

**Fifth Edition
November 2011**

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- health plans, health systems, health care organizations, hospitals and integrated health care delivery systems;
- health care teaching institutions;
- health care information service departments;
- health care information technology departments;
- medical specialty and professional societies;
- researchers;
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throughout the
document provides
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Annotation Table

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Disclosure of Potential Conflict of Interest

In the interest of full disclosure, ICSI has adopted a policy of revealing relationships work group members have with companies that sell products or services that are relevant to this protocol topic. It is not assumed that these financial interests will have an adverse impact on content. They are simply noted here to fully inform users of the protocol.

No work group members have potential conflicts of interest to disclose.

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Evidence Grading

A consistent and defined process is used for literature search and review for the development and revision of ICSI protocols. Literature search terms for the current revision of this document include ventilator associated pneumonia and VAP from January 1, 2009, through March 31, 2011.

Individual research reports are assigned a letter indicating the class of report based on design type: A, B, C, D, M, R, X.

Evidence citations are listed in the document utilizing this format: (*Author, YYYY [report class]; Author, YYYY [report class] – in chronological order, most recent date first*). A full explanation of ICSI's Evidence Grading System can be found on the ICSI Web site at <http://www.icsi.org>.

Class	Description
Primary Reports of New Data Collections	
A	Randomized, controlled trial
B	Cohort-study
C	Non-randomized trial with concurrent or historical controls Case-control study Study of sensitivity and specificity of a diagnostic test Population-based descriptive study
D	Cross-sectional study Case series Case report
Reports that Synthesize or Reflect upon Collections of Primary Reports	
M	Meta-analysis Systematic review Decision analysis Cost-effectiveness analysis
R	Consensus statement Consensus report Narrative review
X	Medical opinion

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Foreword

Introduction

The goal is to prevent ventilator-associated pneumonia, deaths from ventilator-associated pneumonia and other complications in adult patients on ventilators in the intensive care unit by reliably implementing a set of interventions.

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Scope and Target Population

This protocol covers the protocol and orders around patient care management for the prevention of ventilator-associated pneumonia. The ventilator bundle includes the following components: elevation of the head of the bed, daily "sedation vacation" and assessment of readiness to extubate, stress ulcer disease prophylaxis, and deep vein thrombosis prophylaxis. The first components are directed at preventing ventilator-associated pneumonia, and the last two are directed at preventing other complications associated with mechanical ventilation. This protocol does not include admission orders to the intensive care unit or other specific orders for the patient's condition outside of ventilator management.

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Aims

1. Eliminate ventilator-associated pneumonia in adult patients in an intensive care unit. (*Annotation #1*)
2. Increase the use of ventilator-associated pneumonia bundle in all ventilated patients in an intensive care unit. (*Annotations #1, 2*)

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Clinical Highlights

- Reliably implement the ventilator bundle (set of interventions). (*Introduction*)

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Implementation Recommendation Highlights

The following system changes were identified by the guideline work group as key strategies for health care systems to incorporate in support of the implementation of this guideline.

1. Standardize tools, checklists, equipment and practices.
2. Train all staff and physicians on the standard practices and tools to assist in adhering to those standard practices.
3. Implement the entire ventilator bundle to result in significantly better outcomes than any of the elements of the bundle implemented independently. For successful bundle implementation you need:
 - continuous and frequent measurement and feedback on the bundle implementation (process measures);
 - multidisciplinary approach – by involving all those who play vital roles in implementing the various components of the bundle, the need for all the roles to work together becomes imperative for successful bundle implementation;
 - reminders to staff on the various bundle components in multiple ways such as a reminder on the admission order, in patient rooms and on other rounding sheets; and
 - use of the order set (containing all the bundle components) as the routine – a physician has to issue a specific order if something else is to be followed.
4. Recommend an organizational approach, involving critical care expertise, regarding an appropriate standardized situational approach for determining the type of suction system used.

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Related ICSI Scientific Documents

Guidelines

- [Palliative Care](#)
- [Venous Thromboembolism Prophylaxis](#)
- [Antithrombotic Therapy Supplement](#)

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Protocol

Nursing and Respiratory Care (*Annotation #1*)

- Elevate the head of the bed at an angle of 30-45 degrees for a patient at high risk for aspiration in the absence of medical contraindications.
- Cuff pressure should be maintained at 20-25 cm H₂O.
- Circuit changes should occur when visibly soiled rather than routinely.
- Heat and moisture exchangers should not be changed more frequently than every 48 hours or when they become visibly soiled or mechanically malfunction.
- Assess the oral cavity and provide oral care every 6-8 hours and as needed, using a 0.12% or 2% chlorhexidine solution. Apply water-soluble mouth moisturizer and/or lip balm every 6-8 hours (after oral care) and as needed to maintain moisture.
- Use a dedicated suction line for endotracheal tube suctioning of respiratory secretions. Rotate position of oral endotracheal tube not less than every 24 hours. If endotracheal dorsal lumen is used, remove deep oral/subglottic secretions continuously per manufacturer's recommendations.
- Evaluate for kinetic bed therapy.
- Assess patient for daily sedation reduction/discontinuation and implement per institution's guidelines. Reduce or discontinue sedation until patient is awake and can follow simple commands OR patient becomes agitated.
- Assess eligibility for daily weaning trials unless contraindicated.

