



Scottish Intensive Care
Society Audit Group



VAP Prevention Bundle Guidance for Implementation



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Introduction

The Ventilator Associated Pneumonia (VAP) Prevention Bundle and associated tools were first jointly published by SICSAG and Health Protection Scotland (HPS) in January 2008. A review of the content against current available guidelines and evidence has now been undertaken by the Infection Control Team, HPS to ensure that the key recommendations are still accurate for the prevention of VAP, primarily aimed at the prevention of Healthcare Associated Infections (HAI).

The aim of this care bundle is to improve practice, alongside documented evidence of compliance with evidence based practice aimed at improving patient outcomes. This care bundle has been agreed by experts in intensive care and infection control, from around Scotland. They have considerable experience in their own areas of care bundle application and infection control through surveillance. It is also supported by the Scottish Patient Safety Programme <http://www.scottishpatientsafetyprogramme.scot.nhs.uk/programme/resources>.

Recommending best practice of this type requires compromise and pragmatism.

The following pages explain the rationale and detail each bundle element that can be measured against, however local adaptation may be deemed appropriate.

Auditing compliance with bundle elements should be undertaken and describing any account of valid clinical exclusions is essential. The full evidence base used to create this bundle can be found at <http://www.hps.scot.nhs.uk/haic/ic/evidenceforcarebundles.aspx>.

These measures are part of an overall strategy to reduce HAIs in intensive care which includes:

- Hand hygiene,
- Personal protective equipment,
- Environmental cleaning.

Clinical practice aimed at preventing VAP must be seen in the context of managing patients with respiratory failure and especially those who require invasive ventilation.

Avoiding invasive ventilation

Some patients with acute respiratory failure are suitable for non-invasive ventilation¹. Randomised Controlled Trials (RCTs) investigating the benefit of non-invasive ventilation have used primary outcomes such as invasive ventilator days, intensive care days and survival. There is good evidence that non-invasive ventilation improves these outcomes in patients with acute respiratory failure, especially those with an acute exacerbation of COPD, cardiogenic pulmonary oedema and the immuno-suppressed. Non-invasive ventilation may be associated with reduced rates of hospital-associated pneumonia, but the main benefit is in avoiding invasive ventilation.

Similarly, daily assessment of sedation requirement and the suitability for weaning and extubation helps reduce ventilator and ICU days.

We recommend consideration of **non-invasive ventilation, daily assessment of sedation and daily consideration for weaning and extubation** as part of an overall strategy for managing patients with acute respiratory failure.

Non-invasive ventilation and avoiding intubation should be considered in appropriate cases

Improved outcome with initial non-invasive respiratory support trying to avoid intubation has been demonstrated in the following groups¹:

- Cardiogenic pulmonary oedema,
- Acute exacerbation of Chronic Obstructive Pulmonary Disease,
- Immuno-compromised patients: Pneumocystis infection and solid organ transplant recipients.

Worse outcome with initial non-invasive respiratory support trying to avoid intubation has been demonstrated in:

- ICU patients who fail a trial of extubation^{2,3}.

References

1. Garpestad E, Brennan J, Hill NS. Noninvasive Ventilation for Critical Care. *Chest* 2007; 132(2):711–20.
2. Keenan SP, Powers C, McCormack DG and Block G. Non-invasive positive-pressure ventilation for post extubation respiratory distress: a randomized controlled trial *JAMA* 2002; 87(24):3238–44.
3. Esteban A, Frutos-Vivar F, Niall D et al. Non-invasive positive-pressure ventilation for respiratory failure after extubation. *N Engl J Med* 2004; 350:2452–60.

VAP Prevention Bundle

There are five key elements to this bundle which if addressed together should minimise the risk of ventilator associated pneumonia. VAP rates should be part of an infection surveillance programme.

1. Sedation to be reviewed and, if appropriate, stopped each day.
2. All patients will be assessed for weaning and extubation each day.
3. Avoid the supine position, aiming to have the patient at least 30° head up.
4. Use chlorhexidine as part of daily mouth care.
5. Use subglottic secretion drainage in patients likely to be ventilated for more than 48 hours.

Each element is explained with references and exclusions on the following pages.

1. Sedation is reviewed and, if appropriate, stopped each day

Rationale

A RCT of daily sedation breaks versus routine care demonstrated reduced duration of ventilation and intensive care unit stay in those patients having daily interruptions of sedation under the guidance of the research team⁴.

