

Tuberculosis - Sputum Induction Guidelines

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Secretary, NSW Health

This Policy Directive may be varied, withdrawn or replaced at any time. Compliance with this directive is mandatory for NSW Health and is a condition of subsidy for public health organisations.

TUBERCULOSIS - SPUTUM INDUCTION GUIDELINES

This Guideline is to be read in conjunction with NSW Health Department Policy Directives:

PD2007_036	Infection Control Policy
PD2007_006	Occupational Assessment, Screening & Vaccination Against Specified Infectious Diseases

INTRODUCTION

Sputum induction is a procedure used for patients who have trouble producing sputum spontaneously. The patient inhales nebulised hypertonic saline solution, which liquefies airway secretions, promotes coughing and allows expectoration of respiratory secretions.¹ Sputum induction is simple and non-invasive, and if successful, often precludes the need for bronchoscopy.²

The procedure produces coughing so it is likely that infectious droplets, if present, will be expelled into the room air. Strict airborne respiratory precautions should be observed whenever sputum induction is performed.

INDICATION

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. It may also be useful in the diagnosis of miliary tuberculosis and tuberculous pleural effusion

CONTRAINDICATIONS / PRECAUTIONS

1. As hypertonic saline causes bronchoconstriction, the procedure should only be performed after pre-medication with salbutamol and under medical supervision in patients with asthma, suspected asthma, or severely impaired lung function ($FEV_1 < 1$ litre).
2. 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 of unknown origin
 - acute respiratory distress
 - unstable cardiovascular status, (arrhythmias, angina)
 - thoracic, abdominal or cerebral aneurysms
 - hypoxia (SaO_2 less than 90% on room air)
 - lung function impairment (FEV_1 less than 1.0 Litre)
 - pneumothorax
 - pulmonary emboli

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- 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.

3. Patients who are unable to follow instructions.

INFECTION CONTROL

1. Induction of sputum should only be conducted in a single room with a ventilation system that allows for the total exhausting of air from the room to the external environment. The ideal is for these rooms to comply with *Australian Standard HB260-2003* for respiratory isolation rooms (Type 5 room), however the minimum requirement is a single room with door closed and air exhausted to the outside of the building without recirculation.ⁱ
2. Staff performing this procedure should have a documented record of their tuberculin skin test (TST) or Interferon gamma release immunoassay (IGRA) status.
3. Staff must wear the recommended TB respiratory protection⁴ (P2 mask) while in the room and disposable gloves when handling sputum specimen(s) (refer to *NSW Health Policy Directive PD2007_036 Infection Control*).
4. The breathing circuit used for sputum induction should have a filter on the expiratory side to reduce environmental contamination.

ACCREDITED STAFF

This procedure should only be performed by Physiotherapists and Registered Nurses who have been trained and accredited by their health care facility.

PREPARATION FOR THE PROCEDURE

Assess the patient

Assess the patient for the presence of asthma or any of the other conditions listed under “Contraindications/precautions” above.

Explain procedure to patient:

The following points should be explained to the patient prior to the procedure.

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- purpose of the procedure
- when results will be available
- how to notify the staff member if assistance is needed and when procedure is completed
- the hypertonic saline will taste salty
- how to use the nebuliser
- need for mouth breathing during the test
- need for deep inhalation followed by huffing and coughing
- patient should rinse their mouth and gargle with water (to prevent specimen contamination)
- patient should sit upright, place the mouthpiece in the patient's mouth, (apply nose clip) and turn nebuliser on
- patient should be encouraged to produce a deep cough sputum specimen
- importance of staying in the room until coughing has stopped
- importance of donning a surgical mask before leaving the room.

PROCEDURE

1. Before bringing the patient to the area in which the sputum induction is to be performed (see Appendix 1), assemble and check the equipment (see Appendix 2).
2. Fill the nebuliser chamber with water to between “min fill line” and “max fill line”.
3. Place the nebuliser cup into the nebulising chamber and ensure that the convex base is sitting in the water.
4. Load 20ml of the 3% hypertonic saline solution.
5. Inject the hypertonic saline into the nebuliser cup.
6. Connect the assembly to the nebuliser machine.
7. Instruct the patient to thoroughly clean the mouth by brushing with a toothbrush if this has not been done since a meal, or forceful rinsing and repeated gargling with tap water until the returned fluid is free from debris.
8. Bring the patient to the negative pressure room. Seat them comfortably in an upright position.
9. Explain the procedure and possible side effects to the patient (e.g., coughing, dry mouth, chest tightness, nausea and excess salivation) ¹

10. Instruct the patient to:
 - inhale and exhale through the mouthpiece only
 - expectorate saliva in the emesis bowl
 - expectorate sputum coughed up into the sterile jar.
11. Explain the need for the person doing the procedure to wear a TB respiratory protective device (P2 mask), and put it on.
12. Shut all doors and windows and put the “DO NOT ENTER: INDUCED SPUTUM IN PROCESS” sign on the outside of the door.
13. Turn the machine on (a fine mist should appear above the level of the hypertonic solutions).
14. Place the mouthpiece into the patient’s mouth, re-emphasising mouth breathing (the fine mist should now be seen through the clear T-piece on inspiration, and the patient should experience a salty taste in their mouth).