Medications (*Annotation #2*)

- Assess for stress ulcer prophylaxis and ongoing use.
- It is recommended that all patients on admission to a critical care unit be assessed for their risk of venous thromboembolism, and receive thromboprophylaxis based on that risk.

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Annotations

1. Nursing and Respiratory Care

Head of Bed

In the absence of medical contraindications, elevate the head of the bed at an angle of 30-45 degrees for a patient at high risk for aspiration (e.g., a person receiving mechanically assisted ventilation and/or who has an enteral tube in place) (*Centers for Disease Control and Prevention, 2004 [R]; Drakulovic, 1999 [A]; Torres, 1992 [A]*).

Maintaining the head of the bed at greater than 30 degrees may be difficult. Lower elevations (20-30 degrees) may not prevent ventilator-associated pneumonia compared to a "control" elevation of 10 degrees (*van Nieuwenhoven, 2006 [A]*).

Cuff Pressure

Cuff pressure should be maintained at 20-25 cm H₂O. Minimal leak technique is discouraged (*Ferrer, 2002 [R]; Hixson, 1998 [R]; Rello, 1996 [B]*). Rello, et al. noted that low intracuff pressure may be a risk factor for ventilator-associated pneumonia. His data demonstrated a benefit for maintaining cuff pressure in the endotracheal tube above 20 mmHg. As a secondary outcome to his study of continuous aspiration of subglottic secretions, low cuff pressures were associated with a higher risk of ventilator-associated pneumonia for patients not receiving antibiotics (*Rello, 1996 [B]*).

In the review article by Ferrer, et al., it is noted that "stagnant oropharyngeal secretions above the cuff can easily gain access to the lower airway when cuff pressure decreases spontaneously or there is a temporary deflation of the cuff" (*Ferrer, 2002 [R]*). An earlier study of cuff pressures by Oikkonen, et al. found that pooled secretions above the inflated endotracheal cuff may be a source of aspiration and a cause of ventilator-associated pneumonia (*Oikkonen, 1997 [NA]*).

The Centers for Disease Control and Prevention does not currently have recommendations for endotracheal cuff pressures.

Circuit Changes

Less frequent changes do not lead to increased incidence of ventilator-associated pneumonia. Circuit changes should occur when visibly soiled rather than routinely (*Centers for Disease Control and Prevention, 2004 [R]*).

Heated Humidifiers, and Heat and Moisture Exchangers

The Centers for Disease Control and Prevention makes no preferential recommendation regarding the use of heated humidifiers or heat and moisture exchangers.

There is insufficient evidence to conclude that the ventilator-associated pneumonia rate differs in patients ventilated with heated humidifiers compared to heat and moisture exchangers, especially if double-heater-wire circuit technology is used in the latter (*Boots, 2006 [A]; Lorente, 2006 [A]*).

The Centers for Disease Control and Prevention recommends that heat and moisture exchangers not be changed more frequently than every 48 hours or when they become visibly soiled or mechanically malfunction (*Centers for Disease Control and Prevention, 2004 [R]*). In studies where the heat and moisture exchangers were changed either every 48 hours or up to 120 hours as compared to every 24 hours, no increase in ventilator-associated pneumonia was identified. In addition, no differences in technical or clinical performance of the ventilators were identified (*Davis, 2000 [A]; Thomachot, 1998 [A]*).

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Annotations

In a prospective, randomized, non-blinded trial of 155 consecutive patients in a community intensive care unit requiring mechanical ventilation for more than 48 hours, no differences in ventilator-associated pneumonia, bacterial colonization or ventilator support variables were found when comparing heat and moisture exchangers changes after one day or after up to seven days (*Thomachot, 2002 [A]*).

In addition, it was found that endotracheal tube occlusion is a very rare event when humidification is provided by extended (up to seven days) use of heat and moisture exchangers. This was probably attributed to several key points:

- Patients with contraindications (hypothermia, bronchopleural fistulas) must be excluded.
- Tube patency must be checked by regular suctioning.
- Heat and moisture exchangers must be changed when they are visibly soiled.
- Heat and moisture exchangers should be placed vertically above the tracheal tube, and nurses and doctors should repeatedly check the position.

Because these studies were conducted on adult populations in an intensive care unit setting, other studies are required to determine the safety of extended heat and moisture exchangers use in other populations such as pediatric patients and long-term ventilator-dependent patients.

