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Evidence-based Guidelines for Selected and Candidate Hospital-Acquired Conditions

Final Report

Prepared for

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**EVIDENCE-BASED GUIDELINES FOR SELECTED AND CANDIDATE HOSPITAL-
ACQUIRED CONDITIONS**

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EXECUTIVE SUMMARY

The Centers for Medicare and Medicaid Services (CMS') recent payment provisions for preventable hospital-acquired conditions (HAC) are one of many recent CMS "value-based purchasing" initiatives through which the Medicare program is striving to tie payment to performance. Through collaboration with the Centers for Disease Control and Prevention (CDC) and extensive public input, CMS identified 10 HACs as being reasonably preventable based on the application of published, evidence-based guidelines and thus targeted these HACs for program payment reductions. Selected HACs have to be conditions that are high volume and/or high cost, be identified in the CMS grouper as a complicating (CC) or major complicating conditions (MCC) for purposes of MS-DRG assignment, and be reasonably preventable using evidence-based guidelines. In addition to choosing 10 preventable HACs, CMS has identified 8 "candidate conditions" that are still under agency and public review (73 FR 48471-48491).

The purpose of this report is to identify and characterize the contemporary evidence-based guidelines available for each of the selected and candidate HACs that provide recommendations for the prevention of the corresponding condition. Guidelines were primarily identified using the Agency for Healthcare Research and Quality (AHRQ) National Guidelines Clearing House (NGCH) and the CDC, along with relevant professional societies. Guidelines published in the United States were used, if available. In the absence of U.S. guidelines for a specific condition, international guidelines were included.

Evidence-based guidelines that included specific recommendations for the prevention of the condition were identified for each of the 10 selected conditions. For one of the conditions, blood incompatibility, only the U.S. AHRQ Patient Safety Indicator, PSI -16, was identified. In this instance, two international guidelines citing evidence and providing specific prevention recommendations were also included.

There are eight candidate conditions included in the report. Evidence-based guidelines with prevention recommendations were found for seven of the candidate HACs. Iatrogenic pneumothorax, PSI 6, was the only guideline identified for this condition. The indicator is based on expert opinion and provides a mechanism for tracking, but does not provide explicit recommendation for prevention of the condition. For methicillin resistant staphylococcus aureus (MRSA), guidelines were also included that covered strategies in the community to detect and reduce the presence of MRSA in the population served, since MRSA is most commonly brought into the hospital by asymptomatic carriers. Thus, community detection and control is an important additional strategy for transmission prevention in the hospital.

Only the CAUTI 2009 guidelines for urinary catheter-related infection provide an estimate of the effectiveness of the recommended in preventing the condition.

SECTION 1 INTRODUCTION

1.1 Brief Background on Hospital-Acquired Conditions (HACs) and the Importance of Obtaining the Evidence-Based Guidelines Regarding Prevention of these Conditions

The Centers for Medicare and Medicaid Services (CMS') recent payment provisions for preventable hospital-acquired conditions (HACs) are one of many recent CMS "value-based purchasing" initiatives through which the Medicare program is striving to tie payment to performance. Through collaboration with the Centers for Disease Control and Prevention (CDC) and extensive public input, CMS identified 10 HACs as being reasonably preventable based on the application of published, evidence-based guidelines, and thus targeted these HACs for program payment reductions. Selected HACs have to be conditions that are high volume and/or high cost, be identified in the CMS grouper as a complicating (CC) or major complicating (MCC) conditions for purposes of MS-DRG assignment, and be reasonably preventable using evidence-based guidelines. In addition to choosing 10 preventable HACs, CMS has identified 8 "candidate conditions" that are still under agency and public review (73 FR 48471-48491).

This report represents a summary of evidence-based guidelines that can be used as a basis for hospital care that will reasonably be expected to prevent these specific HACs. Thus, this evidence-based guideline information is an essential ingredient in the selection of conditions and the maintenance of the payment decisions for HACs.

1.2 Organization of the Report

In the following sections of this report, we present our methodological approach to identifying the HAC-related evidence-based guidelines (Section 2), the results of our review of those guidelines (Section 3) (Tables 1 and 2), and a summary of the findings (Section 4) (Tables 3 and 4).

SECTION 2 METHODS

2.1 Approach Used to Identify the Appropriate Guidelines

Our search for evidence-based guidelines for each of the HACs applied the following inclusion criteria:

- addressed the HAC of interest
- developed in the United States or international guidelines if no appropriate U.S. guidelines were located
- included information on actions to be taken to prevent and treat the HAC of interest.

2.1.1 Search of Guidelines.gov (www.guidelines.gov)

We began our systematic approach by searching the National Guideline Clearing House (NGCH) for guidelines representing each of the HACs. Alternative terms were used if we did not find the appropriate guidelines. For example, for blood incompatibility, we used the terms ABO compatibility, transfusion, transfusion reaction, and administration of blood products to identify relevant guidelines. Using a snowball approach, as we reviewed one guideline and it referred to another, we would investigate that guideline as well. We were aided by the fact that the NGCH contains a link to each of the HACs.

2.1.2 Search of CDC.gov

We also searched the CDC website for guidelines representing each of the HACs. The CDC did not have guidelines for foreign objects retained after surgery, pressure ulcers Stage III and IV, manifestations of poor glycemic control, or deep vein thrombosis and pulmonary embolism.

2.1.3 Search of Other Sources

In addition to the key sources listed above, we also searched the Agency for Healthcare Research and Quality (AHRQ) to locate HACs not found in the NGCH. In each incident, we were referred back to the NGCH. We also looked at the Federal Register and used PubMed and Google to identify other government and professional clinical associations that may have relevant information. For example, with blood incompatibility, we also searched the American Society of Transplantation, American Association of Blood Banks, and American Society of Clinical Pathology. In addition, links attached to the guidelines for additional information were used to clarify processes for evidence evaluation and as a means to identify other relevant guidelines.

2.1.4 Limitations of the Methods Used

The method of identifying primary secondary sources of guidelines rely on the NGCH and the CDC's primary sources of guidelines relevant to selected and candidate HACs. RTI

recognizes that most, but potentially not all, evidence-based guidelines are contained in the NGCH. We assumed that all U.S. guidelines have been developed by professional societies or governmental agencies and employed a secondary search strategy to identify these sources that may not have provided their guidelines to the NGCH. It is possible that there are other ad hoc groups that have developed guidelines that may be missed by these techniques. For HACs for which U.S. guidelines were not identified, we did search for international guidelines that may be applicable. Because international guidelines may not be perceived to be applicable to U.S. providers, we did not perform a more extensive search and thus may have missed guidelines sets from outside the United States.

