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Centre for Health Protection

Recommendations on Prevention of Ventilator-associated Pneumonia

2nd Edition

Scientific Committee on Infection Control and
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Department of Health

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Background

The Recommendations on Prevention of Ventilator-associated Pneumonia (VAP) represent the fourth accomplishment of The Scientific Committee on Infection Control (SCIC) in the promulgation of preventive measures for the four major systems - namely, surgical site infection, intravascular catheter associated bloodstream infection, catheter-associated urinary tract infection and ventilator-associated pneumonia. It is believed that the recommendations presented in this report will provide guidance on good practice for the prevention of Ventilator-associated Pneumonia, which would ideally set the standard of care in Hong Kong.

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Recommendations on Prevention of Ventilator-associated Pneumonia

Introduction

Ventilator-associated pneumonia (VAP), as defined by the Infectious Disease Society of America (IDSA), is a pneumonia occurring >48 hours after endotracheal intubation (1) . There is no gold standard for the diagnosis of VAP. New lung infiltrate, plus clinical evidence suggesting that the infiltrate is of an infectious origin, such as new onset of fever, purulent sputum, leukocytosis and decline in oxygenation are often used to define pneumonia (1). Microbiological evidence of infection such as organisms cultured from blood, or isolation of an etiologic agent from a specimen obtained by bronchial brushing or biopsy support the etiology of the infection. Consider noting, however, that the presence of positive cultures is not diagnostic of VAP and their absence does not exclude the diagnosis. Different microbiologic sampling and culture techniques have different sensitivity, specificity and positive predictive values (2)

2. Hospital-acquired pneumonia is one of the most common nosocomial infections and the leading cause of death from nosocomial infections in critically ill patients. Approximately one-third of nosocomial pneumonia cases, with the majority being VAP, are acquired in the ICU (3). The incidence of VAP ranges from 5 to more than 20 cases per 1000 hospital admissions (2). US epidemiological studies report an incidence of VAP of 2–16 episodes per 1000 ventilator-days (4,5). Variation of the reported values in different cohorts could be influenced by factors such as implementation of preventive strategies and set of surveillance criteria used (3,6,7).

3. Ventilator-associated pneumonia prolongs lengths of stay in intensive care and hospital, and it increases costs of care and possibly increases mortality (3). The prevention of this infection is therefore a high priority for infection control in intensive care.

4. The recommendations include both non-pharmacological and pharmacological aspects based on best practices. They can serve as a model of practice in the formation of strategies, programmes, and plans for the prevention of ventilator-associated pneumonia in individual institutions.

(a) Infrastructure

(i) Establish ventilator-associated pneumonia (VAP) quality improvement team in intensive care units (8–12). Multidisciplinary teams should include doctors, nurses, chest physiotherapists and pharmacists at the minimum. (6)

(ii) Promote the use of noninvasive positive pressure ventilation (NIPPV) or high-flow oxygen via nasal cannula as alternatives to intubation for suitable patients. (6)

(iii) Standardize care processes through the implementation of guidelines, bundles, protocols or pathways. (6)

(iv) Establish adequate professional manpower to facilitate quality care for the ventilated patient. (13–15)

(v) Senior management should be involved in the implementation of HAI prevention programmes. (6)

(b) Staff training

(i) Integrate VAP prevention program into staff orientation and refreshment programmes in ICU/ HDU / ventilator wards. (6,11,13,16,17)

(ii) Provide adequate coaching and supervision to staff on intubation and care of ventilated patients until they are competent to work independently. (18–20)

(iii) Educate health-care workers regarding the epidemiology of, and infection control procedures for preventing healthcare-associated pneumonia to ensure worker competency. (20)

(iv) Education sessions should be ongoing, multidisciplinary and employ multiple teaching modalities. (6)

(v) Feedback unit VAP rates to the staff on regular basis to increase their awareness. (6)

(c) Shorten the duration of intubation and invasive ventilation

(i) Consider use of noninvasive positive pressure ventilation or high-flow oxygen via nasal cannula whenever possible to shorten the duration of invasive ventilation as non-invasive ventilation is associated with lower risk of VAP. (6,17,20–22)

