, the sputum induction procedure is considered a high-risk procedure, and must be performed using LEV or in a room that meets the ventilation requirements for TB isolation.

Two tools are included in the Appendix to assist in the early identification of persons with suspected or known infectious TB. The first is the Respiratory Isolation of Pulmonary Tuberculosis (RIPT) protocol developed by Roger Lewis, MD, PhD, Department of Emergency Medicine at Harbor-UCLA Medical Center, in Appendix J on page 155. The second tool, “Early Detection of Tuberculosis Questionnaire,” in Appendix D on page 146 is an adaptation of a questionnaire developed by OSHA. See “References” and “Resources” at the end of this document for additional articles and information on the early identification of suspected TB patients.

## Implementing Safe Work Practices

The sputum induction procedure included in this guideline outlines and discusses important issues for patient and employee safety. After adapting the procedure to fit your facility, practice, and equipment, you must educate all employees who may participate in sputum induction procedures. This can involve interdepartmental meetings, educational sessions, and equipment demonstrations by product sales representatives. Periodic monitoring is essential to ensure that the sputum induction procedure is fully implemented by all staff. Periodic updating and refresher sessions will be necessary as staff or equipment change.

## Environmental Controls for Sputum Induction

Environmental controls are the second level in the TB control hierarchy. They help to reduce the risk of *M. tuberculosis* transmission during sputum inductions by removing infectious particles from the air and controlling the direction of airflow. Two main types of environmental controls for sputum induction are LEV devices and rooms that have the same ventilation characteristics as AIIRs. Sputum induction should not be done in facilities that do not have rooms with these characteristics. Patients should be referred to facilities that are appropriately equipped.

A comparison chart showing the advantages and disadvantages of different sputum induction environmental controls is included in “Summary of Sputum Induction Environmental Controls” on page 86.

## Local Exhaust Ventilation (LEV) Devices

LEV devices provide the most efficient method of capturing infectious particles. By capturing these particles close to the point of generation, dispersion of particles to other areas of the building is prevented. If particles are not captured at the source, they become more difficult to control due to the larger space they will occupy. Removal of particles from room air requires longer periods of time, special exhaust or filtration systems, and higher operating costs than if particles are captured at the source.

Local exhaust units should be placed in an AIIR. The effective operation of these units requires that staff know how to set up, use, and maintain them. Respiratory protection for staff is recommended, at least an N-95 respirator.

There are two basic types of local exhaust devices: complete enclosures and partial enclosures.

### Complete Enclosures (Booths and Tents)

A fully enclosed booth or tent is the preferred type of local exhaust device. These devices physically separate the patient from others during sputum induction. Air from booths and tents is usually HEPA-filtered and discharged back into the room, but can also be exhausted outdoors. Some booths and tents can be easily assembled, dismantled, folded, and stored. Others are more difficult to assemble and disassemble, requiring greater installation time and effort.

Booths typically have rigid walls and are less portable than tents and partial enclosures. Some units require assembly in the room, while others come already assembled and can be used immediately.

Tents have flexible walls with rigid frames. They require some minor assembly prior to use and disassembly prior to storage.

### Partial Enclosures (Hoods)

Partial enclosures are hoods that do not fully enclose the patient. These devices are open on one side, where the patient sits. Air is drawn across the patient's breathing zone, then HEPA-filtered and discharged back into the room. Some units discharge exhaust air directly outdoors.

Patients must be instructed to sit as far as possible inside the hood opening when coughing. The hood should maintain an air velocity of at least 200 feet per minute (FPM) at the patient's breathing zone to capture droplet nuclei. Air currents from open windows and doors or people moving about the room, can adversely impact the effectiveness of these devices. Partial enclosures are commonly mounted on carts that can be moved to any room for sputum induction procedures.

Since partial enclosures do not physically separate the patient from others, these devices may not be as effective as fully enclosed units.

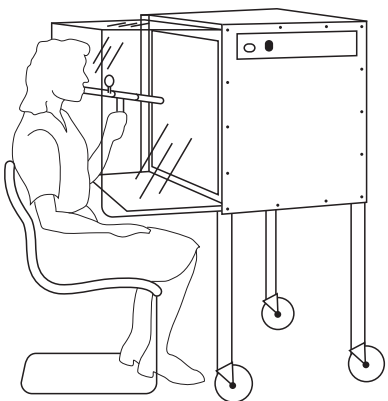
FIGURE 8A.

