



Topic Expert Group: Patient safety and hygiene practice

Prevention of ventilator associated pneumonia

Dubois C, Tissières P, Helder O, Mader S, Borghesi A

Target group

Infants receiving mechanical ventilation and parents

User group

Healthcare professionals, neonatal units, hospitals, and health services

Statement of standard

The risk of ventilator associated pneumonia (VAP) is minimised by systematic application of care bundles.

Rationale

Ventilator associated pneumonia (VAP) may occur in between eight and 50% of ventilated infants (1,2), with a prevalence of up to 37 cases per 1000 ventilator-days (2–8). Criteria used to define VAP vary and affect incidence reporting. Despite formal definition in older infants, a specific definition for newborn infants is lacking. (1)

The risk of nosocomial infection is increased because of immature host defences and frequent invasive procedures. VAP arises when there is bacterial invasion of the pulmonary parenchyma in a patient who receives ventilation for more than 48 hours. (1) VAP arises following colonisation of the aerodigestive tract, aspiration of oral secretions and contaminated equipment. (2) Identification of causative microorganisms is not necessary to establish a diagnosis, but microbiological tests are essential to narrow the spectrum of antibiotic therapy.

Risk factors for VAP include low birth weight, prematurity, prolonged mechanical ventilation, reintubation, frequent endotracheal suctioning, presence of invasive devices, transfusions, inotropic drugs, and a history of bloodstream infection. (4,6,8–14) VAPs are associated with increased mortality, morbidity, prolonged hospital stay, and additional costs. (3,4,6,10,15) Multiple interventions are required to minimise the frequency of VAP. VAP may be reduced by careful attention to care practices. (11,16)

Benefits

Short-term benefits

- Reduced occurrence of VAP (11,16)
- Reduced risk of systemic sepsis (9,10,17)
- Reduced mortality and morbidity (6,12,18)
- Reduced duration of mechanical ventilation (3,6,8–10,13,14)
- Reduced length of hospital stay

Long-term benefits

- Reduced exposure to antibiotics (consensus)



- Reduced risk of chronic lung disease (4,12)
- Improved neuro-developmental outcome (19)
- Reduced healthcare costs (15,18,20)

Components of the standard

Component	Grading of evidence	Indicator of meeting the standard
For parents and family		
1. Parents are informed and instructed by healthcare professionals about ventilator associated pneumonia (VAP) and prevention using proper hand hygiene. (2,21,22) (see TEG Patient safety & hygiene practice)	A (Moderate quality) B (High quality)	Patient information sheet
2. Parents are encouraged to report incidents where they believe an error has been made in hygiene, and receive confidential timely feedback. (23) (see TEG Patient safety & hygiene practice)	A (Moderate quality) B (High quality)	Parent feedback
For healthcare professionals		
3. A unit guideline for screening, documentation, prevention, and treatment for VAP is adhered to by all healthcare professionals. (2,5,11,12,15,16,18,24–32)	A (Moderate quality) B (High quality)	Guideline
4. Head of bed is elevated at least 30°. (5,21)	A (Moderate quality) B (High quality)	Guideline
5. Training on screening, documentation, and treatment for VAP is attended by all responsible healthcare professionals.	B (High quality)	Training documentation
6. Hand hygiene according WHO's 'my five moments of hand hygiene' is applied including after handling respiratory equipment and supplies. (2,15,33,34)	A (High quality) B (High quality)	Guideline
7. A daily evaluation for readiness for extubation is undertaken. (2,11)	A (High quality) B (High quality)	Clinical records
For neonatal unit and hospital		
8. A unit guideline for screening, documentation, prevention, and treatment for VAP is available and	A (Moderate quality) B (High quality)	Guideline



regularly updated.
(2,5,11,12,15,16,18,24–32)

9. A unit guideline including criteria for intubation and extubation, and intubation procedures is available. (2,11,16,35)	A (High quality) B (High quality)	Guideline
10. Training on screening, documentation, treatment and prevention for neonatal VAP is ensured. (31,32)	A (High quality) B (High quality)	Training documentation
For health service		
11. The frequency of neonatal VAP is monitored between neonatal services using a common definition and expressed as infections per 1000 ventilator-days.	B (Moderate quality)	Audit report