2.2 Definition of Evidence-Based Guidelines Applied

Guideline-development processes have been evolving from expert panel recommendations supported by a selective literature search or based on a consensus of the panel members, to the more recent adoption of systematic processes. These processes employ an explicit evidence-grading and strength-of-evidence designation. A full systematic review also includes a literature search framed by critical questions and defined inclusion exclusion criteria. There continue to be important clinical areas for which there is no definitive clinical trial or other relevant evidence base. This issue is typically addressed by either making no recommendation when there is clinical uncertainty, or by making recommendations, clearly specified as being expert opinion, that are typically based on clinical experience and reasoning from underlying scientific principles. To account for this evolution in “evidence-based guidelines,” we developed a three-tiered set of criteria to categorize the type of evidence-base used for each guideline.

We set Level I as the highest level of evidence-based guideline. To account for current guidelines-development processes, we have subdivided this level into Level Ia: guidelines that used a systematic literature search, rated the quality of each individual study considered, and graded the overall strength of evidence, or demonstrated that they used a “best evidence” approach; and Level Ib: guidelines that rated the quality of each individual study considered, graded the overall strength of evidence, or demonstrated the use of a “best evidence” approach, but did not employ a systematic methodology for the review of the literature. For those guidelines that did not describe a systematic methodology and only provided citations for the recommendation, we called these “evidence-cited” and designated them as Level II. Our lowest level, Level III, represented those guidelines that were based on expert opinion or no specific information to describe the basis of the recommendation. Guidelines typically present various levels of recommendation depending on the quality of evidence, and most employ expert opinion for some of the recommendations that are made when there is not sufficient evidence in the literature. The use of expert opinion may occur with Level Ia, Ib, or Level II guidelines and thus, guidelines may be rated as either Level Ia, Ib, or Level II and, **in addition**, Level III.

Level of Evidence

- Level Ia: Systematic literature search and review, indication of review of the quality of the studies or the overall body of literature, or a “best evidence” approach.
- Level Ib: Literature review and review of the quality of the studies or the overall body of literature, or a “best evidence” approach.

- Level II: Evidence is cited, but no discussion of quality or strength of evidence
- Level III: Expert opinion or no information on how recommendations were developed.

SECTION 3 RESULTS

In this section, we describe the guidelines found for each of the 10 selected HACs and the 8 candidate HACs.

3.1 Selected Conditions

In Table 1 below, we present the guidelines identified through our searches that provide recommendations to prevent the selected HACs. Each HAC is discussed in the text immediately below the table, which includes identification of the guideline developer and commentary on the evidence level and whether the guideline includes identification of appropriate actions to be taken to prevent the HAC. Note that, for clarity, the guidelines are references in the text by the guideline developer. Only one of the guidelines identified included statement of the anticipated magnitude of prevention of events anticipated with use of the guideline recommendations.

Table 1
Identified guidelines for each selected hospital-acquired condition

Evidence-based guideline	Source	Evidence level	Comments	Prevention recommendations
Foreign object retained after surgery				
AHRQ PSI 5, Guide to Patient Safety Indicators, 2007 AHRQ and the National Quality Forum	http://www.qualityindicators.ahrq.gov/downloads/psi/psi_guide_v31.pdf http://www.ahrq.gov/qual/nqfpract.htm	Level III: Expert opinion		“Guide to patient safety indicators found to have evidence supporting their use to reduce events”
Statement on the Prevention of Retained Foreign Bodies after Surgery, 2005; American College of Surgeons	http://www.facs.org/fellows_info/statements/st-51.html	Levels II and III: Evidence cited and expert opinion	1 page statement	“Consistent application and adherence to standardized counting procedures”
Air embolism				
Access Device Guidelines- Recommendations for Nursing Practice and Education, 2004 Oncology Nursing Society	http://www.guideline.gov/summary/summary.aspx?doc_id=8338	Level II: Evidence cited	Comprehensive guideline covering all types of vascular access devices	“Insertion technique- Position patient ...15 degree Trendelenburg ...decreases the risk of air embolism”
Blood incompatibility				
AHRQ PSI 16, Guide to Patient Safety Indicators, 2007; AHRQ and the National Quality Forum	http://www.qualityindicators.ahrq.gov/downloads/psi/psi_guide_v31.pdf http://www.ahrq.gov/qual/nqfpract.htm	Level III: Expert opinion		“Guide to patient safety indicators found to have evidence supporting their use to reduce events”
Guidelines for Compatibility Procedures in Blood Transfusion Laboratories- Standards in Haematology, 2004 British Committee for Standards in Haematology Blood transfusion task force	http://www.bcshguidelines.com/pdf/transfusionlabs.pdf	Level II: Evidence cited	Included British and Finnish work due to lack of standards from USA. Guideline currently being revised	“Errors in patient identification and sample labeling may lead to ABO incompatible transfusions
Blood Transfusion Indication and Administration, 2008, Finnish Medical Society Duodecim	http://www.guideline.gov/summary/summary.aspx?doc_id=12787&nbr=6589&css+6&xl=999	Level II: Evidence cited	Finnish Guidelines	“Verify the identity of the patient.”

(continued)

Table 1 (continued)
Identified guidelines for each selected hospital-acquired condition

Evidence based guideline	Source	Evidence level	Comments	Prevention recommendations
Pressure ulcers (Stage III and IV)				
AHRQ PSI 3, Guide to Patient Safety Indicators, 2007; AHRQ and the National Quality Forum	http://www.qualityindicators.ahrq.gov/downloads/psi/psi_guide_v31.pdf . http://www.ahrq.gov/qual/nqfpract.htm	Level Ib and III: Evidence rating and expert opinion	Evidence rating process incorporates frequency of events and reliability of indicators. Only applies to patients with length of stay greater than 5 days and not admitted from a long-term care facility	“Guide to patient safety indicators found to have evidence supporting their use to reduce events”
Preventing pressure ulcers & skin tears, In: Evidence-based Geriatric Nursing Protocols for Best Practice, 2008	http://www.guideline.gov/summary/summary.aspx?doc_id=12262&nbr=006346	Level Ib and III: Evidence rating and expert opinion	Not specific to stage III and IV pressure ulcer	“Assess skin daily, use moisturizers on dry skin” Very detailed protocol
Pressure Ulcer Prevention and Treatment Following Spinal Cord Injury, 2001 Paralyzed Veterans of America	http://www.guideline.gov/summary/summary.aspx?doc_id=2589&nbr=001815	Level Ib and III: Evidence rating and expert opinion		“Avoid prolonged positional immobilization whenever possible.”
Skin Safety Protocol: Risk Assessment And Prevention Of Pressure Ulcers Health Care Protocol, 2007; Institute for Clinical Systems Improvement	http://www.guideline.gov/summary/summary.aspx?doc_id=13699&nbr=7033	Level Ib and III: Evidence rating and expert opinion	Level of recommendations included for some, but not all of the recommendations	Similar recommendations and level of detail as row above. “Full risk assessment includes determining a person’s risk for pressure ulcers”
Clinical Practice Guideline-prediction, Prevention, Early Treatment of Pressure Ulcers in Adults, 1989; U.S. Preventive Services Task Force	http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=hsahcpr&part=A4521	Level Ib and III: Evidence rating and expert opinion	Not specific to stage III and IV pressure ulcer	“All individuals at risk should have a systematic skin inspection at least once a day...Results should be documented.”