Oral Care

A randomized controlled trial and a meta-analysis evaluated the effectiveness of oral decontamination with a 2% chlorhexidine solution for the prevention of ventilator-associated pneumonia. The patient received a 2% chlorhexidine solution or normal saline solution four times per day until endotracheal tube removal. The incidence of ventilator-associated pneumonia, oropharyngeal colonization with gram negative bacilli and overall mortality showed no difference. However, the number of episodes of ventilator-associated pneumonia per 1,000 ventilator days was statistically different between the chlorhexidine and normal saline groups. Irritation of the oral mucous was noted at a higher rate in the chlorhexidine group and was a dose limiting effect.

This study was combined with one other randomized, controlled trial for a meta-analysis that evaluated oral contamination with 2% chlorhexidine and the incidence of pneumonia in mechanically ventilated patients. There was a significant reduction in the rate of ventilator-associated pneumonia in the chlorhexidine group (*Tantipong, 2008 [A]*).

Secretion Removal with Specially Designed Endotracheal Tubes

The American Thoracic Society document recommends continuous aspiration of subglottic secretions; the use of a specially designed endotracheal tube has significantly reduced the incidence of early-onset ventilator-associated pneumonia in several studies (*American Thoracic Society, 2005 [R]*).

Due to the risk of the high aspiration of subglottic secretions during an endotracheal tube switch, changing out a standard endotracheal tube for an endotracheal tube with a subglottic suction lumen is not recommended.

The Centers for Disease Control and Prevention states that if feasible, use an endotracheal tube with a dorsal lumen above the endotracheal cuff to allow drainage (by continuous or frequent intermittent suctioning) of tracheal secretions that accumulate in the patient's subglottic area (*Centers for Disease Control and Prevention, 2004 [R]*). Before deflating the cuff or removing the tube for endotracheal tubes without a dorsal lumen, ensure that secretions are cleared from above the tube cuff.

Smulders, et al. studied 150 patients, with 75 patients receiving subglottic secretion drainage via an endotracheal tube designed for subglottic suction, and 75 patients in a control group using a standard endotracheal tube. In the patients receiving subglottic suctioning, three patients (4%) developed ventilator-associated

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pneumonia, and 12 patients (16%) in the control group developed ventilator-associated pneumonia (*Smulders, 2002 [A]*).

Kollef, et al. reviewed 343 patients undergoing cardiac surgery and requiring mechanical ventilation. One-hundred-sixty patients received subglottic suctioning with a specially designed endotracheal tube. Ventilator-associated pneumonia was seen in eight (5%) patients receiving subglottic suctioning and 15 patients (8.2%) in the control group (*Kollef, 1999 [A]*).

Collard, et al. and Valles, et al. reached the same conclusion, that continuous or intermittent suctioning of subglottic secretions via specially designed endotracheal tubes can significantly reduce the rate of ventilator-associated pneumonia (*Collard, 2003 [M]*; *Valles, 1995 [A]*).

Intubated patients managed with an endotracheal tube with a subglottic secretion removal port have lower rates of ventilator-associated pneumonia and, for patients expected to require more than 72 hours of ventilation, these special endotracheal tubes can reduce duration of mechanical ventilation. Since they are inserted prior to the start of mechanical ventilation, their use lies beyond the scope of a protocol for intubated patients. However, we recommend their use in the context of a hospital wide program to identify patients expected to require prolonged mechanical ventilation (usually patients requiring emergency intubation) and to have the special tubes available to the ED and clinicians who perform emergency intubations for hospitalized patients.

Closed, In-Line Suctioning

This work group concludes that the evidence on closed, in-line suctioning is varied; therefore, at this time it will not be included in the protocol. An article by Freytag, et al. supports the view that application within 72 hours significantly enhances the microbial growth in the lower respiratory tract. Normal saline instilled with endotracheal suctioning may lead to dispersion of microorganisms into the lower respiratory tract. However, when using closed systems, the exposure to hospital personnel is significantly decreased (*Freytag, 2003 [A]*).

The Centers for Disease Control and Prevention makes no preferential recommendation for use of either the multi-use closed suction system or the single-use open suction system (*Centers for Disease Control and Prevention, 2004 [R]*). Other researchers could not demonstrate a decrease of ventilator-associated pneumonias in either closed in-line suction systems or open systems (*Topeli, 2004 [A]*); *Zeitoun, 2003 [A]*).

Jongerden, et al. conducted a meta-analysis of 15 randomized trials that show no significant difference in incidences of ventilator-associated pneumonia and mortality comparing closed suction system to open suction system. No conclusions could be drawn with respect to arterial oxygen saturation, arterial oxygen tension, and secretion removal (*Jongerden, 2007 [M]*).

Choong, et al. shows there is a greater lung volume loss with open catheter suction than with in-line catheters, especially in patients with significant lung disease requiring high positive end-expiratory pressures. In-line catheters avoid alveolar derecruitment and exacerbating hypoxemia during suction (*Choong, 2003 [A]*).