(ii) Manage ventilated patients without sedatives whenever possible (6,22,23)

(iii) Ensure appropriate dosage of sedation or narcotics is prescribed. Consider use of sedation scale such as the Richmond Agitation Sedation Scale (RASS) to avoid over-sedation. (22,24)

(iv) Interrupt or lighten sedations daily (spontaneous awakening trials or SAT) for patient without contraindications at an appropriate time to see if patient can be safely managed with less sedation or no sedation (for adults and older paediatric patients). (6,13,24)

(v) Assess readiness to extubate once a day (spontaneous breathing trials or SBT) in patients without contraindications. (6)

(vi) Examples of contraindications to SAT and SBT include increased intracranial pressure, active myocardial ischemia and paralysis

(vii) Pair spontaneous breathing trials with spontaneous awakening trials. (6)

(viii) Liberate from invasive ventilation as soon as possible. (21,25)

(ix) Avoid unplanned (e.g. self) extubation by increased monitoring during trial for lightening sedation. (6,17,24) Unnecessary re-intubation may increase the risk of VAP. (26–28)

(x) Provide early exercise and mobilization. (6)

(d) Basic principles on preventing contamination

(i) Apply appropriate infection precautions to prevent patients from exposure to highly transmissible or epidemiologically-important pathogens. (29)

(ii) Practice of standard precautions should be observed. (20)

(iii) Perform hand hygiene before and after performing respiratory care such as, manipulation of ventilator circuits or tracheal tube. (17,20,28,30,31)

(iv) Wear clean gloves when contact with respiratory secretions is anticipated. Gloves should be changed and hand hygiene practiced between patients. (20,32)

(e) Tracheal tube intubation

(i) Maintain aseptic technique in the whole intubation procedure. Mask and gloves should be worn. (22,33–36)

(ii) Insert endotracheal tube via oral route when there is no contraindication. Compared with nasal intubation, orotracheal intubation is associated with low risk of sinusitis and VAP. (6,13,17,18,20,21,28)

(iii) There is insufficient evidence currently to suggest benefit of ultrathin polyurethane ETT cuffs over conventional PVC cuffs. (6,37,38)

(iv) Use aseptic technique when replacing a new tracheostomy tube. (20)

(f) Perform tracheal suction properly

(i) Perform suction only when indicated. Avoid routine suction. The depth of suction catheter insertion should be measured beforehand. Care should be taken to suction pressure to avoid damaging the respiratory mucosa. (39,40)

(ii) Perform suction with aseptic technique. The type of suction systems, open or closed, makes no difference in the incidence of VAP. (6,13,18,20,28,41–43)

(iii) The advantage of closed suction method is that there is no dissemination of aerosols. (44) Therefore, measures to prevent the transmission of infectious aerosols are not required. (45)

(iv) When open tracheal suction method is used:

(v) Use a sterile, single-use suction catheter. (20,22,39)

(vi) Perform hand hygiene before wearing gloves. (20)

(vii) It is preferable to use sterile gloves than clean gloves for endotracheal suction. (20,22,39) If clean gloves are used, ensure the sterility of inserted part of suction catheter is maintained.

(viii) When a suction catheter is blocked by secretions, it is preferable to discard it and use a new suction catheter.

(ix) When closed suction method is used:

(x) Wear clean gloves. (39,46)

(xi) Change the in-line suction catheter following manufacturer's recommendation or when the suction catheter is visibly soiled. (20)

(g) Saline instillation

(i) The practice of using saline instillation to loosen sputum for suction before tracheal suctioning is controversial and cannot be recommended until sufficient data is available. (6,47,48)

(ii) If saline instillation is deemed necessary, single dose sterile solution should be used. (48,49)