### Complete Enclosure



FIGURE 8B.

### Partial Enclosure



## Sputum Induction Rooms

A room with special ventilation should be used for sputum induction to prevent infectious particles from escaping to other areas of the facility.

The CDC *Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-care Settings, 2005* recommend that sputum induction rooms have the following characteristics:

- Negative pressure relative to adjacent areas
- Air change rate of at least 6 mechanical ACH for existing isolation and procedure rooms. However, the CDC Guidelines also recommend, “Whenever feasible, this airflow rate should be increased to  $\geq 12$  mechanical ACH by adjusting or modifying the ventilation system or should be increased to  $>12$  equivalent ACH by supplementing with air-cleaning technologies (e.g., fixed or portable room air recirculation systems or UVGI systems)
- Air change rate of at least 12 ACH for new or renovated isolation and procedure rooms
- Supply and exhaust grilles should be positioned on opposite sides of the room to promote good air mixing. The exhaust grille should be positioned near the patient
- Air from the room should be exhausted directly outdoors, away from air-intake vents, persons, and animals. Exhaust ducts should be located away from areas (e.g., side-walks or windows) that can be opened. The CDC Guidelines allow for recirculation into the general ventilation system if unavoidable and the air is HEPA-filtered before recirculation. Local codes and regulations should be checked, as even HEPA-filtered air cannot be recirculated in many localities.

Local codes and regulations should be consulted to determine specific ventilation system requirements for your area. For example, Cal/OSHA, who require 12 ACH for sputum induction rooms, will not accept an air change rate of 6 ACH for this setting.

## Air Exhausted Outdoors from Sputum Induction Booths, Hoods, and Rooms

Air exhausted outdoors from complete enclosures, partial enclosures, and AIRs should be discharged at a safe location in accordance with local regulations. If this is not possible, the air removed from the room should be HEPA-filtered prior to being exhausted.

## Maintaining Sputum Induction Devices and Rooms with HEPA Filters

The maintenance of partial and complete enclosures includes inspecting and replacing pre-filters and final HEPA filters. Many of these devices are equipped with filter gauges that indicate when filters are dirty and need replacement. Pre-filters (used to prolong the life of HEPA filters) need to be changed more often than final HEPA filters. Filters should be changed and disposed of in accordance with local requirements. Some localities may require that staff wear respirators and treat the discarded filters as medical waste.

Recommendations on scheduled maintenance may vary with each manufacturer. A staff person or facility engineer should be assigned to monitor the maintenance of the sputum induction device. This person should be trained in the basic principles of the unit’s operation, including recommended periodic checks.

*Adequate time must elapse between patients to allow for the removal of >99% of airborne contaminants by the exhaust system.*

## Location of Sputum Induction Rooms

Sputum induction rooms and local exhaust devices should be placed near patient care areas, where staff can monitor and assist patients as needed. The room should be located away from waiting rooms and other areas where patients or visitors are likely to enter and risk exposure.

Air should be discharged away from other outdoor air intakes or openings into the building (such as operable windows and doors, and outdoor air intakes into building ventilation systems).

## Signage

It is essential to place a warning sign on the door of any room being used for sputum induction. Signage should:

- Warn patients and family members not to enter the room
- Remind clinic staff that a respirator is required for entrance when the room is, or has recently been, occupied by a person with suspected or known infectious TB
- Indicate when the room was last occupied by a person with suspected or known infectious TB and at what time the room will be safe to enter without a respirator.

The sign's message should be clear to non-English speaking individuals and children. One suggestion is a sign that combines a stop sign symbol with the message, "Do not enter, N-95 respirator required." A second sign should state, "Room will be safe to enter without a respirator at \_\_\_\_\_." The sign should state the clearance time period needed to attain 99% clearance of airborne particles in the room. This will make it easier for staff to determine when it is safe to enter the room.

Signs can be developed in-house or purchased from a company that specializes in medical signs and labels. Professionally made signs tend to be more readily noticed, and therefore are generally more effective. Sample signs are included in Appendix L starting on page 157.