Kinetic Bed Therapy

In 2004, a prospective, randomized, multicenter study found that kinetic bed therapy significantly decreased the occurrence of ventilator-associated pneumonia and lobar atelectasis (*Ahrens, 2004 [A]*).

Dodek, et al. and Collard, et al. recommend clinicians consider the use of kinetic beds (*Dodek, 2004 [R]*; *Collard 2003 [M]*). Collard reported a meta-analysis of six randomized, controlled trials of kinetic therapy in which surgical and neurological patients had a statistically significant reduction in risk for pneumonia. Dodek reported, on the basis of seven level two trials, that use of kinetic therapy is associated with a decreased ventilator-associated pneumonia incidence.

Kinetic bed therapy (continuous lateral rotation) can reduce the incidence of ventilator-associated pneumonia but it does not seem to reduce other important outcomes such as mortality or ventilation duration. Because

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it requires a special bed that may not be available to all ICUs, we do not make a strong recommendation that it be used routinely in ventilated patients.

Sedation Reduction

Regular testing of the patient's ability to sustain adequate ventilation, oxygenation and breathing comfort (e.g., spontaneous breathing trial) has been shown to significantly reduce duration of mechanical ventilation for acute respiratory failure.

Daily cessation (after the second day of intubation) of continuous infusions of sedative medications decreases the duration of mechanical ventilation and decreases diagnostic testing to evaluate impaired mental status that occurs after intensive care admission (*Kress, 2000 [A]*). Use of a sedation algorithm that frequently adjusts sedative and analgesics doses to promote tolerance of the intensive care unit environment while maintaining wakefulness was also shown to reduce the duration of mechanical ventilation (*De Jonghe, 2005 [C]*).

Individual intensive care units can modify the above research protocols for local circumstances, but essential elements of these protocols include regular patient assessment by a sedation scale, daily dose cessation or hourly dose reduction if patients are considered oversedated, use of opiates as a co-sedative if pain is likely, and use of bolus therapy to achieve adequate sedation before increasing the continuous infusion rate. The main contraindication to sedative cessation is neuromuscular blockade, and severe respiratory failure and life-support withdrawal are relative contraindications.

Weaning Readiness

Daily (or more frequently), brief weaning trials allow early assessment of patients' ability to sustain ventilation, oxygenation, breathing comfort and hemodynamic stability. Studies have shown that respiratory therapist or nurse-driven protocols that communicate to physicians the patient's tolerance and physiological response to 30-60 minutes of unsupported (e.g., continuous positive airway pressure [CPAP] or t-piece) or minimally supported breathing (e.g., pressure support of 7 cm H₂O) leads to decreased duration of mechanical ventilation. Clinical judgment is necessary in the decision to extubate patients, incorporating the results of the weaning trial but also the patient's level of consciousness, airway stability, illness course and hemodynamic status. There are numerous reasons to temporarily postpone daily weaning trials: increased intracranial pressure, severe respiratory failure such as FiO₂ greater than 50%, positive end-expiratory pressure greater than or equal to eight or prone positioning, unstable airway or hemodynamics, neuromuscular blockade, apnea, or anticipated life support withdrawal (*MacIntyre, 2001 [R]*; *Marelich, 2000 [A]*; *Kollef, 1997 [A]*; *Ely, 1996 [A]*).

Combining daily sedation cessation followed by a spontaneous breathing trial is more effective than performing daily spontaneous breathing trials alone. Combining the two interventions may decrease intensive care unit length of stay by three days; it increases ventilator-free days (alive and breathing unassisted during the 28-day interval after intubation) and decreases the duration that patients are comatose (*Girard, 2008 [A]*).

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2. Medications

Stress Ulcer Prophylaxis

The Centers for Disease Control and Prevention make no recommendation for the preferential use of sucralfate, H₂-antagonists, and/or antacids for stress-bleeding prophylaxis in patients receiving mechanically assisted ventilation. Stress ulcer prophylaxis is used clinically in various strategies of prevention in the critical, intensive care patient. The recommendation of a particular regimen will, in part, depend upon which primary outcome a provider is focusing his/her efforts of prevention.

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Annotations

Kollef conducted a literature search. His conclusion is that there is convincing evidence to suggest interventions can be employed to prevent hospital-acquired pneumonia or ventilator-associated pneumonia. The evidence-based interventions focus on the prevention of aerodigestive tract colonization (avoidance of unnecessary antibiotics and stress ulcer prophylaxis, use of sucralfate for stress ulcer prophylaxis, selective digestive decontamination, short-course parenteral prophylaxis in high-risk patients) (Kollef, 2004 [R]).