(h) Care of the respiratory care equipment

(i) Ensure the policies and practices for disinfection, sterilization, and maintenance of respiratory equipment are aligned with evidence-based standards. (6) Re-used respiratory accessories, including the breathing systems used for anesthesia, respirometer, resuscitation bag, nebulizer and test lung, should be properly cleansed and decontaminated after each use in accordance with the manufacturer's instructions. (6,20,22)

(ii) Develop maintenance care incorporated with infection control principles:

(iii) Allocate individualized respiratory equipment for each patient as far as possible. (23,29)

(iv) Provide a new set of disposable or high level disinfected ventilator tubing for each patient. (21)

(v) Minimize ventilator circuit breaks and change the ventilator circuit only if visibly soiled or malfunctioning. (6,13,22,28,50)

(vi) Use sterile water to fill the humidifier of ventilator. (20,22,23,51) It is an acceptable option to set up a closed water-refilling system to minimize manipulation of the humidifier system. (20,51,52)

(vii) Change suction collection canisters and tubing between patients. (29)

(viii) Handle and store disinfected respiratory equipment or sterile items properly to preserve their sterility.

(ix) Check the expiry date and inspect package integrity of all sterile respiratory items before use.

(x) Ensure that disinfected respiratory equipment (e.g. nebulizers) is not re-contaminated during rinsing process. Sterile water should be used for rinsing. (20,53)

(xi) In-line medication nebulizers: Use single dose vials of sterile medication or solution for nebulization whenever available. If multi-dose medication vials are used, ensure their sterility is maintained by proper storage and handling. (20)

(i) Prevent condensate from ventilator circuits draining towards patients

(i) Position the ventilator's humidifier below the bed level to prevent condensation from draining toward the patients. Drain and discard the condensate from ventilator tubing to water traps periodically. (6,17,20,28,54).

(ii) Always drain ventilator tubing and remove oral secretion before

repositioning patient. (55,56)

(j) Prevent leakage of subglottic secretion into the lower airway

(i) Maintain the tracheal tube cuff pressure adequately to prevent the leakage of secretion into the lower airway. (6,17,21,28)

(ii) Ensure oral and subglottic secretion is cleared before tracheal cuff deflation. (18,20,56)

(iii) Consider use of subglottic drainage endotracheal tube and tracheostomy tube for selected eligible patients e.g. those likely to require greater than 48 or 72 hours of intubation. (6,17,57–60)

(k) Prevent aspiration

(i) Place the ventilated patient in semi-upright position between 30 and 45 degrees, especially during feeding and transport, unless there is a contraindication. (6,17,18,20–22,24,61)

(ii) Verify the gastric tube is in proper position every time before feeding. (62)

(iii) Adjust the rate of tube feeding carefully according to individual's tolerance to prevent gastric over-distention. (21,28)

(iv) Placing a feeding tube in the small bowel instead of gastrostomy tube for feeding in long-term ventilated patient might lead to a lower risk of pneumonia although it has not been clearly and consistently shown to decrease mortality. (63)

(v) Avoid use of large-bore gastric tube unnecessarily as it affects the sphincter closure and increases the risk of regurgitation. (64)

(vi) The absence of gastric volume monitoring was not inferior to routine residual gastric volume monitoring in terms of development of VAP. (65)

(l) Proper humidification of the inspired gas

(i) Comparing the use of heated humidifiers and heat and moist exchangers (HMEs), there is no significant difference in the incidences of VAP in patients among the two groups. (20,28,66,67) However, HME can be considered an acceptable option because it is easier to use, and it can save manpower and thus reduce the healthcare cost. (28)

(ii) Make sure the patient has no contraindications when using heat and moist exchanger. (18,28,66)

(iii) Change an HME when it malfunctions mechanically or becomes visibly soiled. (6,20,68)

(iv) Adjust the heated humidifier setting to provide optimum airway humidification. The inspired gas should be warmed to achieve physiological body temperature of 37°C and physiological humidity. (69)

(m) Provide oral care to ventilated patients

(i) Include oral care as a part of standard ventilator care protocol. (6,20,70–73) Poor oral hygiene may increase the risk of VAP. (71) Implementation of oral care can be facilitated with oral care kits. (70–72)

(ii) An increasing amount of data suggests that oral care with Chlorhexidine may actually increase mortality rate. (74–77) It is recommended to perform oral care with normal saline.