(continued)

Table 1 (continued)
Identified guidelines for each selected hospital-acquired condition

Evidence based guideline	Source	Evidence level	Comments	Prevention recommendations
Injuries from falls & trauma (fractures, dislocations, intracranial injuries, crushing injuries, burns, electric shock)				
AHRQ PSI 8, Guide to Patient Safety Indicators, 2007 AHRQ and the National Quality Forum	http://www.qualityindicators.ahrq.gov/downloads/psi/psi_guide_v31.pdf http://www.ahrq.gov/qual/nqfpract.htm	Level Ib and III: Evidence rating and expert opinion	Evidence rating process incorporates frequency of events and reliability of indicators	“Guide to patient safety indicators found to have evidence supporting their use to reduce events”
Prevention of falls (acute care) health care protocol, 2008; Institute for Clinical Systems Improvement	http://www.guideline.gov/summary/summary.aspx?doc_id=13697&nbr=7031	Levels Ib and III: Evidence rating and expert opinion		Protocol with 6 detailed annotations for fall reduction
Preventing falls in acute care In: Evidence-based geriatric nursing protocols for best practice, 2008	http://www.guideline.gov/summary/summary.aspx?doc_id=12265&nbr=006349	Levels Ib and III: Evidence rating and expert opinion		Includes recommendations for risk assessment and prevention of falls in older patients.
Fall management guideline, 2006, Health Care Association of New Jersey	http://www.guideline.gov/summary/summary.aspx?doc_id=13484&006893	Level III: Expert opinion; (evidence not specifically stated)		Very detailed specific description for performing elements of a clinical assessment to prevent falls.
Changing the practice of physical restraint use in acute care, 2005; University of Iowa	http://www.guideline.gov/summary/summary.aspx?doc_id=8626&nbr=004806	Levels Ib and III: Evidence rating and expert opinion		Recommendation to reduce or eliminate physical restraints without increasing falls
Practice Advisory for Prevention and Management of Operating Room Fires, 2008; American Society of Anesthesiologists	http://www.guideline.gov/summary/summary.aspx?doc_id=12547&nbr=006463	Levels II and III: Evidence cited and expert opinion		“For all procedures: Surgical drapes should be configured to minimize the accumulation of oxidizers under the drapes and from flowing into the surgical site.

(continued)

Table 1 (continued)
Identified guidelines for each selected hospital-acquired condition

Evidence based guideline	Source	Evidence level	Comments	Prevention recommendations
Reducing Adverse Events In: Evidence-based geriatric nursing best protocols for practice, 2008 Hartford Institute for Geriatric Nursing	http://www.guideline.gov/summary/summary.aspx?doc_id=12258&nbr=06342	Levels Ib and III: Evidence rating and expert opinion		“Initiation of a new medication – Assess for potential drug-disease and drug-drug interactions and correct doses – the most common causes of adverse drug reactions.”
Deep vein thrombosis (DVT)/pulmonary embolism(PE) for total knee replacement or hip replacement				
AHRQ PSI 12, Postoperative PE or DVT, Guide to patient safety indicators, 2007 AHRQ and the National Quality Forum	http://www.qualityindicators.ahrq.gov/downloads/psi/psi_guide_v31.pdf http://www.ahrq.gov/qual/nqfpract.htm	Levels Ib and III: Evidence rating and expert opinion	Evidence rating process incorporates frequency of events and reliability of indicators	“Guide to patient safety indicators found to have evidence supporting their use to reduce events”
American Academy of Orthopaedic Surgeons Clinical Guideline on the Prevention of Symptomatic Pulmonary Embolism in Patients Undergoing Total Hip or Knee Arthroplasty, 2007	http://www.guideline.gov/summary/summary.aspx?doc_id=10850&nbr=005665	Levels Ia and III: Systematic review of literature and expert opinion		Specific recommendations for determining risk classification and prevention therapy
Venous Thromboembolism Prophylaxis, 2008; Institute for Clinical Systems Improvement	http://www.guideline.gov/summary/summary.aspx?doc_id=13482&nbr=006891&string=	Level Ib and III: Evidence rating and expert opinion		Specific recommendations for prevention in patients undergoing hip replacement or knee replacement
Antithrombotic Therapy for Venous Thromboembolic Disease. American College of Chest Physicians evidence-based clinical practice guidelines 2008	http://www.guideline.gov/summary/summary.aspx?doc_id=12957&nbr=006666&string=DVT	Levels Ib: Evidence rating		Addresses treatment of DVT

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Table 1 (continued)
Identified guidelines for each selected hospital-acquired condition

Evidence based guideline	Source	Evidence level	Comments	Prevention recommendations
Manifestations of poor glycemic control <i>Diabetic ketoacidosis, Hypoglycemic coma, Nonketotic hyperosmolar coma; Secondary diabetes with ketoacidosis or hyperosmolarity</i>				
Medical Guidelines for Clinical Practice for the Management of Diabetes Mellitus. Diabetes management in the hospital setting, American Association of Clinical Endocrinologists	http://www.guideline.gov/summary/summary.aspx?doc_id=11100&nbr=005859	Level Ib: Evidence rating		Recommendations for the routine glucose monitoring and a plan for treatment of each hospitalized patients with diabetes designed to maintain glucose control and prevent hyperglycemic or hypoglycemic episodes and resultant complications. Recommendations also provide for special circumstances including the use of concomitant medication that may worsen glucose control.
Standards of Medical Care in Diabetes, 2009; American Diabetes Association	http://care.diabetesjournal.org/content/32/Supplement_1/S6.full.pdf.html	Level Ib and III: Evidence rating and expert opinion	Yearly guideline update	Recommendations for the monitoring, treatment of glucose to prevent and treat manifestations of hypoglycemia and hyperglycemia
Diagnosis and Management of Type 2 Diabetes Mellitus in Adults: Institute for Clinical Systems Improvement	http://www.guideline.gov/summary/summary.aspx?doc_id=12693&nbr=006581	Levels Ia and III: Systematic review and expert opinion,		Recommendations for the monitoring, treatment of glucose to prevent and treat manifestations of hypoglycemia and hyperglycemia
Catheter-associated urinary tract infection				
Guideline for Prevention of Catheter Associated Urinary Tract Infection (CAUTI), 2009; CDC	http://www.cdc.gov/ncidod/dhqp/pdf/guidelines/CAUTI_Guideline2009_final.pdf	Levels Ia: Systematic Review		Recommendation for the appropriate use and procedures for insertion and maintenance of urinary catheters to minimize the occurrence of urinary tract infection