Darlong, et al. conducted a randomized clinical controlled study in an intensive care unit on 52 patients. The incidence of upper gastrointestinal bleeding was similar in the ranitidine and sucralfate groups, higher in the control. The mean gastric pH was higher with ranitidine. The incidence of positive cultures with gram-negative organisms was significantly higher in the ranitidine group (75% compared to 33% with sucralfate). The incidence of positive growth in the bronchoalveolar lavage (BAL) culture was similar in all three groups (Darlong, 2003 [A]).

Kantorova, et al. stated they could not show that omeprazole, famotidine or sucralfate prophylaxis can affect already very low incidence of clinically important stress-related bleeding in high-risk surgical intensive care unit patients. Furthermore, their data suggested that especially gastric pH increasing medications could increase the risk for nosocomial pneumonia. Routine prophylaxis for stress-related bleeding even in high-risk patients seems not to be justified (Kantorova, 2004 [A]).

Collard, et al. conducted an extensive literature search and synthesis of methods for the prevention of ventilator-associated pneumonia. The preventive practices with the strongest supportive evidence were sucralfate instead of H₂-antagonists for stress ulcer prophylaxis, and selective digestive tract decontamination. After evaluation, the author recommends sucralfate rather than H₂-antagonists in patients at low to moderate risk for gastrointestinal tract bleeding. Selective digestive tract decontamination is not recommended because routine use may increase antimicrobial resistance (Collard, 2003 [M]).

Assess the need for ongoing stress ulcer prophylaxis. Discontinuation of prophylaxis should be considered if the patient is extubated, if there is no significant gastrointestinal bleeding upon transfer out of the intensive care unit, traumatic brain or spinal cord injury does not exist, if the patient is receiving enteral feeds, if the patient is not on a high-dose of glucocorticoid therapy and/or is not on an outpatient medication (Kim, 2010 [C]).

Venous Thromboembolism Prophylaxis

Venous thromboembolism prophylaxis is recommended for most patients in the intensive care unit or with risk factors for venous thromboembolism. Geerts, et al. reviewed prevention of thromboembolism for a wide range of clinical conditions (Geerts, 2008 [R]). The following statements can be made based on the evidence presented in this reference.

General Venous Thromboembolism Recommendations:

- The rationale for the use of thromboprophylaxis is based on solid principles and scientific evidence. Most hospitalized patients have one or more risk factors for venous thromboembolism, and the risk factors are generally cumulative.
- There is a strong association between asymptomatic deep venous thrombosis and the subsequent development of symptomatic venous thromboembolism.
- The prevention of fatal (or any) pulmonary embolus is the top priority, and this outcome is uncommon. The prevention of symptomatic deep venous thrombosis and pulmonary embolus is important since these occurrences are associated with considerable acute mortality, substantial costs and long-term sequelae.
- Mechanical methods of prophylaxis should be considered for all patients with high bleeding risks. Pneumatic compression devices increase venous outflow and/or reduce stasis within the leg veins.

Annotations

These mechanical methods have been shown to reduce the risk of deep venous thrombosis in a number of patient groups. However, they have not been shown to reduce the risk of death or pulmonary embolus. The use of these devices (when used properly) is an acceptable option in certain patient groups, especially in those patients at high risk for bleeding complications, or when used in combination with anticoagulant prophylaxis.

- It is recommended that on admission to a critical care unit, all patients be assessed for their risk of venous thromboembolism, and that accordingly, most patients should receive thromboprophylaxis.

Specific venous thromboembolism prophylaxis recommendations for intensive care unit patients:

Intensive care unit patients are at high risk for deep vein thrombosis and pulmonary embolism but also for bleeding, thrombocytopenia coagulopathy and renal impairment. During an intensive care unit stay, different types of thromboprophylaxis might be appropriate at different times, including, at times, combined therapies of an anticoagulant medication (heparins or fondaparinux) and intermittent compression devices.

For more information, see the ICSI [Venous Thromboembolism Prophylaxis](#) guideline and the ICSI [Anti-thrombotic Therapy Supplement](#) guideline.

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This section provides resources, strategies and measurement for use in closing the gap between current clinical practice and the recommendations set forth in the protocol.

The subdivisions of this section are:

- Aims and Measures
 - Measurement Specifications
- Implementation Recommendations
- Resources
- Resources Table

Aims and Measures

1. Eliminate ventilator-associated pneumonia in patients in an intensive care unit. (*Annotation #1*)

Measure for accomplishing this aim:

- a. Rate of ventilator-associated pneumonias per 1,000 patient ventilator days in patients in intensive care unit as measured by the Centers for Disease Control and Prevention (CDC) National Health Safety Network (NHSN). (*Million Lives Campaign, CDC NHSN Measure*)

2. Increase the use of ventilator-associated pneumonia bundle in all ventilated patients in an intensive care unit. (*Annotations #1, 2*)

Measure for accomplishing this aim:

- a. Percentage of intensive care patients on mechanical ventilation for whom all five elements of the ventilator "bundle" are implemented and documented on the daily goals sheet and/or elsewhere in medical record with an "All or None" indicator:

- Head of bed elevation 30 degrees or greater (*Joint Commission ICU-1 Measure*)
- Daily "sedative interruption" and daily assessment of readiness to extubate
- PUD (peptic ulcer disease) prophylaxis (*Joint Commission ICU-2 Measure*)
- Deep vein thrombosis (DVT) prophylaxis (unless contraindicated) (*Joint Commission ICU-3 Measure*)
- Daily oral care with chlorhexidine

(*5 Million Lives Campaign Measure*)

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Measurement Specifications

Measure #1a

Rate of ventilator-associated pneumonias per 1,000 patient ventilator days in patients in intensive care unit as measured by the Centers for Disease Control and Prevention (CDC) National Health Safety Network (NHSN).

Notes

This is an Institute for Healthcare Improvement (IHI) 5 Million Lives Campaign and Centers for Disease Control and Prevention National Health Safety Network outcome measure.

Full specifications for this measure can be found at the IHI Web site at <http://www.ihl.org/IHI/Programs/Campaign/VAP.htm>

Web site link is up to date as of March 2011.

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Aims and Measures

Measure #2a

Percentage of intensive care patients on mechanical ventilation for whom all five elements of the ventilator "bundle" are implemented and documented on the daily goals sheet and/or elsewhere in medical record with an "All or None" indicator:

- Head of bed elevation 30 degrees or greater (*Joint Commission ICU-1 Measure*)
- Daily "sedative interruption" and daily assessment of readiness to extubate
- PUD (peptic ulcer disease) prophylaxis (*Joint Commission ICU-2 Measure*)
- Deep vein thrombosis (DVT) prophylaxis (unless contraindicated) (*Joint Commission ICU-3 Measure*)
- Daily oral care with chlorhexidine

Notes

This is an Institute for Healthcare Improvement (IHI) 5 Million Lives Campaign process measure. This measure is an "All or None" indicator, i.e., all five elements of ventilator "bundle" need to be implemented for the measure to count.

Full specifications for this measure can be found at the IHI Web site at <http://www.ihl.org/IHI/Programs/Campaign/VAP.htm>.

For quality improvement purposes, each individual bundle can be measured separately. Full specifications for Joint Commission ICU "bundle" measures can be found at the Joint Commission Web site at http://www.jointcommission.org/national_hospital_quality_measures_-_icu/.

Web sites link is up to date as of March 2011.

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Implementation Recommendations

Prior to implementation, it is important to consider current organizational infrastructure that addresses the following:

- System and process design
- Training and education
- Culture and the need to shift values, beliefs and behaviors of the organization

The following system changes were identified by the protocol work group as key strategies for health care systems to incorporate in support of the implementation of this protocol.

1. Standardize tools, checklists, equipment and practices.
2. Train all staff and physicians on the standard practices and tools to assist in adhering to those standard practices.
3. Implement the entire ventilator bundle to result in significantly better outcomes than any of the elements of the bundle implemented independently. For successful bundle implementation you need:
 - continuous and frequent measurement and feedback on the bundle implementation (process measures);
 - multidisciplinary approach – by involving all those who play vital roles in implementing the various components of the bundle, the need for all the roles to work together becomes imperative for successful bundle implementation;
 - reminders to staff on the various bundle components in multiple ways such as a reminder on the admission order, in patient rooms and on other rounding sheets; and
 - use of the order set (containing all the bundle components) as the routine – a physician has to issue a specific order if something else is to be followed.
4. Recommend an organizational approach, involving critical care expertise, regarding an appropriate standardized situational approach for determining the type of suction system used.

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Resources

Criteria for Selecting Resources

The following resources were selected by the protocol work group as additional resources for providers and/or patients. The following criteria were considered in selecting these resources.

- The site contains information specific to the topic of the protocol.
- The content is supported by evidence-based research.
- The content includes the source/author and contact information.
- The content clearly states revision dates or the date the information was published.
- The content is clear about potential biases, noting conflict of interest and/or disclaimers as appropriate.

Resources Available to ICSI Members Only

ICSI has knowledge resources that are *only* available to ICSI members (these are indicated with an asterisk in far left-hand column of the Resources Table). In addition to the resources listed in the table, ICSI members have access to a broad range of materials including tool kits on Continuous Quality Improvement processes and Rapid Cycling that can be helpful. To obtain copies of these or other Resources, go to [Education and Quality Improvement](#) on the ICSI Web site. To access these materials on the Web site, you must be logged in as an ICSI member.

The resources in the table on the next page that are not reserved for ICSI members are available to the public free-of-charge unless otherwise indicated.