## Clearance Time Between Patients in Sputum Induction Rooms or Complete Enclosures

Adequate time must elapse between patients to allow for the removal of >99% of airborne contaminants by the exhaust system. Exhaust fans serving the rooms or enclosures must always be left on during the clearance period to remove the airborne particles. Staff entering before sufficient time has elapsed must wear a respirator.

Appendix G on page 150 contains a step-by-step worksheet to help determine the time required to achieve a removal efficiency of >99% in a room or enclosure.

The relatively small size of complete enclosures makes high air changes in these devices readily achievable. The manufacturer's instructions should be consulted for recommended clearance times for complete enclosures.

## Verifying Negative Pressure in Rooms, Booths, and Tents

The CDC Guidelines recommend the confirmation of negative pressure through the use of manometer measurements, smoke tubes, or other reliable indicators. Confirmation should be done daily whenever a sputum induction room is used for high-risk procedures. Negative pressure in LEV devices, such as partial or complete enclosures, should also be verified daily. This testing can be done with tissue paper or incense sticks if the other instruments are not available.

To use smoke or incense, release the smoke parallel to the door about 2 inches in front of the gap under the closed door outside the room as shown in figure 9. The smoke should be observed moving under the door into the AIR, or into the enclosure.

To use tissue paper, hold a thin strip of tissue parallel to the door outside the room, extending across the gap under the closed door. The tissue should be drawn towards the room by the airflow under the door. Tissue is not as sensitive to air movement as smoke or incense.

FIGURE 9.

### Smoke Test with Incense



## Respiratory Protection for Sputum Induction

In the absence of LEV, administrative and environmental controls will reduce, but not eliminate, the risk of exposure to *M. tuberculosis* in rooms used to perform sputum induction procedures on persons with suspected or known infectious TB. The third level of the TB control hierarchy is the use of respiratory protection. HCWs present during a high-risk procedure, such as sputum induction, must wear N-95 NIOSH-approved respirators unless the patient produces the sputum while isolated in a properly functioning LEV device. Since LEV devices capture infectious particles at their source, respirators are not required.

Staff entering a room or booth after sputum induction must wear respiratory protection until >99% of airborne contaminants have been removed from the air. This time period will vary depending on the size of the area, the number of ACH, and the estimated amount of air mixing. This same time period should be used when calculating the time interval that must pass before another patient can use the enclosure or room. See “Room Clearance Time Calculation Worksheet” in Appendix G on page 150 for a form to calculate clearance times.

# Performing Sputum Induction

- Sputum induction on a person with suspected or known infectious TB is considered a high-risk procedure because it can expose HCWs to droplet nuclei containing *M. tuberculosis*. LEV devices should be used to capture airborne contaminants at or near their source so they do not enter the general air circulation
- If sputum induction is performed without LEV devices, the CDC Guidelines recommend a minimum of 6 ACH in the sputum induction room. However, at least 12 ACH are preferred, recommended for new/renovated construction, and may be required by local codes. The room air should be exhausted directly outdoors at least 25 feet away from air inlets and operable windows and doors. The room should be under negative pressure, which should be monitored daily when sputum induction procedures are being performed
- Partial LEV devices should be monitored daily to confirm airflow when being used for persons with suspected or known infectious TB
- Partial LEV devices should maintain an air velocity of at least 200 feet per minute at the patient's breathing zone. This velocity should be checked monthly
- Complete LEV enclosures should be monitored daily when being used for persons with suspected or known infectious TB to assure that the device is operating correctly
- Standard precautions must be followed in all patient care activities. Gloves must be worn when hand contact with blood or other potentially infectious materials is anticipated. Masks and eye protection must be worn if the face may be splashed, sprayed, or splattered with blood or other potentially infectious material. Gowns or aprons must be worn if clothing or skin may be splashed or splattered with blood or other potentially infectious material
- A properly fitted NIOSH-approved respirator must be worn by any employee who enters a sputum induction room or other complete enclosure during a cough-inducing procedure or before 99% of the airborne particles are removed from the space
- Disposable nebulizers, corrugated tubing, and mouthpiece are preferred. Reusable items must be washed and disinfected by:
  - Pasteurization (75°C water for 30 minutes) or
  - High-level disinfection with a glutaraldehyde product following manufacturer's label instructions
- Aseptic technique must be used when placing sterile water or hypertonic saline in the nebulizer chamber. While some ultrasonic devices have a tap water reservoir, only sterile solutions should be placed in the cups or nebulizers that produce the mist inhaled by the patient.
- Disposable tubing, cups, and tissues may be disposed of in regular trash containers. Only blood-containing body fluids, which may drip or splash, must be disposed of in special biohazard containers.