(continued)

Table 1 (continued)
Identified guidelines for each selected hospital-acquired condition

Evidence based guideline	Source	Evidence level	Comments	Prevention recommendations
Strategies to Prevent CAUTI in Acute Care Hospitals, 2008; Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America	http://www.guideline.gov/summary/summary.aspx?doc_id=13394&nbr=006805	Level Ib and III: Evidence rating and expert opinion		Recommendations for preventing and monitoring catheter-associated urinary tract infection
Best Practice Policy Statement on Urological Surgery Antimicrobial Prophylaxis, 2007; American Urologic Association	http://www.guideline.gov/summary/summary.aspx?doc_id=12210&nbr=006297	Level Ib and III: Evidence rating and expert opinion		Prophylactic antibiotic recommendations for urologic instrumentation. Including catheters to prevent systemic infections in select patients
Vascular catheter-associated infection				
Strategies to Prevent Central Line-Associated Bloodstream Infection in Acute Care Hospitals, 2008; Infectious Diseases Society of America, Society for Healthcare Epidemiology of America	http://www.guideline.gov/summary/summary.aspx?doc_id=13395&nbr=006806	Level Ib and III: Evidence rating and expert opinion	An update of prior guidelines	Comprehensive recommendations for the insertion and maintenance of central line catheters
Prevention of blood stream infections. In: Prevention and Control of Health Care Associated infections in Massachusetts, 2008	Massachusetts Department of Public Health / NGCH http://www.guideline.gov/summary/summary.aspx?doc_id=12922&nbr=006636	Level Ib and III: Evidence rating and expert opinion		“Maintain aseptic technique for the insertion and care of intravascular catheters.”
Access Device Guidelines: Recommendation for Nursing Practice and Education, 2004; Oncology Nursing Society	http://www.guideline.gov/summary/summary.aspx?doc_id=8338&nbr=004666	Level II: Evidence cited	Evidence not specific to each recommendation	Addresses peripheral and central lines for administration of chemotherapy

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Table 1 (continued)
Identified guidelines for each selected hospital-acquired condition

Evidence based guideline	Source	Evidence level	Comments	Prevention recommendations
Guidelines for the Prevention of Intravascular Catheter-related Infections, 2002; CDC	http://www.cdc.gov/MWR/PREVIEW/MMWRHTML/rr5110a1.htm	Levels Ia and III: Systematic review and expert opinion	2009 update document in draft form, completing public comment and not currently available	Addresses central venous line and vascular access catheters insertion and maintenance in adults and children
Surgical site infection (SSI)				
Strategies to Prevent Surgical Site Infections in Acute Care Hospitals, 2008; Infectious Diseases Society of America, Society for Healthcare Epidemiology of America	http://www.guideline.gov/summary/summary.aspx?doc_id=13399&nbr=006810	Level Ib and III: Evidence rating and expert opinion	Recommendations for general surgery, including coronary bypass surgery, orthopedic surgery, and bariatric surgery	Comprehensive recommendations to prevent surgical site infection
Prevention of surgical site infections, In: Prevention and Control of Healthcare-Associated Infections in Massachusetts, 2008; Massachusetts Department of Public Health	http://www.guideline.gov/summary/summary.aspx?doc_id=12921&nbr=006635	Level Ib and III: Evidence rating and expert opinion		“Whenever possible, identify and treat all infections remote to the surgical site before elective operation and postpone elective operations on patients with remote site infections until the infection has resolved.”
Antibiotic Prophylaxis in Spine Surgery, 2007; North American Spine Society	http://www.guideline.gov/summary/summary.aspx?doc_id=12191&nbr=006288	Level Ib and III: Evidence rating and expert opinion	No specific guidelines for neck, shoulder and elbow	“Patients undergoing spine surgery should receive preoperative prophylactic antibiotics.”

a. Foreign Object Retained after Surgery

i. Guidelines identified

We found two guidelines relating to foreign object retained after surgery:

- Statement on the Prevention of Retained Foreign Bodies after Surgery (American College of Surgeons [ACS])
- PSI 5, Foreign Body Left In during Procedure (AHRQ)

ii. Guidelines considered “evidence based”

The ACS statement cites evidence and expert opinion, but does not mention quality rating of individual studies or strength of evidence. AHRQ PSI 5 is based on expert opinion.

iii. Identification of the appropriate actions to be taken to prevent the condition

Both statements describe actions to take to prevent the retention of foreign objects. The ACS statement recommends consistent application and adherence to standardized counting procedures and use of the AHRQ PSIs.

b. Air Embolism

i. Guidelines identified

We identified one guideline for air embolism in the NGCH; this guideline is comprehensive as it covers all types of vascular access devices:

- Access Device Guidelines: Recommendations for Nursing Practice and Education (ACS)

ii. Guidelines considered “evidence based”

The statement for the ACS guideline cites evidence, but does not mention the quality rating of individual studies or the strength of evidence.

iii. Identification of the appropriate actions to be taken to prevent the condition

The ACS guideline recommends an insertion technique, with the patient in the Trendelenberg position to decrease the risk of air embolism.

c. Blood Incompatibility

i. Guidelines identified

One U.S guideline and three international guidelines were identified for blood incompatibility:

- PSI 16, Transfusion Reaction (AHRQ).
- Guidelines for Pre-Transfusion Compatibility Procedures in Blood Transfusion Laboratories (*Transfusion Medicine*)
- Guidelines for Compatibility Procedures in Blood Transfusion Laboratories—Standards in Haematology (British Committee for Standards in Haematology [BCHS] Blood Transfusion Task Force)
- Blood Transfusion: Indications and Administration (Finnish Medical Society Duodecim).

ii. *Guidelines considered “evidence based”*

All of the guidelines cite evidence, and the Finnish guideline also cites expert opinion. There are no quality ratings of individual studies or strength of evidence mentioned. AHRQ PSI 16 is based on expert opinion.

iii. *Identification of the appropriate actions to be taken to prevent the condition*

