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# Secretion clearance strategies in Australian and New Zealand Intensive Care Units

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ABSTRACT

*Introduction/aims:* To describe the processes of care for secretion clearance in adult, intubated and mechanically ventilated patients in Australian and New Zealand Intensive Care Units (ICUs).
*Methods/results:* A prospective, cross-sectional study was conducted through the Australian and New Zealand Intensive Care Society Clinical Trials Group (ANZICS CTG) Point Prevalence Program. Forty-seven ICUs collected data from 230 patients intubated and ventilated on the study day. Secretion clearance techniques beyond standard suctioning were used in 84/230 (37%) of patients during the study period. Chest wall vibration 34/84 (40%), manual lung hyperinflation 24/84 (29%), chest wall percussion 20/84 (24%), postural drainage/patient positioning 17/84 (20%) and other techniques including mobilisation 15/84 (18%), were the most common secretion clearance techniques employed. On average (SD), patients received airway suctioning 8.8 (5.0) times during the 24-h study period. Mucus plugging events were infrequent (2.7%). The additional secretion clearance techniques were provided by physiotherapy staff in 24/47 (51%) ICUs and by both nursing and physiotherapy staff in the remaining 23/47 (49%) ICUs.
*Conclusion:* One-third of intubated and ventilated patients received additional secretion clearance techniques. Mucus plugging events were infrequent with these additional secretion clearance approaches. Prospective studies must examine additional secretion clearance practices, prevalence of mucus plugging episodes and impact on patient outcomes.


## 1. Background

In critically ill, mechanically ventilated patients standard airway management to prevent secretion retention generally includes airway suctioning based on clinical need and the provision of adequate humidification.[1,2] In Australian and New Zealand Intensive Care Units (ICUs) however, additional secretion clearance techniques are a common part of patient management.[3] A recent observational study in a single ICU in Australia reported on the frequent use of secretion clearance techniques such as ventilator hyperinflation, patient positioning.[4] While strategies to prevent and/or manage secretion retention may be regularly employed, there are

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few objective methods available to identify secretion retention and hence little is known about the incidence, management and outcomes of secretion retention.[5,6] The number of airway complications that arise due to secretion retention is not known and neither are the methods employed by clinicians to detect signs of secretion retention.[1,2]

There is a need to better understand current secretion clearance approaches in adult mechanically ventilated patients in intensive care.

### 1.1. Aims

To describe current processes of care for secretion clearance approaches within adult, intubated and mechanically ventilated patients in Australian and New Zealand ICUs.

## 2. Objectives

1. Establish the frequency and type of secretion clearance techniques used in intubated and mechanically ventilated patients.
2. Establish the methods used for the management of suspected mucus plugging of endotracheal tube and or major airways.
3. Establish the physiotherapy staffing profiles and ICU practices surrounding secretion management.

## 3. Methods

A prospective, cross-sectional study was conducted through the Australian and New Zealand Intensive Care Society Clinical Trials Group (ANZICS CTG) Point Prevalence Program. Participating ICUs collected data on all patients present in the ICU at a 10 am census point on a pre-specified day in September or October 2015.[21] Data were entered into an electronic data capture system (REDCap—Vanderbilt University, Tennessee, USA) hosted at The George Institute for Global Health.[7]

Human Research Ethics Committee approval was obtained at each participating hospital with the requirement for consent waived at all sites. Patients aged 16 years or older were included if they were intubated with an endotracheal or tracheostomy tube and/or mechanically ventilated for 24 h or greater at 10 am on the designated study day. Patient demographics collected included age, gender, baseline clinical characteristics, Acute Physiological And Chronic Health Evaluation (APACHE) II score [8]; admission diagnosis and number of days in the ICU on study day. Information on the type and diameter of artificial airway (endotracheal tube or tracheostomy tube), the type of humidification device (heated humidifier or passive heat moisture exchanger) was also collected. Data on any additional invasive devices required, including but not limited to: high frequency oscillatory ventilation, veno-venous or −arterial extracorporeal support, intracranial pressure monitoring, cerebro-spinal fluid drainage, or use of an intra-aortic balloon counter-pulsation device or ventricular assist device, were also collected as these may have impacted on the outcomes of interest.