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Resources Table

*	Author/Organization	Title/Description	Audience	Web Sites/Order Information
	American Association of Critical Care Nurses	Web site for variety of resources	Health Care Professionals	http://www.aacn.org
	Association for Professionals in Infection Control	Web site for variety of resources	Health Care Professionals	http://www.apic.org
	Infectious Disease Society of America	Web site for variety of resources	Health Care Professionals	http://www.idsociety.org
	Institute for Healthcare Improvement	IHI 5 Million Lives Campaign kit to prevent ventilator-associated pneumonia.	Health Care Professionals	http://www.ihl.org Search: 5 Million Lives Campaign
	Joint Commission	Web site for regulatory standards and patient safety goals	Health Care Professionals	http://www.jointcommission.org Search: ventilator-associated pneumonia
	Society for Healthcare Epidemiology of America	Web site for variety of resources	Health Care Professionals	http://www.shea-online.org
	Society of Critical Care Medicine	Web site for variety of resources	Health Care Professionals	http://www.sccm.org

* Available to ICSI members only.

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ICSI Order Sets utilize two types of boxes for orders. One is the open box that clinicians will need to check for the order to be carried out. The second box is a pre-checked box and are those orders that have strong evidence and/or are standard of care and require documentation if the clinician decides to "uncheck" the order.

There is increasing evidence that pre-checked boxes are more effective in the delivery of care than physician reminders, even within the computerized medical record environment. Organizations are recognizing the benefit of using pre-checked boxes for other orders to promote efficiency. Organizations are encouraged, through a consensus process, to identify those orders to utilize pre-checked boxes to increase efficiency, reduce calls to clinicians, and to reduce barriers for nursing and other professionals to provide care that is within their scope.

Patient information would be part of the medical record in electronic ordering. Institutions will need to add this section per their organization's policy.

Physician information would not be necessary in electronic ordering. How to contact would not be actionable in electronic ordering.

Throughout the order set you will note annotation numbers. These annotation numbers correspond with the guideline itself and provide associated discussion and evidence when available.

It is assumed that clinicians will supplement this information from standard pharmaceutical sources to inform their decisions for individual patients.

Order Set

This order set will cover the orders around ventilator management for the prevention of ventilator-associated pneumonia. This order set will not include admission orders to ICU or other specific orders for the patient's condition outside of ventilator management.

Legend:

- Open boxes are orders that a clinician will need to order by checking the box.
- Pre-checked boxes are those orders with strong supporting evidence and/or regulatory requirements that require documentation if not done. (See Annotation #1)

Patient Information (Two are required.)

Last Name: _____

First Name: _____

Date of Birth: ____/____/____

Patient's Age: _____

ID #: _____

Nursing and Respiratory Care (See Annotation #1)

- Head of bed approximately, equal to or greater than 30 degrees unless currently contraindicated.
 - Contraindication (please state) _____
- Evaluate need for Kinetic Bed Therapy.
- Cuff pressure 20-25 cm H₂O.
- Circuit changes: no routine changes, only when visibly soiled or mechanically malfunctioning or per manufacturer's recommendations.
- Heated humidifiers or heat and moisture exchangers: no routine changes, only when visibly soiled or mechanically malfunctioning or per manufacturer's recommendations.
- Oral care:
 - Assess oral cavity and lips every 6-8 hours and as needed for hydration, lesions, pressure points, infections, thrush, etc.
 - Brush teeth for 1-2 minutes every 6-8 hours with 0.12% or 2% chlorhexidine.
 - Perform oral care every 6-8 hours and as needed, using 0.12% or 2% chlorhexidine solution with gentle brushing of the gingival oral buccal.
 - Apply water-soluble mouth moisturizer and/or lip balm every 6-8 hours (after oral care) and as needed to maintain moisture.
- Use a dedicated suction line for endotracheal tube suctioning of respiratory secretions.
 - Change suction device and tubing per manufacturer's recommendations.
- Rotate position of oral endotracheal tube (ETT). (Recommend not less than every 24 hours.)
 - 24 hours **OR**
 - Use ETT holders that take pressure off the mouth. (Recommend removing oral and subglottic secretions by suctioning before repositioning the ETT.)
 - If endotracheal dorsal lumen is used, remove deep oral/subglottic secretions continuously per manufacturer's recommendations. (Recommend using a specially designed endotracheal tube with a dorsal lumen.)

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Order Set**Sedation Reduction**

- Assess patient for daily sedation reduction/discontinuation and implement per institution's guidelines. Reduce or discontinue sedation until:
- patient is awake and can follow simple commands, **OR**
 - patient becomes agitated.

Weaning Readiness

- Assess eligibility for daily weaning trials unless contraindicated.