All of the guidelines describe actions to reduce the occurrence of blood incompatibility. The *Transfusion Medicine* guidelines recommend ABO and RhD pre-transfusion grouping of the recipient. The BCHS guidelines point out that errors in patient identification and sample labeling may lead to ABO-incompatible transfusions. The Finnish guideline cites patient identification.

d. Pressure Ulcers (Stages III and IV)

i. *Guidelines identified*

Five U.S. guidelines were identified relating to pressure ulcers:

- Clinical Practice Guideline–Prediction, Prevention, Early Treatment of Pressure Ulcers in Adults (U.S. Preventive Services Task Force)
- Preventing pressure ulcers & skin tears, In: *Evidence-based Geriatric Nursing Protocols for Best Practice* (Hartford Institute for Geriatric Nursing)
- Pressure Ulcer Prevention and Treatment Following Spinal Cord Injury (Paralyzed Veterans of America [PVA])
- Skin Safety Protocol: Risk Assessment and Prevention of Pressure Ulcers (Institute for Clinical Systems Improvement [ICSI])
- PSI 3, Decubitus Ulcers, which only applies to patients with length of stay greater than 5 days and not admitted from a long-term care facility (AHRQ).

ii. *Guidelines considered “evidence based”*

All of the guidelines cite evidence and use expert opinion for some recommendations. All but AHRQ PSI 3 provide evidence grading and strength of recommendation for each recommendation. The U.S. Preventative Services Task Force and the Hartford Institute guidelines did not contain specific information about stage III and IV pressure ulcers.

iii. *Identification of the appropriate actions to be taken to prevent the condition*

The AHRQ PSI 3 actions are “found to have evidence supporting their use to reduce events.” The U.S. Preventative Services Task Force guideline recommends that all individuals at risk should have a systematic skin inspection at least once a day, with results documented. The Hartford Institute guideline not only recommends daily assessment, but also the use of moisturizers on dry skin as part of a very detailed protocol. The PVA guideline recommends avoiding prolonged positional immobilization whenever possible. The ICSI guidelines recommend a head-to-toe skin assessment at admission in conjunction with a reliable risk assessment tool.

e. Injuries from Falls and Trauma

i. *Guidelines identified*

Seven U.S. guidelines relating to injuries from falls and trauma were identified through the NGCH:

- Prevention of Falls (acute care). Health Care Protocol (ICSI)
- Preventing falls in acute care, In: *Evidence-based Geriatric Nursing Protocols for Best Practice* (Hartford Institute for Geriatric Nursing)
- Falls Management Guideline, 2007 (Health Care Association of New Jersey [HCANJ])
- Changing the Practice of Physical Restraint Use in Acute Care (University of Iowa)
- Practice Advisory for Prevention and Management of Operating Room Fires (American Society of Anesthesiologists [ASA])
- Reducing adverse events, In: *Evidence-based Geriatric Nursing Protocols for Best Practice* (Hartford Institute for Geriatric Nursing)
- PSI 8, Postoperative Hip Fracture (AHRQ).

ii. *Guidelines considered “evidence based”*

All but one of the guidelines, the HCANJ guideline, cite evidence for their recommendations. Five of the guidelines use level-of-evidence levels and strength of recommendations, including expert opinion, for each recommendation opinion. The ASA guideline cites evidence, but does not report an evidence-grading system.

iii. Identification of the appropriate actions to be taken to prevent the condition

Five of the fall-related guidelines provide detailed recommendations: the Hartford Institute Preventing Falls guideline; the ICSI guideline (protocol with 6 detailed annotations); the Hartford Institute Reducing adverse events guideline; and the HCANJ guideline (detailed procedures for clinical assessment).

The Hartford Institute protocol, Reducing Adverse Events, recommends assessing the patient for any potential drug-disease and drug-drug interactions or incorrect doses, which are the most common causes of adverse drug reactions that could lead to falls.

The ASA guideline recommends that for all procedures, surgical drapes should be configured to minimize the accumulation of oxidizers under the drapes and prevent them from flowing into the surgical site.

f. Deep Vein Thrombosis (DVT)/Pulmonary Embolism (PE) for Total Knee Replacement or Hip Replacement

a. Guidelines identified

Four prevention guidelines were identified for deep vein thrombosis (DVT)/pulmonary embolism (PE) for total knee replacement or hip replacement:

- PSI 12, Postoperative Pulmonary Embolism or Deep Vein Thrombosis (AHRQ)
- Clinical Guideline on the Prevention of Symptomatic Pulmonary Embolism in Patients Undergoing Total Hip or Knee Arthroplasty (American Academy of Orthopaedic Surgeons [AAOS])
- Venous Thromboembolism Prophylaxis, 2008 (ICIS)
- Antithrombotic therapy for venous thromboembolic disease, In: *The American College of Chest Physicians Evidence-based Clinical Practice Guidelines 2008* (American College of Chest Physicians [ACCP])

b. Guidelines considered “evidence based”

All of the guidelines are evidence-based, and all but the ACCP guidelines cite expert opinion. There are quality ratings of individual studies and strength of evidence for recommendations for all of the guideline recommendations except for AHRQ PSI 12.

c. Identification of the appropriate actions to be taken to prevent the condition

Two guidelines describe actions to take to prevent DVT/PE. The AAOS guideline recommends that all patients should be assessed pre-operatively for elevated risk (greater than standard risk) of pulmonary embolism. The ICSI guidelines recommend that risk factor assessment be completed pre-operatively for every patient whose surgical admission is planned.

g. Manifestations of Poor Glycemic Control

i. Guidelines identified

Three guidelines were identified that address manifestations of poor glycemic control:

- Medical Guidelines for Clinical Practice for the Management Of Diabetes Mellitus (The American Association of Clinical Endocrinologists [ACEA])
- The Standards of Medical Care 2009 (American Diabetes Association [ADA])
- Diagnosis and Management of Type-2 Diabetes Mellitus in Adults (ICSI).

ii. Guidelines considered “evidence based”

All three of the guidelines cite evidence and use levels of evidence and strength of recommendation for each recommendation. The ADA standards cite evidence and expert opinion. The ICSI guidelines use systematic review with quality rating of individual studies and strength of evidence mentioned, as well as expert opinion.

iii. Identification of the appropriate actions to be taken to prevent the condition

All of the guidelines provide comprehensive recommendation for the diagnosis and treatment of diabetes mellitus and its complications. They each include hospital-specific guidelines that provide recommendations to appropriately monitor and treat glucose levels to prevent hypoglycemia and hyperglycemia for primary and secondary causes of poor glucose control. The guidelines also address treatment of ketoacidosis and hyperosmolar coma after they have developed.

h. Catheter-Associated Urinary Tract Infection

i. Guidelines identified

Three guidelines were identified for catheter-associated urinary tract infection (UTI):

- Guideline for Prevention of Catheter Associated Urinary Tract Infection (CAUTI) 2009 (Healthcare Infection Control Practices Advisory Committee [HICPAC])
- Strategies to Prevent CAUTI in Acute Care Hospitals (The Society for Healthcare Epidemiology of America [SHEA])
- Best Practice Policy Statement on Urological Surgery Antimicrobial Prophylaxis (American Urological Association Education and Research, Inc. [AUA]).