Note: Potential problems in equipment assembly which would decrease effectiveness of induced sputum include:

- one of the two one-way valves in the system may be positioned the wrong way.
 - there may be not enough/too much water in the nebuliser chamber.
 - there may not be enough 3% hypertonic saline in the nebuliser cup.
15. Allow the patient to inhale the hypertonic mist for approximately 5 minutes. Then instruct them to take several deep breaths off the nebuliser. If the patient does not initiate coughing spontaneously, ask them to attempt a forced cough.
 16. The person doing the procedure may use gentle chest physiotherapy e.g., vibration and percussion to produce sputum.
 17. Patient must be observed closely at all times during the procedure:
 - watch patient carefully for signs of respiratory distress.
 - a view window in the door should be provided to monitor the patient from outside the room.
 - if the patient requires assistance, the health professional must don a TB respiratory protection device (P2 mask) before entering the room and remove it after leaving the room.
 18. The procedure should be stopped when:
 - the patient has produced 1-2 ml of sputum for each specimen
 - 15 minutes of nebulisation is reached

- the patient complains of dyspnoea, chest tightness or wheeze.
19. Terminate the procedure if unsuccessful after 15 minutes, or if the patient is showing signs of respiratory distress or is light headed or feels nauseated.
 20. Place the patient's identification sticker on the specimen container; write on the sticker the time and date of the procedure.
 21. Assess the patient's condition post procedure, and take appropriate action if required.
 22. Remove the nebulise chamber and metal shield from the machine. Rinse and dry both with water and paper towel.
 23. Wipe over the nebuliser machine with methylated spirits.
 24. Dispatch the specimen to the Pathology Department.

DOCUMENTATION

Document the procedure and any significant details in the patient's progress notes and the nursing care plan. Once a result becomes available document this: 1) for inpatients in both the medical notes and on the result sheet in the front of the bed side charts, or 2) for out-patients document in the medical notes only.

FOLLOWING THE PROCEDURE

Place a sign on the door indicating when the room will be safe to enter

Adequate time must be allowed after the procedure 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 table 1).

Table 1.

Air changes per hour (ACH) and time required for removal efficiencies of 99.9% of airborne contaminants ⁷ **

Air Changes/Hour (ACH)	99.9 % Removal Efficiency
	Minutes required for removal efficiency #
2	207
4	104
6	69
12	35
15	28
20	14

Key: ** This table can be used to estimate the time necessary to clear the air of airborne *Mycobacterium tuberculosis* after the patient leaves the area or when aerosol-producing procedures are complete.

Time in minutes to reduce airborne concentration by 9.9%

Professor Debora Picone AM
Director-General

APPENDIX 1: Sputum induction rooms

A room with negative pressure should be used for sputum induction to prevent infectious particles from escaping to other areas of the facility. Air in rooms used for sputum induction should not be re-circulated unless it is via a well-maintained HEPA filtration unit. The air should be vented externally and external vents should not be in proximity to other patient areas (i.e. placement of vents needs to be done in consideration of the impact on the hospital population).

Type 5 (Respiratory isolation) room - Australian Standard HB 260-2003

Type 5 (Respiratory isolation) rooms are rooms that are suitable for the isolation of patients with infections transmissible by the airborne route and which are designed to minimise the potential for these infections to be transmitted to other patients or staff. Appropriate personal protection should be utilised by individuals entering the room.

A Type 5 (respiratory isolation) room will comprise a single room with an ensuite, but engineered such that the interior of the room can be made to be at a negative pressure with respect to the corridor with no, or minimal leakage of, air into the corridor.

With currently available technology and engineering practices, this means that an anteroom will usually be required. The anteroom should not be shared between rooms. The anteroom will not need to function as an absolute airlock. No air from the room should be recirculated into other areas within the facility (unless a HEPA filter is used).

Air change rates should be greater than or equal to twelve air change rates per hour with a minimum of two air changes per hour of outside air, whichever results in the greater air quantity, should be achievable when the filters have reached their maximum pressure drop.⁸

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 being exposure.

Air Exhausted Outdoors from Sputum Induction Rooms

No air from respiratory isolation rooms should be reticulated via or to any other ventilation system. Air from these rooms should be exhausted directly outside of the building. The discharge points should be located as far as possible from air intakes, animals and persons. Alternatively, if external exhausting is not possible, air that is to be re-circulated should be directed through HEPA filters.

Maintaining Sputum Induction Devices and Rooms with HEPA Filters

The maintenance of rooms used for sputum induction 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.

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.

APPENDIX 2: EQUIPMENT

- Recommended P2 facemask ^{4, 5} (for health care worker)
- Aerosol generator/ ultrasonic nebuliser machine
- Corrugated aerosol tubing (disposable preferred)
- One-way valve(s) and filter
- Mouthpiece (disposable preferred)
- Hypertonic saline solution
- Disposable gloves
- Cup of water and paper tissues
- Vomit bowl
- Clear plastic zip-lock specimen bag with biohazard label
- Sterile sputum container identified with the patient's details
- Completed laboratory request form with patient details
- Surgical mask^{6,7} (for patient if/when leaving room)
- Sign stating: **“INDUCED SPUTUM IN PROGRESS – DO NOT ENTER”**
- 1 x T – piece
- 1 x Nebuliser cup
- 1 x Nebuliser lid
- 1 x 20 ml Syringe
- 1 x 19 Gauge needle
- 1 x Sharps container

Emergency Equipment

- Wall-supplied or cylinder oxygen
- Hudson oxygen mask
- 1 x metre oxygen tubing
- Ventolin/Atrovent and nebuliser or spacer

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