Where to go – further development of care

Further development	Grading of evidence
For parents and family N/A	
For healthcare professionals N/A	
For neonatal unit	
<ul style="list-style-type: none"> Develop checklists for monitoring care of intubated patients. 	B (Moderate quality)
For hospital N/A	
For health service	
<ul style="list-style-type: none"> Refine and implement VAP care bundles. (11,16) 	A (Moderate quality)
<ul style="list-style-type: none"> Develop a European definition of VAP for newborn infants. 	B (High quality)

Getting started

Initial steps
For parents and family
<ul style="list-style-type: none"> Parents are verbally informed and educated by healthcare professionals about hand hygiene, nosocomial infections, and intubation.
For healthcare professionals
<ul style="list-style-type: none"> Attend training on screening, documentation, and treatment for VAP. Develop strategies for non-invasive ventilation when appropriate.



For neonatal unit and hospital

- Develop and implement a unit guideline on screening, documentation, prevention, and treatment for VAP.
- Develop information material on VAP and prevention using proper hand hygiene for parents.
- Support healthcare professionals to participate in training on screening, documentation, and treatment for VAP.
- Develop written protocols for ventilator care and audit compliance.
- Document and monitor the frequency of VAP.

For health service

- Develop a national guideline for screening, documentation, prevention, and treatment for VAP.

Description

A care bundle for the prevention of VAP includes:

- A clear pragmatic definition of neonatal VAP.
- A unit specific guideline covering ventilation strategy aimed at the use of ventilation strategies to minimise duration of endotracheal intubation.
- Development of objective criteria for intubation and extubation and use non-invasive respiratory support whenever possible.
- A daily assessment of readiness for extubation to be recorded in the clinical record.
- Careful attention to hand hygiene before and after contact with the infant for oral care and handling respiratory equipment and supplies.
- Procedures for minimising contamination of endotracheal tubes during insertion.
- Adoption of full sterile precautions for suctioning.
- Use of closed endotracheal suction devices.
- Regular oropharyngeal suction before ET manipulation, changing infant position, extubation and reintubation.
- Head of bed elevated at least 30°.
- Oral care provided 3-4 hourly.
- Minimisation of ventilator circuit changes (e.g. only on visible soiling, malfunction).
- Regular audits of adherence to the protocol.
- Monitoring and reporting the occurrence of VAP (rate per 1000 ventilator days).
- Regular training sessions for staff on prevention of VAP care bundle.

Source

1. Centers for Disease Control and Prevention (CDC). Pneumonia (Ventilator-associated (VAP) and non-ventilator-associated Pneumonia(PNEU)) Event Centers for Disease Control and Prevention. [Internet]. 2018. Available from: <http://www.cdc.gov/nhsn/PDFs/pscManual/6pscVAPcurrent.pdf>