The HICPAC guideline was identified through the CDC website, and the SHEA and AUA guidelines were identified via the NGCH.

ii. *Guidelines considered “evidence based”*

All of the guidelines cite evidence. The HICPAC guideline uses systematic review with the GRADE system, which does not provide for expert opinion. The SHEA and AUA guidelines both use level-of-evidence grading for every recommendation, as well as expert opinion.

iii. *Identification of the appropriate actions to be taken to prevent the condition*

The HICPAC guideline recommends the use of urinary catheters in operative patients only as necessary, rather than routinely. The **guideline notes that 17% to 69% of CAUTI may be preventable with recommended infection control measures** “The strategies to prevent CAUTI in acute care recommended the insertion of urinary catheters only when necessary for patient care and leaving them in place only as long as indications persist.”

i. **Vascular Catheter-Associated Infection**

i. *Guidelines identified*

Four guidelines were identified for vascular catheter-associated infection:

- Strategies to Prevent Central Line-Associated Bloodstream Infection in Acute Care Hospitals (Infectious Disease Society of America [IDSA]-SHEA)
- Prevention of blood stream infections, In: *Prevention and Control of Health Care Associated infections in Massachusetts* (MDPH)
- Access Device Guidelines: Recommendation for Nursing Practice And Education (Oncology Nursing Society [ONS])
- Guidelines for the Prevention of Intravascular Catheter-related Infections 2002 (CDC)

All of these guidelines were obtained through the NGCH except for the CDC’s Guidelines for the Prevention of Intravascular Catheter-related Infections.

ii. *Guidelines considered “evidence based”*

All of the guidelines cite evidence. The IDSA-SHEA guidelines use level-of-evidence and strength-of-recommendation methodology and incorporated expert opinion. The MDPH guideline uses the CDC grading system for level of evidence and strength of recommendation and cites expert opinion. The ONS guidelines cite evidence, but do not provide level of evidence and strength of recommendation. The CDC guidelines use systematic review and provided for expert opinion.

iii. *Identification of the appropriate actions to be taken to prevent the condition*

The IDSA-SHEA guideline recommends use of a catheter checklist to ensure adherence to infection prevention practices at the time of CVC insertion. The MDPH guideline recommends the maintenance of aseptic technique for the insertion and care of intravascular catheters. The strategies to prevent central line-associated infections in acute-care hospitals

recommend the use of aseptic technique, including the use of a cap, mask, sterile gown, sterile gloves, and a large sterile sheet for the insertion of central venous catheters (CVCs), such as peripherally inserted central catheters, or guide-wire exchange.

These guidelines do not provide information on the likelihood of preventing vascular catheter-associated infection if the prevention strategies are followed.

j. Surgical Site Infection

i. Guidelines identified

Three guidelines were identified for surgical site infection:

- Strategies to Prevent Surgical Site Infection in Acute Care Hospitals, 2008 (IDSA-SHEA)
- Prevention of surgical site infections, In: *Prevention and Control of Healthcare-associated Infections in Massachusetts* (MDPH)
- Antibiotic Prophylaxis in Spine Surgery, 2007 (North American Spine Society [NASS])

All of these guidelines were obtained through the NGCH.

ii. Guidelines considered “evidence based”

Each of the three guidelines uses a level-of-evidence grading system and strength-of-recommendation grade for each recommendation. All sets of guidelines incorporate expert opinion into their level-of-evidence grading.

iii. Identification of the appropriate actions to be taken to prevent the condition

The IDSA-SHEA and the MDPH guidelines recommend clipping rather than shaving the surgical site, the timely and appropriate use of prophylactic antibiotics, and the control of blood glucose for patients undergoing coronary bypass surgery. These guidelines also specify that, whenever possible, all infections remote to the surgical site should be identified and treated before elective operation, and elective operations on patients with remote site infections should be postponed until the infection has resolved. The NASS guideline recommends that patients undergoing spine surgery receive appropriate and timely preoperative prophylactic antibiotics.

3.2 Candidate Conditions

In Table 2, we present the guidelines identified through our searches. The text sections immediately below the table discuss each candidate HAC and provide the developer of the guidelines in parentheses and commentary on the evidence level and whether the guideline includes identification of appropriate actions to be taken to prevent the HAC. Note that, for clarity, the guidelines are references in the text by the developer. None of the guidelines identified included a statement of the magnitude of prevention of events anticipated with use of the guideline recommendations.

Table 2
Identified guidelines for each candidate hospital-acquired condition

Evidence-based Guideline	Source	Evidence level	Comments	Prevention Recommendations
Delirium				
Delirium: prevention, early recognition, and treatment, In: Evidence-based Geriatric Nursing Protocols for Best Practice., 2008; Hartford Institute for Geriatric Nursing – Academic Institution	http://www.guideline.gov/summary/summary.aspx?doc_id=12261 http://consultgeriatric.org/topics/delirium/want_to_know_more	Level Ib and III: Evidence rating and expert opinion	Guidelines developed by nursing experts from across the country; update of 2003 guidelines	Addresses assessment and mitigation of risk factors for delirium, as well as monitoring of delirium
Prevention of delirium in older hospitalized patients, In: Making Health Care Safer: A Critical Analysis of Patient Safety Practices, 2001; AHRQ	http://ahrq.gov/clinic/ptsafety/chap28.htm	Level Ib and III: Evidence rating and expert opinion	Literature review	Seven recommendations to prevent delirium in older hospitalized patients
Practice Guideline for the Treatment of Patients With Delirium, 1999; American Psychiatric Association	Practice guidelines for the treatment of patients with delirium. Am J Psychiatry, 1999. 156(5 Suppl): p. 1-20. http://www.psychiatryonline.com/practiceGuide/loadGuidelinePdf.aspx?file=DeliriumPG_05-15-06	Level Ib and III: Evidence rating and expert opinion	The work group that included psychiatrists with clinical and research expertise in delirium	Comprehensive guidelines for the assessment and management of delirium.
Ventilator-associated pneumonia				
Guidelines for the Management of Adults with Hospital-acquired, Ventilator-associated, and Healthcare-associated Pneumonia; American Thoracic Society, Infectious Diseases Society of America	<i>Am J Respir Crit Care Med</i> 2005; 171:388-416. http://ajrccm.atsjournals.org/cgi/content/full/171/4/388	Level Ib and III: Evidence rating and expert opinion		Recommendation for assessment and reduction of risk factors and treatment of Ventilator-associated pneumonia