(iii) Consider mechanical tooth brushing. (6)

(n) Stress Ulcer Prophylaxis

(i) Use of histamine type 2 receptor blockers, proton pump inhibitors and antacids may increase the risk for the development of healthcare-associated pneumonia, especially in patients receiving enteral nutrition. (78–82)

(ii) The risk of bleeding should be balanced against the risk of VAP and *C. difficile* infection when using prophylaxis for stress ulcer in patients with bleeding within the past year.

(o) Prophylactic Antibiotics

(i) Prolonged use of prophylactic antibiotics is not recommended because prior administration of antibiotics was found to increase risk for the development of late-onset VAP and the potential for development of antibiotic-resistant pathogens. (83,84)

(ii) There is no firm evidence that the use of short course (less than 24 hours) prophylactic antibiotics in high risk patients (trauma, severe head injury, coma, high-risk surgical procedure) following intubation, surgery, or the initial trauma (85) reduces the risk of VAP. More evidence is required before this can be recommended.

(p) Antimicrobial Stewardship Programme

(i) Antimicrobial Stewardship Programme (ASP) is defined as the optimal selection, dosage, route of administration and duration of antibiotic treatment. It is one of the core components of infection control. (86)

(ii) Preauthorization and/or prospective audit and feedback improve antibiotic use. ASP should include one or a combination of both strategies. (87)

(iii) ASPs should implement guidelines and strategies to reduce antibiotic therapy to the shortest effective. (87) A 7-day course of antimicrobial therapy for patients with VAP rather than a longer duration is recommended. (1)

(iv) A longer course of antimicrobial therapy may be needed for patients with risk factors such as immunocompromised status, complicated infections e.g. lung abscess or suboptimal clinical response. (3)

(v) It is recommended to use clinical criteria alone, rather than serum Procalcitonin (PCT) plus clinical criteria, to decide on initiation of antibiotic therapy. (1) Procalcitonin is useful to guide antibiotic duration in cases with anticipated course of treatment lasting for more than 7-8 days. (3,88)

(vi) It is recommended that hospitals regularly generate and disseminate a local antibiogram, ideally one that is specific to their intensive care population(s) if possible to guide selection of an empiric antibiotic regimen. (1)

(q) Quality improvement Programmes

(i) Process measures: Perform direct observation of compliance with VAP-specific process measures at set interval. (6,17)

(ii) Compliance with hand-hygiene. (6,31)

(iii) Compliance with monitoring average sedation levels to assure patients are minimally sedated, daily sedation interruption and assessment of readiness to wean. (6,24)

(iv) Compliance with regular oral care. (6)

(v) Compliance with semi-recumbent positioning. (6)

(vi) Outcome measures: Conduct ongoing active surveillance for ventilator-associated pneumonia in ICU or high dependent area. (6,20,89,90) Two sets of surveillance definitions are shown in annexes 1 & 2.

(vii) Continue quality improvement: Establish a system to review the updated evidences on VAP prevention strategies, identify the areas for improvement in the units and develop best practices. (8,9)