Another RCT demonstrated that a nurse-led protocol reduced ventilator time⁵.

This approach requires each ICU to examine their sedation practice and scoring and develop a system that allows a safe sedation hold policy, see example on page three from NHS Forth Valley.

Note

It is important to remember to review the patient's analgesic requirements if the sedation remains off.

Measurement criteria

Ensure that sedation is reviewed and if appropriate stopped each day.

Exclusions

1. Paralysed patient.
2. Patient with brain injury, sedated with possible ICP problem.
3. Patient who is difficult to ventilate - coughing/asynchrony.
4. Patient who is difficult to oxygenate $\geq 70\%O_2$ or PEEP ≥ 10 .
5. Patient receiving therapeutic hypothermia.
6. Patient receiving palliative/terminal care.

Example- NHS Forth Valley's sedation hold policy

The following guidance has been used successfully in NHS Forth Valley.

Sedation breaks should ideally occur **before 10am**. If appropriate consider switching off sedation at the end of the night shift. In order to maintain patient and staff safety, liaise closely with the nurse in charge and colleagues.

- Sedative agents should be stopped, but not disconnected from the patient,
- Allow the patient to wake,
- If the patient is co-operative and able to understand commands leave the sedation off,
- Distressed or agitated patients require re-sedating,
- Recommence the sedation at half the previous rate,
- Administer boluses as appropriate / required to achieve safety.

References

4. Kress JP, Pohlman AS, O'Connor MF, Hall JB. Daily interruption of sedative infusions in critically ill patients undergoing mechanical ventilation. *N Engl J Med* 2000; 342:1471–77.
5. Brook AD, Ahrens TS, Schaiff R et al. Effect of a nursing-implemented sedation protocol on the duration of mechanical ventilation. *Crit Care Med* 1999; 27(12): 2609–15.
6. Quenot JP, Ladoire S, Devoucoux F et al. Effect of a nurse-implemented sedation protocol on the incidence of ventilator-associated pneumonia. *Crit Care Med* 2007; 35(9):2031-6.

2. Assess all patients for weaning and extubation each day

Rationale

Daily screening of the respiratory function of ventilated patients followed by trials of spontaneous breathing in appropriate patients reduced the duration of mechanical ventilation and was associated with fewer complications than usual care⁷.

Other RCTs have demonstrated that weaning protocols reduce ventilator times^{8,9}.

Measurement criteria

Ensure that all patients are assessed for weaning and extubation each day.

Exclusions

1. Paralysed patient.
2. Patient with brain injury, sedated with possible ICP problem.
3. Patient who is difficult to ventilate - coughing/asynchrony.
4. Patient who is difficult to oxygenate $\geq 70\%O_2$ or PEEP ≥ 10 .
5. Patient receiving therapeutic hypothermia.
6. Patient receiving palliative/terminal care or PEEP ≥ 10 .

References

7. Ely EW, Baker AM, Dunagan DP et al. Effect on the duration of mechanical ventilation of identifying patients capable of breathing spontaneously. *N Engl J Med*. 1996; 335:1864-9.
8. Kollef MH, Shapiro SD, Silver P et al. A randomized, controlled trial of protocol-directed versus physician-directed weaning from mechanical ventilation. *Crit Care Med*. 1997; 25:567-74.
9. Marelich GP, Murin S, Battistella F et al. Protocol weaning of mechanical ventilation in medical and surgical patients by respiratory care practitioners and nurses: effect on weaning time and incidence of ventilator-associated pneumonia. *Chest* 2000; 118:459-467.

3. Avoid the supine position and aim to have the patient at least 30° head up

Rationale

Sitting ventilated patients up reduces oesophageal reflux, pulmonary aspiration and may prevent VAP.

Semi-recumbent positioning has been the subject of a number of studies including RCTs and subsequent meta-analyses.

Draculovic et al¹⁰ randomized 90 ventilated patients to supine or semi-recumbent positioning. There was a dramatic reduction in the risk of microbiologically proven VAP in the semi-recumbent group, (5 v. 23%). This means that only six patients would need to be treated in the semi-recumbent position to prevent one episode of VAP (95% confidence intervals 3-23).

