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## **Sputum Induction**

*Standard Operating Procedures for Health Care Workers*

*HIV care and treatment facilities*

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## 1. Introduction

This SOP provides guidance on conducting sputum induction safely. It addresses the following issues:

- Indications for sputum induction
- Contraindications for sputum induction
- Where to perform the sputum induction procedure
- Preparing for the sputum induction procedure
- Performing the sputum induction procedure
- Safe sputum induction for a person with suspected or known infectious TB
- TB Infection Control measures needed for sputum induction

## 2. About Sputum Induction

Sputum induction is used to obtain sputum for diagnostic purposes when patients are unable to spontaneously produce a specimen. The procedure uses nebulized hypertonic saline solution to irritate the airway, increase and liquefy secretions, promote coughing, and allow expectoration of secretions to produce a specimen. Sputum induction is 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 the air. Appropriate infection control measures must be taken whenever sputum induction is performed.

## 3. Indications and contraindications for Sputum Induction

### 3.1. Indication for Sputum Induction

Sputum induction is used as an aid to the diagnosis of pulmonary tuberculosis (TB) in patients who are unable to spontaneously expectorate adequate sputum specimens.

### 3.2. Contraindications and Precautions

- As hypertonic saline may trigger bronchospasm, it should not be used on patients with known airway hypersensitivity such as asthma or on patients actively wheezing at the time of the procedure. If deemed critical for the establishment of a diagnosis, the procedure should only be performed after pre-medication with salbutamol and under constant medical supervision in patients with asthma, suspected asthma, or severely impaired lung function ( $FEV_1 < 1$  litre).
- As the procedure causes severe coughing, the procedure should not be performed in patients in whom severe coughing may be harmful. This may include patients with:
  - Haemoptysis
  - Acute respiratory distress
  - Unstable cardiovascular status (e.g. arrhythmias, angina)
  - Thoracic, abdominal or cerebral aneurysms
  - Hypoxia ( $SaO_2$  less than 90% on room air)
  - Lung function impairment ( $FEV_1$  [if known] less than 1.0 Litre)

- Pneumothorax
- Pulmonary emboli
- Fractured ribs or other chest trauma
- Recent eye surgery
- The relative risks and benefits of the procedure should be discussed with the treating medical team and with the patient before proceeding in the presence of these conditions
- The procedure should not be performed in patients who are unable to follow instructions

#### 4. Where to perform sputum induction

Unless the facility has a dedicated sputum induction room with negative pressure, sputum induction should be performed outdoors, to ensure that the risk of nosocomial *M. tuberculosis* transmission is minimized. Mobile equipment can be used in a dedicated outdoor area to ensure privacy.

A suitable open area should be identified outside the facility that is:

- Away from other patients and staff
- Accessible with mobile equipment (screen for privacy, extension lead to connect nebulizer equipment, moveable table)
- With good natural airflow, directed away from other people

#### 5. Sputum Induction Procedure

The following table describes the steps to be taken in preparing for and performing the sputum induction procedure:

Procedure	Key points
1. Assess the patient	Assess the patient for the presence of asthma or any of the other contraindications listed under section 3.2. “Contraindications/precautions”
2. Explain the procedure to the patient	<ul style="list-style-type: none"> <li>● Purpose of the procedure</li> <li>● When the results will be available</li> <li>● How to notify the healthcare worker <ul style="list-style-type: none"> <li>○ If assistance is needed</li> <li>○ When the procedure is completed</li> </ul> </li> <li>● That the hypertonic saline will taste salty</li> <li>● How to use the nebulizer</li> <li>● How to open and expectorate into the sputum container</li> <li>● How to place the sputum container in the plastic bag</li> <li>● The need for mouth breathing during the test</li> <li>● The potential side effects (coughing, dry mouth, chest tightness, nausea, or excess salivation)</li> <li>● Importance of staying in the sputum induction area until coughing has stopped</li> </ul>