Secretion clearance data included the use of airway suctioning (type, open, closed or semi-closed; and number of airway suction episodes in the 24 h); saline instillation prior to or during suctioning; additional secretion clearance techniques including the number of episodes in the prior 24-h period and detail of specific techniques used (including but not limited to: postural drainage/patient positioning, manual hyperinflation, ventilator hyperinflation, chest wall percussion, chest wall vibration). Mucus plugging of the artificial airway or lower airways data was collected on any episodes (or suspected episodes) of in the 24-h period. Mucus plugging of the artificial airway or lower airways may have been suspected where any of the following occurred: (1) the presence of obstructive patterns on the ventilator waveforms e.g. "sawtoothing" on the expiratory flow waveform[9] and/or; (2) flattened or prolonged end-expiratory flow waveform; (3) an inability to deliver mechanical ventilation, where the tidal volume delivered cannot sustain adequate gas exchange and the patient may require disconnection from mechanical ventilation for the delivery of manual lung ventilation with a resuscitation circuit; (4) acute hypoxaemia and/or hypercarbia and/or patient respiratory distress; (5) inability to pass suction catheter the full length of the endotracheal or tracheostomy tube; (6) the need for open suction if not standard procedure in the ICU; (7) the need for emergency manual lung ventilation; (8) the need for emergency bronchoscopy; (9) the need for emergency saline lavage/lubricant during airway suctioning; (10) the need for unplanned endotracheal, inner tube of tracheostomy or tracheostomy tube change. Data were also collected on which ICU professionals delivered secretion clearance techniques and the ICU physiotherapy staffing levels.

## 4. Analysis

Statistical analysis was performed using Stata 12.1 (Statacorp). Variables that were normally distributed are reported as means and standard deviations, and non-normally distributed data are reported as medians with interquartile ranges. Proportions are reported as percentages.

## 5. Results

### 5.1. ICU and patient data

Data were collected from 682 patients from 47 participating ICUs across two study days. Of these, 230/682 (34%) were intubated and ventilated on the study day and were included in this study.

Patient characteristics are shown in Table 1. The majority of patients were male and were admitted to ICU postoperatively.

**Table 1**
Demographics.

| Demographics of intubated ICU patients (n = 230) | |
|---|---|
| Characteristics | n (%) |
| Age, years (mean, SD) | 55 (16) |
| Gender | |
| Female | 89 (39%) |
| Male | 141 (61%) |
| Weight kg (mean, SD) | 85 (27) |
| Admission APACHE II score, (median, IQR) | 19 (15, 25) |
| Source of ICU admission | |
| Emergency department | 70 (30%) |
| Postoperative | 71 (31%) |
| Ward | 51 (22%) |
| Transfer from other hospital or ICU | 38 (17%) |
| Previous ICU admission (in this hospital admission) | |
| No | 210 (91%) |
| Yes | 20 (9%) |
| Admission diagnosis of sepsis, burns/trauma, ARDS | |
| Sepsis[a] | 100 (43%) |
| Trauma/burns | 28 (12%) |
| Severe ARDS | 10 (4%) |
| Intubation type | |
| Endotracheal tube | 170 (74%) |
| Tracheostomy tube | 60 (26%) |
| Airway diameter (median, range, n = 179 patients) | 8 (6–9) |
| Length of ICU stay at study day, days (n = 193) | 16.7 (15) |
| 28 days after study day ICU mortality (n = 1 missing) | 15.7% |

[a] Sepsis definition: a defined focus of infection and two or more (2) systemic inflammatory response syndrome (SIRS) criteria on the study day.

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