(continued)

Table 2 (continued)
Identified guidelines for each candidate hospital-acquired condition

Evidence-based Guideline	Source	Evidence level	Comments	Prevention Recommendations
Prevention of ventilator-associated pneumonia, In: Prevention and Control of Healthcare-Associated Infections in Massachusetts; convened by the Betsy Lehman Center for Patient Safety and Medical Error Reduction, Massachusetts Department of Public Health; 2008 Jan 31. p. 56-60	.http://www.mass.gov/Eeohhs2/docs/dph/patient_safety/haipcp_final_report_pt1.pdf	Level Ib and III: Evidence rating and expert opinion		Recommendation for assessment and reduction of risk factors and treatment of Ventilator-associated pneumonia
AARC Clinical Practice Guidelines: Care of the Ventilator Circuit and Its Relation to Ventilator-Associated Pneumonia, 2003; AARC	http://www.rcjournal.com/cpgs/pdf/09_03.0869.pdf	Level Ia and III: Systematic review and expert opinion		Identifies risk factors and recommends practices for management of the ventilator circuit to prevent ventilator-associated pneumonia
Guidelines for Preventing Health-Care–Associated Pneumonia, 2003; CDC	http://www.cdc.gov/ncidod/dhqp/gl_hcpneumonia.html	Level Ib and III: Evidence rating and expert opinion		Recommendations for general infection control and specific measures for ventilator circuits
Clostridium difficile				
Strategies to Prevent Clostridium Difficile Infections in Acute Care Hospitals, 2008; Society for Healthcare Epidemiology of America, the Infectious Diseases Society of America	http://www.guidelines.gov/summary/summary.aspx?docid=13398&nbr=006809&string=Clostridium+AND+Difficile http://www.journals.uchicago.edu/doi/full/10.1086/591065	Level Ib and III: Evidence rating and expert opinion		Approaches to Minimize C. difficile transmission, and appropriate use of antibiotics
Multidrug Resistant Organisms in Health Care Settings, 2006; CDC	http://www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf	Level Ib and III: Evidence rating and expert opinion		Approaches to Minimize C. difficile transmission, and appropriate use of antibiotics

(continued)

Table 2 (continued)
Identified guidelines for each candidate hospital-acquired condition

Evidence-based Guideline	Source	Evidence level	Comments	Prevention Recommendations
Legionnaires' Disease				
Guidelines for Preventing Health-Care–Associated Pneumonia, 2003; CDC and the Healthcare Infection Control Practices Advisory Committee	Tablan OC, Anderson LJ, Besser R, Bridges C, Hajjeh R. Guidelines for preventing health-care-associated pneumonia, 2003: recommendations of CDC and the Healthcare Infection Control Practices Advisory Committee. MMWR Recomm Rep 2004 Mar 26; 53(RR-3):1-36. [433 references] http://www.cdc.gov/ncidod/dhqp/gl_hcpneumonia.html	Level Ib and III: Evidence rating and expert opinion		Approaches to reduce the transmission of legionella
Iatrogenic pneumothorax				
AHRQ PSI 6, Iatrogenic Pneumothorax, Guide to Patient Safety Indicators, 2007; AHRQ and the National Quality Forum	http://www.qualityindicators.ahrq.gov/downloads/psi/psi_guide_v31.pdf . http://www.ahrq.gov/qual/nqfpract.htm	Level III: Expert opinion	Evidence rating process incorporates frequency of events and reliability of indicators	“Guide to patient safety indicators found to have evidence supporting their use to reduce events”
Staphylococcus aureus sepsis				
Guidelines for the Prevention of Intravascular Catheter-related Infections, 2002	CDC http://www.cdc.gov/MWR/PREVIEW/MMWRHTML/rr5110a1.htm	Level Ia and III: Systematic review and expert opinion	2009 update document in draft form, completing public comment and not currently available	Addresses central venous line and vascular access catheters insertion and maintenance in adults and children

(continued)

Table 2 (continued)
Identified guidelines for each candidate hospital-acquired condition

Evidence-based Guideline	Source	Evidence level	Comments	Prevention Recommendations
Methicillin-resistant staphylococcus aureus				
Strategies to Prevent Transmission of Methicillin-Resistant Staphylococcus Aureus in Acute Care Hospitals	Infectious Diseases Society of America - Medical Specialty Society, Society for Healthcare Epidemiology of America, October 2008 Not adapted from a previous guideline http://www.journals.uchicago.edu/doi/full/10.1086/591061 http://www.ncbi.nlm.nih.gov/pubmed/18840090?dopt=Abstract	Level Ib and III: Evidence rating and expert opinion		Strategies to detect MRSA colonization, prevent its spread and treat infections are recommended
SHEA Guideline for Preventing Nosocomial Transmission of Multidrug Resistant Strains of Staphylococcus Aureus And Enterococcus.	Muto C, Jernigan J, Ostrowsky B, et al. <i>Infect Control Hosp Epidemiol</i> 2003;24:362-386 http://www.ncbi.nlm.nih.gov/pubmed/12785411?dopt=Abstract	Level Ia: Systematic Review		Recommends strategies to detect and prevent the spread of MRSA in the community and the hospital setting
Management of Multidrug-resistant Organisms in Healthcare Settings	Centers for Disease Control and Prevention, Healthcare Infection Control Practices Advisory Committee, 2006 Siegel J, Rhinehart E, Jackson M, Chiarello L, Healthcare Infection Control Practices Advisory Committee. Management of multidrug-resistant organisms in healthcare settings, 2006. Available at: http://www.cdc.gov/nidod/dhqp/pdf/ar/MDROGuideline2006.pdf .	Level Ib and III: Evidence rating and expert opinion		Strategies to detect and prevent the spread and treat infections with multidrug resistant organisms, including MRA are recommended

(continued)

Table 2 (continued)
Identified guidelines for each candidate hospital-acquired condition