Van Nieuwenhoven et al¹¹ conducted a RCT in 221 ventilated patients. The intended 45° backrest elevation in the experimental arm was not met, despite using research nurses around the clock; however a mean angle of 28° was achieved. In the control group, a mean angle of 10° was achieved. The VAP rates in both arms were low, with little difference (11.6 and 7.3%, respectively).

A meta-analysis of RCTs evaluating the impact of the patient position on the incidence in VAP reported that an angle of 45° rather than 15-30° was associated with a significantly lower incidence¹², however the authors acknowledged that this may be difficult to achieve in practice and indeed these data and findings were challenged in a later published article¹³. Furthermore the NICE patient safety guidance 2 which was published in 2008 also reports that obtaining an angle of 45° in patient positioning was difficult in practice, with an angle of around 30° being more practical¹⁴.

What can we learn from these seemingly disparate findings? Firstly that it is very difficult to achieve 45° backrest elevation, though elevation to nearly 30° is possible. It may be that avoidance of the supine position, particularly in patients being enterally fed, is more important than semi-recumbency.

Notes

Backrest elevation should be done whenever practical during patient care.

Bed angle can be checked against the SICSAG VAP Prevention Bedside Aide-Memoir which has lines at 30° and 45°. This is available on the SICSAG website www.sicsag.scot.nhs.uk.

Measurement criteria

Ensure that the supine position is avoided and aim to have the patient at least 30° head up.

Exclusions

1. Unstable, shocked patient (eg requiring fluid challenges, high dose vasoactive drugs).
2. Unstable pelvic or spinal injury (it may still be possible to tilt the whole bed).
3. Patient receiving palliative/terminal care.

References

10. Drakulovic MB, Torres A, Bauer TT, et al. Supine body position as a risk factor for nosocomial pneumonia in mechanically ventilated patients: a randomised trial. *Lancet* 1999; 354: 1851-1858.
11. Van Nieuwenhoven CA, Vandenbroucke-Grauls C, van Tiel FH, *et al*. Feasibility and effects of the semi recumbent position to prevent ventilator-associated pneumonia: a randomized study. *Critical Care Medicine* 2006; **34**: 396-402.
12. Alexiou VG, Ierodiakonou V, Dimopoulos G, Falagas ME. Impact of patient position on the incidence of ventilator-associated pneumonia: a meta-analysis of randomized controlled trials. *Journal of Critical Care* 2009 Dec; 24(4):515-22.
13. Silvestri L, Gregori D, van Saene HK, Belli R, Blazic M. Semirecumbent position to prevent ventilator-associated pneumonia is not evidence based. *Journal of Critical Care* 2010; 25(1):152-3.
14. National Institute for Health and Clinical Excellence, National Patient Safety Agency. Technical patient safety solutions for ventilator-associated pneumonia in adults. NICE 2008 [cited 2012 Jun 19]; Available from: URL: <http://www.nice.org.uk/nicemedia/live/12053/41684/41684.pdf>.

4. Use chlorhexidine as part of daily mouth care

Rationale

Oral antiseptics such as chlorhexidine will reduce oro-pharyngeal colonization and hence VAP.

Use of a chlorhexidine solution has been shown to be an effective way of reducing VAP in mechanically ventilated patients and this recommendation is consistent across all the current identified sources of evidence based guidance including systematic reviews and meta-analyses^{15,16,17}.

Notes

Various chlorhexidine preparations have been used in clinical trials. It is recognised that the probable optimal preparation is 2% chlorhexidine, but this is not commercially available in Scotland. 1% chlorhexidine gluconate gel is available and about 2cm may be applied by a gloved hand to the inside of each cheek, four times a day.

Chlorhexidine may become colonised by infective organisms such as pseudomonas if contaminated by careless use, therefore:

- Tubes of chlorhexidine must be for single patient use,
- Chlorhexidine gel must be applied with a clean (not sterile) glove donned for the application,
- Chlorhexidine can be inactivated by toothpaste, a gap of at least two hours should be left between its application and tooth brushing.

Measurement criteria

Ensure that chlorhexidine is used as part of daily mouth care.

Exclusions

1. Oro-pharyngeal trauma or surgery.
2. Known hypersensitivity to chlorhexidine (rare).
3. Patient receiving palliative/terminal care.