## Equipment

- Aerosol generator/nebulizer
- Clear plastic zip-lock bag with biohazard label
- Corrugated aerosol tubing (disposable preferred)
- Cup of water
- Disinfectant (household bleach 1:10 dilution or tuberculocidal quaternary ammonium compound)
- Gloves
- Lab slip
- Mouthpiece (disposable preferred)
- Respirator (N-95 for HCW)
- Sterile sputum collection container
- Sterile water or sterile hypertonic saline
- Surgical mask (for patient)
- Tissues

TABLE 8.

**Step-by-step Guide to Performing Sputum Induction**

PROCEDURE	KEY POINTS
<p><b>1. Explain the procedure to the patient</b></p>	<ul style="list-style-type: none"> <li>• Purpose of procedure</li> <li>• Disinfection or disposal of equipment after patient use</li> <li>• When results will be available</li> <li>• How to use the nebulizer</li> <li>• How to open and expectorate into sputum container</li> <li>• How to place container in plastic bag</li> <li>• How to notify nurse if assistance is needed or when procedure is completed</li> <li>• Importance of staying in the room or booth until coughing has stopped</li> <li>• Importance of replacing surgical mask before leaving room or booth (if appropriate)</li> </ul>
<p><b>2. Instruct patient in sputum induction</b></p>	<ul style="list-style-type: none"> <li>• Remind patient to not begin the sputum induction procedure until staff member has left the room and closed door (where applicable)</li> <li>• Rinse mouth or drink water prior to beginning procedure</li> <li>• Inhale mist with deep breaths</li> <li>• Cough vigorously if spontaneous coughing does not occur. Cover mouth with tissue when coughing, unless expectorating into a jar</li> <li>• Continue attempts until 5-10 ml of sputum have been obtained. (Show patient how much is needed on specimen container.) Confirm quantity of sputum with your testing laboratory</li> </ul>
<p><b>3. Prepare nebulizer for patient use</b></p>	<ul style="list-style-type: none"> <li>• Two types of nebulizers are commonly used for sputum induction:             <ul style="list-style-type: none"> <li>• Compressor devices that create an aerosol with compressed air</li> <li>• Ultrasonic devices that use sound waves in a tap water reservoir to create aerosol</li> </ul> </li> <li>• Test nebulizer to ensure that adequate mist is produced</li> </ul>
<p><b>4. Ensure patient has all necessary equipment and understands all instructions</b></p>	<ul style="list-style-type: none"> <li>• Patient should remain in booth or room after procedure begins</li> <li>• Turn on LEV and/or verify that air is flowing into device or room (room or device is at negative pressure)</li> </ul>