	<ul style="list-style-type: none"> <li>• Importance of wearing a surgical mask before leaving the sputum induction area (if appropriate)</li> <li>• The need for the healthcare worker to wear a respirator during the procedure</li> </ul>
3. Instruct the patient on sputum induction	<ul style="list-style-type: none"> <li>• Wait until the healthcare worker has moved away from the sputum induction area before beginning the sputum induction procedure (if necessary, the healthcare worker may remain in the area during the procedure, but should wear an N95 respirator)</li> <li>• Rinse mouth and gargle with water or drink water before starting the procedure (to prevent specimen contamination)</li> <li>• Sit upright, place the mouthpiece in the mouth (apply nose clip if available) and turn nebulizer on <ul style="list-style-type: none"> <li>○ If needed the healthcare worker can assist</li> </ul> </li> <li>• Inhale the mist deeply followed by huffing and coughing</li> <li>• Cough vigorously if spontaneous coughing does not occur</li> <li>• Cover the mouth with tissue when coughing, unless expectorating into a jar</li> <li>• Produce a deep cough sputum specimen in the sputum jar</li> <li>• Discard saliva in a separate container (or emesis bowl/kidney dish)</li> <li>• Continue attempts until 5-10 ml of sputum has been obtained (show patient how much is needed on specimen container)</li> </ul>
4. Prepare nebulizer for patient use before bring the patient to the sputum induction area	<ul style="list-style-type: none"> <li>• Assemble and check the equipment</li> <li>• Load 5-10ml of the 5% hypertonic saline solution into the of nebulizer cup</li> <li>• Connect the assembly to the nebulizer machine</li> <li>• Test the nebulizer to ensure that adequate mist is produced</li> </ul>
5. Ensure patient has all necessary equipment and understands all instructions	<ul style="list-style-type: none"> <li>• Bring the patient to the sputum induction area, seating him/her comfortably in an upright position</li> <li>• Instruct patient to remain in the area after procedure begins</li> <li>• Verify that fresh air is flowing into the area</li> <li>• Place the mouthpiece into the patient's mouth (or request the patient to do so), re-emphasizing mouth breathing</li> <li>• Turn on the nebulizer (the fine mist should now be seen through the clear T-piece on inspiration, and the patient should experience a salty taste)</li> </ul>
6. Detect potential problems in the assembly of the equipment that could decrease the effectiveness of	<ul style="list-style-type: none"> <li>• One of the two one-way valves in the system may be positioned the wrong way</li> <li>• There may be not enough/too much water in the</li> </ul>

the procedure	<p>nebulizer chamber</p> <ul style="list-style-type: none"> <li>• There may not be enough hypertonic saline in the nebulizer cup</li> </ul>
7. Place a sign indicating that sputum induction is in progress	Put a “DO NOT ENTER: INDUCED SPUTUM IN PROCESS” sign near the outdoor sputum induction area
8. Observe patient at all times during the procedure	<ul style="list-style-type: none"> <li>• Watch carefully for signs of respiratory distress and ensure that patient does not leave the area until coughing has stopped</li> <li>• Monitor the patient from a distance near the outdoor sputum induction area</li> <li>• If the patient needs assistance, put on an N95 respirator before approaching the patient</li> </ul>
9. Perform sputum induction	<ul style="list-style-type: none"> <li>• Allow the patient to inhale the hypertonic mist for approximately 5 minutes</li> <li>• Instruct the patient to take several deep breaths off the nebulizer</li> <li>• If the patient does not initiate coughing spontaneously, ask the patient to attempt a forced cough</li> <li>• Use gentle chest physiotherapy (e.g. vibration and percussion) if necessary to produce sputum</li> </ul>
10. End the sputum induction procedure	<p>The procedure should be stopped when:</p> <ul style="list-style-type: none"> <li>• The patient has produced 5-10 ml of sputum</li> <li>• 15 minutes of nebulization is reached</li> <li>• The patient complains of dyspnoea, chest tightness or wheeze</li> <li>• The patient shows signs of respiratory distress or is light-headed or feels nauseated</li> </ul> <p>Write the patient’s details, collection date and time on the container, place the bar-coded NHLS sticker on the specimen container and dispatch the specimen to the laboratory.</p>
11. Assess the patient’s condition post-procedure, and take appropriate action if required.	Patients who experience severe bronchospasm after sputum induction may be candidates for bronchodilator or aerosol therapy to relieve bronchospasm (0.5 ml salbutamol respiratory solution in the treatment cup)
12. Wear properly fitted N95 respirator if entering or remaining in sputum induction room/area	<ul style="list-style-type: none"> <li>• Infectious droplet nuclei may be dispersed into the air during the procedure</li> </ul>
13. Ensure that the patient remains in the area until coughing has stopped	Contain infectious particles in the sputum induction area
14. Ensure patient wears a mask if it is necessary to leave the area before coughing has stopped	Prevent dispersion of infectious particles
15. Place a sign near the sputum induction area indicating when the it will be safe to enter	<ul style="list-style-type: none"> <li>• Adequate time must be allowed for removal of at least 99% of airborne contaminants.</li> <li>• For an outdoor area, at least 5 minutes should lapse</li> </ul>