Medications (See Annotation #2)**Stress Ulcer Prophylaxis**

- Assess for stress ulcer prophylaxis:
- No prophylaxis (state reason) _____
- Moderate to high risk of GI bleeding or nothing by mouth status:
- sucralfate 1 gm enteral 4 times daily
- famotidine 20 mg IV/enteral every 12 hours (for CrCl less than 50 mL/min reduce to every 24-36 hours), or other H₂-antagonist per hospital formulary
- lansoprazole 30 mg IV/enteral daily, or a proton pump inhibitor per hospital formulary

Pharmacologic Prophylaxis

Choose one: (*Aspirin or platelet inhibitors are not recommended as monotherapy. For creatinine clearance less than 30 mL/min, UFH is preferred.*)

- Unfractionated heparin 5,000 units subcutaneous every 8 hours beginning at admission.
(**Notify physician** and **discontinue** unfractionated heparin if platelet count drops 50% or more from baseline value.)
- Dalteparin (*Notify physician and discontinue dalteparin if platelet count drops 50% or more from baseline value.*)
- For creatinine clearance greater than or equal to 30 mL/min, 5,000 units subcutaneous every 24 hours beginning at admission
- For creatinine clearance less than 30 mL/min, UFH is preferred
- Enoxaparin (*Notify physician and discontinue enoxaparin if platelet count drops 50% or more from baseline value.*)
- For creatinine clearance greater than or equal to 30 mL/min, 40 mg subcutaneous every 24 hours beginning at admission
- For creatinine clearance less than 30 mL/min, 30 mg subcutaneous every 24 hours beginning at admission. UFH is preferred
- For renal dialysis patients, _____ consider UFH
- For a patient with a BMI greater than or equal to 35, give 40 mg subcutaneous every 12 hours
- For a patient with a BMI less than 18.5, give 30 mg subcutaneously every 24 hours
- Fondaparinux 2.5 mg subcutaneous every 24 hours
- For creatinine clearance less than 30 mL/min, UFH is preferred

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Order Set

- Notify physician** if bleeding occurs. Initiate patient education and obtain orders for the following:
 - Platelet count every other day beginning day 2 of bleeding and discontinuing on day 14
 - Hemoglobin every other day beginning day 2 of bleeding

Mechanical Prophylaxis

- Pneumatic compression: *(Recommended if there are contraindications to pharmacologic prophylaxis.)*
 - Intermittent
 - Continuous

Authorized Prescriber Signature: _____

Printed Name: _____

Date & Time of Orders: ____/____/____ ____:_____

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The subdivision of this section is:

- References

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Links are provided for those new references added to this edition (author name is highlighted in blue).

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Document Drafted Oct – Dec 2004
First Edition May 2005
Second Edition Jun 2006
Third Edition Jun 2007
Fourth Edition Aug 2009
Fifth Edition Begins Oct 2011

Released in November for Fifth Edition.

The next scheduled revision will occur within 24 months.

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Document History

- In 2011 the document was converted from an order set to a protocol.

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ICSI Document Development and Revision Process

Overview

Since 1993, the Institute for Clinical Systems Improvement (ICSI) has developed more than 60 evidence-based health care documents that support best practices for the prevention, diagnosis, treatment or management of a given symptom, disease or condition for patients.

Document Development and Revision Process

The development process is based on a number of long-proven approaches. ICSI staff first conducts a literature search to identify pertinent clinical trials, meta-analysis, systematic reviews, regulatory statements and other professional protocols. The literature is reviewed and graded based on the ICSI Evidence Grading System.

ICSI facilitators identify gaps between current and optimal practices. The work group uses this information to develop or revise the clinical flow and algorithm, drafting of annotations and identification of the literature citations. ICSI staff reviews existing regulatory and standard measures, and drafts outcome and process measures for work group consideration. The work group gives consideration to the importance of changing systems and physician behavior so that outcomes such as health status, patient and provider satisfaction, and cost/utilization are maximized.

Medical groups, who are members of ICSI, review each protocol as part of the revision process. The medical groups provide feedback on new literature, identify areas needing clarification, offer recommended changes, outline successful implementation strategies and list barriers to implementation. A summary of the feedback from all medical groups is provided to the protocol work group for use in the revision of the protocol.

Implementation Recommendations and Measures

Each protocol includes implementation strategies related to key clinical recommendations. In addition, ICSI offers protocol-derived measures. Assisted by measurement consultants on the protocol development work group, ICSI's measures flow from each protocol's clinical recommendations and implementation strategies. Most regulatory and publicly reported measures are included but, more importantly, measures are recommended to assist medical groups with implementation; thus, both process and outcomes measures are offered.

Document Revision Cycle

Scientific documents are revised every 12-24 months as indicated by changes in clinical practice and literature. Each ICSI staff monitors major peer-reviewed journals every month for the protocols for which they are responsible. Work group members are also asked to provide any pertinent literature through check-ins with the work group mid-cycle and annually to determine if there have been changes in the evidence significant enough to warrant document revision earlier than scheduled. This process complements the exhaustive literature search that is done on the subject prior to development of the first version of a protocol.

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