PROCEDURE	KEY POINTS
<p>5. Patient must be observed at all times during the procedure</p>	<ul style="list-style-type: none"> <li>• Watch carefully for signs of respiratory distress and ensure that patient does not leave the room until coughing has stopped</li> <li>• A view window in the door should be provided to monitor the patient</li> </ul>
<p>6. Wear properly fitted, NIOSH-approved respirator if entering or remaining in sputum induction room</p>	<ul style="list-style-type: none"> <li>• Infectious droplet nuclei may be dispersed into the air during the procedure</li> <li>• Staff standing outside properly functioning local exhaust booth or AIIR do not need to wear respirators</li> </ul>
<p>7. Ensure that patient remains in the room/enclosure until coughing has stopped</p>	<ul style="list-style-type: none"> <li>• Contain infectious particles in the room/enclosure</li> </ul>
<p>8. If it is necessary for the patient to leave before coughing has stopped, ensure patient is masked</p>	<ul style="list-style-type: none"> <li>• Prevent dispersion of infectious particles</li> </ul>
<p>9. If sputum induction is performed on a suspected or confirmed infectious TB patient, the patient should be masked continuously when not in the LEV device or sputum induction room</p>	<ul style="list-style-type: none"> <li>• Prevent dispersion of infectious particles</li> </ul>
<p>10. Ensure that door is closed after patient completes the procedure and leaves the room or complete enclosure</p>	<ul style="list-style-type: none"> <li>• Prevent contaminated air from escaping into the corridor (if room is used)</li> </ul>
<p>11. Place a sign on the door indicating when the room will be safe to enter</p>	<ul style="list-style-type: none"> <li>• Adequate time must be allowed for removal of at least 99% of airborne contaminants. This time period will vary, depending on the amount of air exhausted from the room, room air mixing, and the size of the room (see Appendix G on page 150)</li> </ul>
<p>12. Prepare room for next patient</p>	<ul style="list-style-type: none"> <li>• Wait required time for room to clear of infectious airborne particles (see #11) or wear properly-fitted, NIOSH-approved respirator when entering room</li> <li>• Remove and discard disposable items. If reusable components are used, soak in detergent or enzyme solution to prevent drying of secretions</li> <li>• Wipe counter with approved disinfectant between procedures and at the end of the day. If preferred, an imperviously-backed absorbent paper may be placed on counter and changed between patients</li> </ul>

TABLE 9.

## Summary of Sputum Induction Environmental Controls — Advantages & Disadvantages

TYPE OF CONTROL	ADVANTAGES	DISADVANTAGES
<p><b>Complete Enclosure</b></p> <p>Booth or Tent</p>	<ul style="list-style-type: none"> <li>• Complete physical separation between patient and staff</li> <li>• Provides highest degree of safety for staff</li> <li>• Airborne particles quickly captured due to high air-change rates. Short airborne particle clearance times (vs. sputum induction room)</li> <li>• Can be moved to accommodate room function changes</li> <li>• Tents can be folded for compact storage</li> <li>• Tents are more portable than booths</li> </ul>	<ul style="list-style-type: none"> <li>• Cost is higher than partial enclosures</li> <li>• Requires routine maintenance such as changing the HEPA filter and pre-filter</li> <li>• Tents require some assembly prior to use</li> <li>• Booths are not as portable as partial hoods</li> </ul>
<p><b>Partial Enclosures</b></p> <p>Partial hood is enclosed on all sides except side where patient sits</p>	<ul style="list-style-type: none"> <li>• Provides a high degree of safety for staff</li> <li>• Commercially available devices are equipped with HEPA filters (do not require special exhaust systems)</li> <li>• Cost is relatively low compared to complete enclosures</li> <li>• Portable, small enough to be used at patient's bedside, and easy to store</li> </ul>	<ul style="list-style-type: none"> <li>• Does not provide complete physical separation between patient and staff</li> <li>• Requires more supervision of patient than complete enclosures to ensure proper placement of patient</li> <li>• Air velocity (minimum 200 feet per minute) at the side of patient's head must be verified monthly</li> <li>• Requires routine maintenance such as changing the HEPA filter and pre-filter</li> <li>• Noise of operating unit may be annoying to patient</li> </ul>
<p><b>Sputum Induction Rooms</b></p> <p>Room meeting all recommendations (see "Sputum Induction Rooms" on page 79) and/or requirements for AIIRs</p>	<ul style="list-style-type: none"> <li>• Provides complete separation between staff and patients</li> <li>• If an AIIR is available, sputum induction can be done in this room with no additional ventilation equipment</li> </ul>	<ul style="list-style-type: none"> <li>• Separate designated room required</li> <li>• If an AIIR is not available, these rooms require installation of dedicated exhaust systems or HEPA filtration systems prior to recirculation of air (local codes should be checked for requirements)</li> <li>• Airborne particle clearance times will be high due to lower ACH rates (vs. booths and tents)</li> <li>• Room ventilation system must be monitored to ensure proper operation</li> <li>• Operation can be affected by general building ventilation systems</li> <li>• Most expensive option if an existing AIIR is not available</li> </ul>