	before the next patient enters the area after the previous patient has left.
16. Document	<ul style="list-style-type: none"> <li>• Document the procedure and any significant details in the patient’s record.</li> <li>• Once a result becomes available document this in the patient’s record.</li> </ul>
17. Prepare for the next patient	<ul style="list-style-type: none"> <li>• Wait required time for area to clear of infectious airborne particles (see #15) or wear a properly-fitted N95 respirator</li> <li>• Remove and discard disposable items in regular trash containers. Only blood-containing body fluids must be disposed of in special biohazard containers.</li> <li>• If reusable components are used, wash these components and disinfect in glutaraldehyde solution (cidex) following the manufacturer’s instruction label</li> <li>• Wipe counter with approved disinfectant between procedures and at the end of the day. If preferred, a linen saver may be placed on counter and changed between patients.</li> </ul>

**Table 5.1: Sputum Induction Procedure steps and key points**

## 6. Infection Control for Sputum Induction

Elements of a TB Infection Control program that are essential for a safe sputum induction program include:

- Administrative controls:
  - A triage program to identify persons with suspected or known infectious TB prior to sputum induction
  - A written sputum induction SOP that includes TB infection control instructions
  - Monitoring compliance with the sputum induction SOP
  - Employee training on safe and effective sputum induction procedures
  - Appropriate signage for high-risk procedure areas
    - For patients/visitors not to enter the area
    - To remind staff that a respirator is required to enter the area
    - To indicate when the area was last occupied by a patient with (suspected) TB and at what time the area will be safe to enter without a respirator
- Environmental controls, which include use of the following:
  - Outdoor sputum induction area (usually using thin fabric curtains or mobile screens for patient privacy) – this is the most practical approach for low-resource settings such as PHC facilities in South Africa
  - In more specialized centers Local Exhaust Ventilation (LEV), with maximized natural ventilation, may be used if sputum induction is conducted indoors, with or without supplementary UVGI

- Monitoring and maintenance programs for environmental controls
- A respiratory protection program
  - Use of fitted N95 respirators by staff present during high-risk procedures
  - Respiratory protection must be worn until >99% of airborne contaminants have been removed from the air

## 7. Equipment for sputum induction

- N95 respirator (for healthcare worker)
- Aerosol generator/Ultrasonic nebulizer machine
- Extension cable if using outdoor area
- Corrugated aerosol tubing (disposable preferred)
- One-way valve(s) and filter
- Mouthpiece (disposable preferred)
- Hypertonic saline solution (5%, in 200ml bottles)
- Disposable gloves
- Cup of water
- Paper tissues
- emesis bowl or other container
- Plastic specimen bag
- Sterile sputum containers identified with the patient's details
- Completed NHLS laboratory request form with patient details
- Surgical mask (for patient if/when leaving area)
- Mobile screen (for privacy in outdoor area)
- Sign stating: **"INDUCED SPUTUM IN PROGRESS – DO NOT ENTER"**
- 1 x T – piece
- 1 x Nebulizer cup
- 1 x Nebulizer lid
- 1 x 20 ml Syringe
- 1 x 19 Gauge needle
- 1 x Sharps container
- Detergent/cidex for disinfection of non-disposable tubing/nebulizer equipment

### Emergency Equipment

- Wall-supplied or cylinder oxygen
- Oxygen mask
- 1 x metre oxygen tubing
- Salbutamol (Ventolin®)/Ipratropium bromide (Atrovent®) and nebulizer or spacer

## REFERENCES

Francis J. Curry National Tuberculosis Center, 2007: *Tuberculosis Infection Control: A Practical Manual for Preventing TB*, pp 74 – 86. [http://www.nationaltbcenter.edu/TB\\_IC](http://www.nationaltbcenter.edu/TB_IC) (07/07/2009)

The Centers for Disease Control and Prevention, 2005, *Guidelines for preventing the transmission of mycobacterium tuberculosis in health-care facilities*.

<http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5417a1.htm>