2. Klompas M, Branson R, Eichenwald EC, Greene LR, Howell MD, Lee G, et al. Strategies to prevent ventilator-associated pneumonia in acute care hospitals: 2014 update. *Infect Control Hosp Epidemiol*. 2014 Sep;35 Suppl 2:S133-154.
3. Yuan T-M, Chen L-H, Yu H-M. Risk factors and outcomes for ventilator-associated pneumonia in neonatal intensive care unit patients. *J Perinat Med [Internet]*. 2007 Jan 1 [cited 2018 May 16];35(4). Available from: <https://www.degruyter.com/view/j/jpme.2007.35.issue-4/jpm.2007.065/jpm.2007.065.xml>
4. Tan B, Zhang F, Zhang X, Huang Y-L, Gao Y-S, Liu X, et al. Risk factors for ventilator-associated pneumonia in the neonatal intensive care unit: a meta-analysis of observational studies. *Eur J Pediatr*. 2014 Apr;173(4):427–34.
5. Garland JS. Strategies to Prevent Ventilator-Associated Pneumonia in Neonates. *Clin Perinatol*. 2010 Sep;37(3):629–43.
6. Apisarntharak A, Holzmann-Pazgal G, Hamvas A, Olsen MA, Fraser VJ. Ventilator-associated pneumonia in extremely preterm neonates in a neonatal intensive care unit: characteristics, risk factors, and outcomes. *Pediatrics*. 2003 Dec;112(6 Pt 1):1283–9.
7. Cernada M, Brugada M, Golombek S, Vento M. Ventilator-associated pneumonia in neonatal patients: an update. *Neonatology*. 2014;105(2):98–107.
8. Tripathi S, Malik GK, Jain A, Kohli N. Study of ventilator associated pneumonia in neonatal intensive care unit: characteristics, risk factors and outcome. *Internet J Med Update*. 2010;5:12–9.
9. Badr MA, Ali YF, Albanna EAM, Beshir MR, Amr GE. Ventilator associated pneumonia in critically-ill neonates admitted to neonatal intensive care unit, zagazig university hospitals. *Iran J Pediatr*. 2011 Dec;21(4):418–24.
10. Soliman W, Khattab A, El-Lahony D. Ventilator-associated pneumonia in the neonatal intensive care unit. *Menoufia Med J*. 2014;27(1):73.
11. Azab SFA, Sherbiny HS, Saleh SH, Elsaheed WF, Elshafiey MM, Siam AG, et al. Reducing ventilator-associated pneumonia in neonatal intensive care unit using “VAP prevention Bundle”: a cohort study. *BMC Infect Dis*. 2015 Aug 6;15:314.
12. Deng C, Li X, Zou Y, Wang J, Wang J, Namba F, et al. Risk factors and pathogen profile of ventilator-associated pneumonia in a neonatal intensive care unit in China: Neonatal VAP: risk and pathogen. *Pediatr Int*. 2011 Jun;53(3):332–7.
13. Cernada M, Aguar M, Brugada M, Gutiérrez A, López JL, Castell M, et al. Ventilator-Associated Pneumonia in Newborn Infants Diagnosed With an Invasive Bronchoalveolar Lavage Technique: A Prospective Observational Study*. *Pediatr Crit Care Med*. 2013 Jan;14(1):55–61.
14. Lee P-L, Lee W-T, Chen H-L. Ventilator-Associated Pneumonia in Low Birth Weight Neonates at a Neonatal Intensive Care Unit: A Retrospective Observational Study. *Pediatr Neonatol*. 2017 Feb;58(1):16–21.
15. Foglia E, Meier MD, Elward A. Ventilator-Associated Pneumonia in Neonatal and Pediatric Intensive Care Unit Patients. *Clin Microbiol Rev*. 2007 Jul 1;20(3):409–25.
16. Weber CD. Applying Adult Ventilator-associated Pneumonia Bundle Evidence to the Ventilated Neonate: *Adv Neonatal Care*. 2016 Jun;16(3):178–90.
17. Kusahara DM, Enz C d. C, Avelar AFM, Peterlini MAS, Pedreira M d. LG. Risk Factors for Ventilator-Associated Pneumonia in Infants and Children: a Cross-sectional Cohort Study. *Am J Crit Care*. 2014 Nov 1;23(6):469–76.