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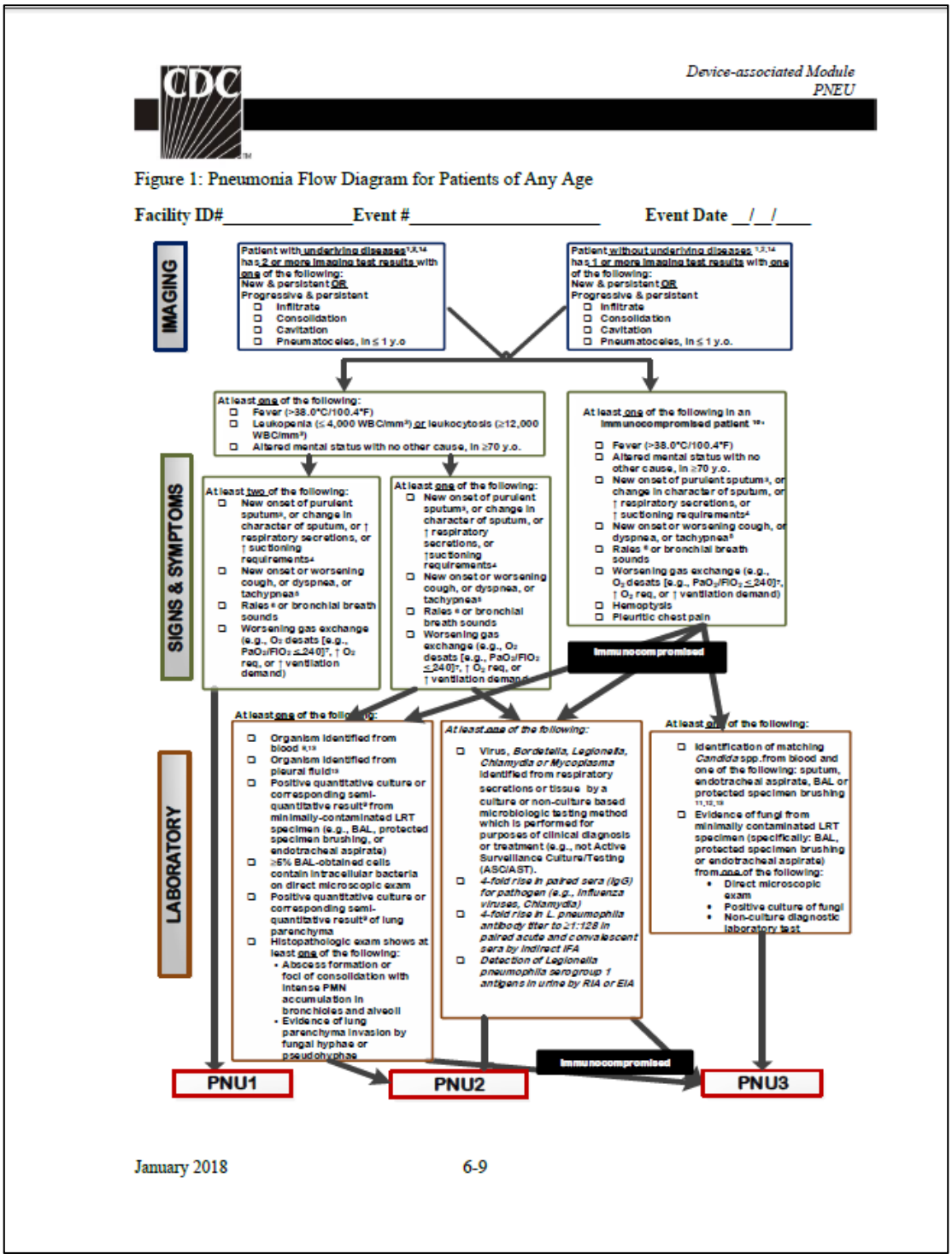
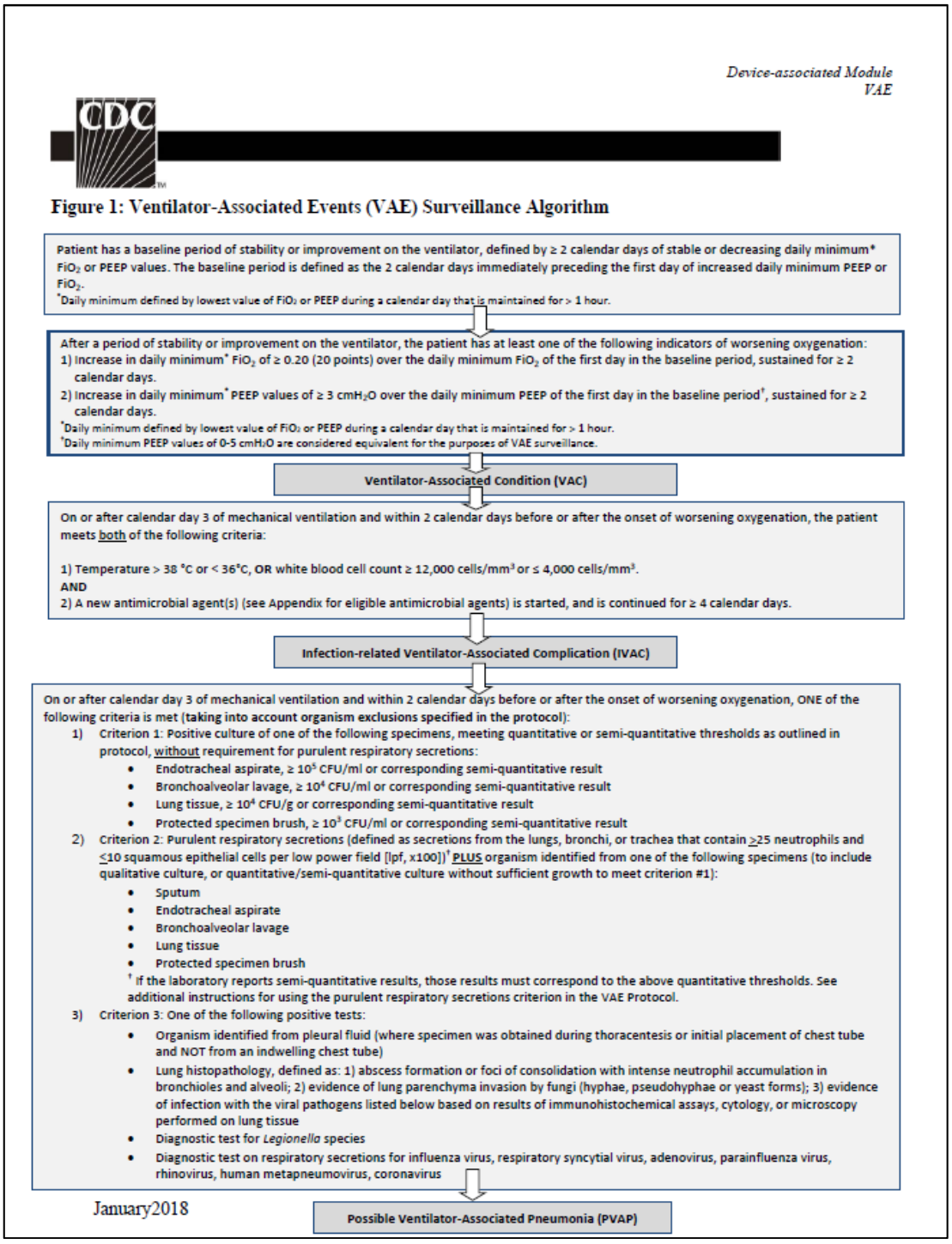
Annex 1: CDC Surveillance - Pneumonia Flow Diagram for Patients of Any Age

(Source: https://www.cdc.gov/nhsn/pdfs/pscmanual/6pscvapcurrent.pdf)



Annex 2^: CDC Surveillance - Ventilator-Associated Event (VAE)
(For use in adult locations only)
(Source: https://www.cdc.gov/nhsn/pdfs/pscmanual/10-vae_final.pdf)



^ All recommendations to prevent VAP also apply to preventing VAEs but there are some additional important measures, particularly conservative fluid management and low tidal volume ventilation. (91)

Hong Kong Bundle to Prevent VAP

1. Elevate the head of patient to 30-45 degrees unless contraindicated.
2. Provide oral care to ventilated patients on a regular basis.
3. Perform hand hygiene before and after each respiratory care.
4. Use minimal or no sedation if possible.
5. Assess readiness to wean and to extubate at least on daily basis.
6. Prevent condensate from entering patient's airway.
7. Maintain proper care of the respiratory consumables and equipment.