Reference

15. Chan EY, Ruest A, Meade MO, Cook DJ. Oral decontamination for prevention of pneumonia in mechanically ventilated adults: systematic review and meta-analysis. *BMJ* 2007 Apr 28; 334(7599):889.
16. Tantipong H, Morkhareonpong C, Jaiyindee S, Thamlikitkul V. Randomized controlled trial and meta-analysis of oral decontamination with 2% chlorhexidine solution for the prevention of ventilator-associated pneumonia. *Infect Control Hosp Epidemiology* 2008 Feb; 29(2):131-6.
17. Labeau SO, Van d, V, Brusselaers N, Vogelaers D, Blot SI. Prevention of ventilator-associated pneumonia with oral antiseptics: a systematic review and meta-analysis. [Review]. *The Lancet Infectious Diseases* 2011 Nov; 11(11):845-54.

5. Use subglottic secretion drainage in patients likely to be ventilated for more than 48 hours

Rationale

Subglottic drainage of potentially contaminated oro-pharyngeal secretions from above the tracheal tube cuff may prevent aspiration, lower airway colonization and hence pneumonia. Subglottic secretion drainage has been the experimental arm of six RCTs and one meta-analysis of nearly 900 patients^{18,19}.

The meta-analysis found that subglottic secretion drainage halved the incidence of VAP, particularly during the first week of intubation of patients expected to be ventilated for more than three days. Additionally, duration of ventilation was reduced by almost two days and intensive care unit stay by nearly three days.

The meta-analysis was well conducted, recognising the heterogeneity of the five trials and attempted to resolve some of the differences between trials by sensitivity analysis. An important difference was the study setting; one trial was conducted in a cardiothoracic intensive care unit, with short periods of ventilation and no statistically significant difference in VAP rates between the two study arms. The method of diagnosis was the most important source of heterogeneity, with only one study relying on quantitative analysis of bronchoscopically obtained secretions. This study demonstrated a reduced chance of VAP in the experimental arm, with seven patients needing to be treated by subglottic drainage to prevent one episode of VAP (95% CI 4-43).

It is recognised that endotracheal tubes and tracheostomy tubes with subglottic drainage ports are available, but there may be cost implications to using them and risks to changing tubes after ICU admission.

Note

Subglottic aspiration ports should be aspirated hourly.

Measurement criteria

Ensure that subglottic secretion drainage is used in patients likely to be ventilated for more than 48 hours.

Exclusion

1. Intubated prior to ICU admission (the risk of re-intubation must be considered; both the immediate risks of difficult or failed intubation and cardiovascular compromise and late complications such as VAP).
2. Local unit decision not to use tube with subglottic suction in this patient after considering individual risks and benefits.
3. Patient receiving palliative/terminal care.

You may wish to consider providing tracheal tubes with subglottic drainage ports outwith your ICU.

References

18. Dezfulian C, Shojania K, Collard HR, et al. Subglottic secretion drainage for preventing ventilator-associated pneumonia: a meta-analysis. *The American Journal of Medicine* 2005; 118:11-18.
19. Lorente L, Lecuona M, Jiménez A, Mora M, and Sierra A. Influence of an Endotracheal Tube with Polyurethane Cuff and Subglottic Secretion Drainage on Pneumonia. *Am. J. Respir. Crit. Care Med.* 2007; 176: 1079-1083.

Method of humidification

Method of humidification has not been convincingly demonstrated to have an overall beneficial effect, but is worthy of comment.

Traditional humidification of ventilator circuits used heated water humidifiers. While these achieve excellent heat and moisture contents of inspired gases, there is a risk of bacterial colonization of the condensate that forms inside the ventilator tubing. This may then be a source for inadvertent lower airway contamination.

Heat and moisture exchange filters may provide adequate humidification and warming of inspired gases.

Their use reduces colonization of the breathing circuit.

Ten small trials have examined VAP in patients randomized to receiving either method of humidification. Pooling the results of these trials together, without taking methodological differences into account, does not show statistically different VAP rates²⁰.

It is likely that the method of humidification does not play a significant role in the prevention of VAP. Heat and moisture exchange filters may be preferred on the grounds of cost and ease of use. However, their dead-space contributes to difficulties in carbon dioxide elimination in patients with ARDS.

Reference

20. <http://www.sicsebm.org.uk/VAP/HMEs.htm>

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