18. Cernada M, Brugada M, Golombek S, Vento M. Ventilator-associated pneumonia in neonatal patients: an update. *Neonatology*. 2014;105(2):98–107.
19. Stoll BJ. Neurodevelopmental and Growth Impairment Among Extremely Low-Birth-Weight Infants With Neonatal Infection. *JAMA*. 2004 Nov 17;292(19):2357.
20. Brilli RJ, Sparling KW, Lake MR, Butcher J, Myers SS, Clark MD, et al. The business case for preventing ventilator-associated pneumonia in pediatric intensive care unit patients. *Jt Comm J Qual Patient Saf*. 2008 Nov;34(11):629–38.
21. Bellissimo-Rodrigues F, Pires D, Zingg W, Pittet D. Role of parents in the promotion of hand hygiene in the paediatric setting: a systematic literature review. *J Hosp Infect*. 2016 Jun;93(2):159–63.
22. Fleming-Carroll B, Matlow A, Dooley S, McDonald V, Meighan K, Streitenberger K. Patient Safety in a Pediatric Centre: Partnering with Families. *Healthc Q*. 2006 Oct 15;9(sp):96–101.
23. Fleming-Carroll B, Matlow A, Dooley S, McDonald V, Meighan K, Streitenberger K. Patient safety in a pediatric centre: partnering with families. *Healthc Q Tor Ont*. 2006;9 Spec No:96–101.
24. Tablan OC, Anderson LJ, Besser R, Bridges C, Hajjeh R, CDC, et al. Guidelines for preventing health-care--associated pneumonia, 2003: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee. *MMWR Recomm Rep Morb Mortal Wkly Rep Recomm Rep*. 2004 Mar 26;53(RR-3):1–36.
25. Sole ML, Poalillo FE, Byers JF, Ludy JE. Bacterial growth in secretions and on suctioning equipment of orally intubated patients: a pilot study. *Am J Crit Care Off Publ Am Assoc Crit-Care Nurses*. 2002 Mar;11(2):141–9.
26. Chao Y-FC, Chen Y-Y, Wang K-WK, Lee R-P, Tsai H. Removal of oral secretion prior to position change can reduce the incidence of ventilator-associated pneumonia for adult ICU patients: a clinical controlled trial study. *J Clin Nurs*. 2009 Jan;18(1):22–8.
27. Dreyfuss D, Djedaini K, Weber P, Brun P, Lanore J-J, Rahmani J, et al. Prospective Study of Nosocomial Pneumonia and of Patient and Circuit Colonization During Mechanical Ventilation with Circuit Changes Every 48 Hours Versus No Change. *Am Rev Respir Dis*. 1991 Apr;143(4_pt_1):738–43.
28. Cordero L, Sananes M, Ayers LW. Comparison of a closed (Trach Care MAC) with an open endotracheal suction system in small premature infants. *J Perinatol Off J Calif Perinat Assoc*. 2000 May;20(3):151–6.
29. Kollef MH. Mechanical Ventilation with or without 7-Day Circuit Changes: A Randomized Controlled Trial. *Ann Intern Med*. 1995 Aug 1;123(3):168.
30. Hsieh T-C, Hsia S-H, Wu C-T, Lin T-Y, Chang C-C, Wong K-S. Frequency of Ventilator-associated Pneumonia With 3-day Versus 7-day Ventilator Circuit Changes. *Pediatr Neonatol*. 2010 Feb;51(1):37–43.
31. Yilmaz G, Aydin H, Aydin M, Saylan S, Ulusoy H, Koksali I. Staff education aimed at reducing ventilator-associated pneumonia. *J Med Microbiol*. 2016 Dec 16;65(12):1378–84.
32. Boev C, Xue Y, Ingersoll GL. Nursing job satisfaction, certification and healthcare-associated infections in critical care. *Intensive Crit Care Nurs*. 2015 Oct;31(5):276–84.
33. Sax H, Allegranzi B, Chraïti M-N, Boyce J, Larson E, Pittet D. The World Health Organization hand hygiene observation method. *Am J Infect Control*. 2009 Dec;37(10):827–34.



34. Won S-P, Chou H-C, Hsieh W-S, Chen C-Y, Huang S-M, Tsou K-I, et al. Handwashing Program for the Prevention of Nosocomial Infections in a Neonatal Intensive Care Unit. *Infect Control Hosp Epidemiol.* 2004 Sep;25(09):742–6.
35. Bigham MT, Amato R, Bondurant P, Fridriksson J, Krawczeski CD, Raake J, et al. Ventilator-Associated Pneumonia in the Pediatric Intensive Care Unit: Characterizing the Problem and Implementing a Sustainable Solution. *J Pediatr.* 2009 Apr;154(4):582-587.e2.

First edition, November 2018

Lifecycle

5 years/next revision 2023

Recommended citation

EFCNI, Dubois C, Tissières P et al., European Standards of Care for Newborn Health: Prevention of ventilator associated pneumonia. 2018.