Evidence-based Guideline	Source	Evidence level	Comments	Prevention Recommendations
Community Associated Methicillin-resistant Staphylococcus Aureus: Guidelines for Clinical Management and Control of Transmission, 2005; Wisconsin Division of Public Health; October	Borlaug G, Davis JP, Fox BC. Community Associated methicillin-resistant <i>Staphylococcus aureus</i> : guidelines for clinical management and control of transmission. http://dhfs.wisconsin.gov/communicable/re-sources/pdffiles/CAM-RSAGuide_1105.pdf	Level II and III: Evidence cited and expert opinion		Guidelines for the detection of colonization, prevention of transmission and treatment of MRSA
Surgical site infection following cardiac device procedures				
Update on Cardiovascular Implantable Electronic Device Infections and Their Management. A Scientific Statement From the American Heart Association, 2010	http://circ.ahajournals.org/cgi/reprint/CIRCULATIONAHA.109.192665	Level Ib and III: Evidence rating and expert opinion		Guidelines for the prevention and management of implanted device infection including preprocedure antibiotic prophylaxis
Strategies to Prevent Surgical Site Infections in Acute Care Hospitals, 2008 Infectious Diseases Society of America and Society for Healthcare Epidemiology of America	http://www.guideline.gov/summary/summary.aspx?doc_id=13399&nbr=006810	Level Ib and III: Evidence rating and expert opinion	Guidelines for prevention of SSI, cardiac device insertion not specifically discussed	Timely and appropriate selection and use of prophylactic antibiotics
Infection Control Guidelines for the Cardiac Catheterization Laboratory: Society Guidelines Revisited, 2006; Society for Cardiovascular Angiography and Interventions	Catheterization and Cardiovascular Intervention 2006; 67:78-86. http://www3.interscience.wiley.com/journal/12170640/abstract	Level II: Evidence cited	Primary focus is on invasive and interventional procedures with a passing reference to device implantation.	Guidelines to address general infection control procedures in the cardiac catheterization laboratories

a. Delirium

i. Guidelines identified

Three U.S. guidelines were found that addressed the prevention, recognition, and treatment of delirium in hospitals:

- Delirium: prevention, early recognition, and treatment, In: *Evidence-based Geriatric Nursing Protocols for Best Practice* (Hartford Institute for Geriatric Nursing)
- Practice Guideline for the Treatment of Patients with Delirium (American Psychiatric Association [APA])
- Prevention of delirium in older hospitalized patients, In: *Making Healthcare Safe, A Critical Analysis of Patient Safety Practices* (AHRQ)

The Hartford Institute developed their guideline in 2008 as an update to their 2003 guidelines; expert nurses from across the country developed the guideline's recommendations. The APA guideline is much older, originally from 1999. The AHRQ practices are from 2001.

ii. Guidelines considered "evidence based"

The Hartford Institute protocols use a six-tier grading level of evidence. Systematic reviews are the highest level of evidence (Level I), followed by randomized controlled trials (RCTs) at Level II, and on down to Level VI for expert opinions and consensus panels. The protocols' recommendations are based on the protocols from two multi-component delirium prevention studies, published in 1999 and 2001. The APA guideline employs a comprehensive literature review; evidence grading, including expert opinion; and evidence tables, and the guideline has undergone widespread review and comment. The AHRQ guideline is a comprehensive review with evidence grading and expert opinion.

iii. Identification of the appropriate actions to be taken to prevent the condition

The Hartford Institute protocols provide parameters for assessment, nursing care strategies to eliminate or minimize risk factors, and instructions for establishing a therapeutic environment and providing follow-up measures of quality care. For example, the protocols' specific recommendations for eliminating or minimizing risk factors include the following:

- Administer medications judiciously; avoid high-risk medications
- Prevent/promptly and appropriately treat infections
- Prevent/promptly treat dehydration and electrolyte disturbances
- Provide adequate pain control
- Maximize oxygen delivery (supplemental oxygen, blood, and blood pressure support as needed)

- Use sensory aids as appropriate
- Regulate bowel/bladder function
- Provide adequate nutrition.

The APA's guideline provides the following information: disease definition; epidemiology and natural history for delirium; treatment principles and alternatives; formulation and implementation of treatment plans; and clinical features influencing treatment. This guideline also includes discussion of appropriate assessment instrument and prevention recommendations that focus on clinical identification of delirium (causes and differential diagnoses) and treatments to prevent further complications.

The AHRQ guideline discusses seven specific recommendations for the prevention of delirium in older hospitalized patients.

b. Ventilator-Associated Pneumonia

i. Guidelines identified

Four guidelines were identified for ventilator-associated pneumonia:

- Guidelines for the Management of Adults with Hospital-acquired, Ventilator-associated, and Healthcare-associated Pneumonia (American Thoracic Society [ATS] and IDSA)
- Prevention of ventilator-associated pneumonia, In: *Prevention and Control of Healthcare-Associated Infections In Massachusetts* (MDPH)
- AARC Clinical Practice Guidelines: Care of the Ventilator Circuit and Its Relation to Ventilator-Associated Pneumonia, 2003 (American Association of Respiratory Care [AARC])
- Guidelines for Preventing Health-Care–Associated Pneumonia, 2003 (CDC)

The ATS and the IDSA published their guidelines in 2005 and 2008, respectively, on the management of adults with hospital acquired, ventilator-associated, and healthcare-associated pneumonia. The ATS guidelines were the primary source for the most recent 2008 guidelines from the MDPH. The MDPH guidelines focus on the prevention of ventilator-associated pneumonia and are part of a larger body of work on prevention and control of healthcare-associated infections in Massachusetts. The AARC guidelines for the care of the Ventilator Circuit was published in 2003 and provides specific recommendations for identifying risk factors and for management of the ventilator circuit to prevent ventilator-associated pneumonia. The CDC recommendations were the combined effort of the CDC and HICPAC. This effort provided no new recommendations for ventilator-associated pneumonia from their 1994 guidelines, but the new guidelines did note that there were unresolved issues in regard to oral decontamination.

ii. *Guidelines considered “evidence based”*

The ATS-IDSA guidelines use the same grading system for evidence-based recommendations previously used for the ATS Community-Acquired Pneumonia statement. Using three tiers of evidence levels, the guidelines’ highest level consists of RCTs. Well designed, non-randomized controlled trials (e.g., large case series, cohort studies, case-controlled studies) are considered Level II, with case studies and expert opinion at the lowest level, Level III.

Though the MDPH guidelines use the ATS guidelines as their source, they employ a more specific grading system when reviewing the evidence. In addition, the MDPH guidelines are developed from a comprehensive reference library developed by a local specialist in hospital-acquired infection and further supplemented by searches conducted by an experienced librarian (as advised by the Expert Panel and Task Group members). All studies were reviewed for internal validity or methodological rigor, and only high-quality studies were used for the evidence base from which guidelines’ recommendations were developed. The MDPH grading system consists of five tiers of levels of evidence, with RCTs at the highest level (Level I), continuing on through to Level IV for expert opinions. Level V is reserved for when no quality studies are identified and no other clear guidance are available. The strength of recommendation ranking consists of six tiers, from A (strongly recommended) to D (recommended against implementation), followed by UI (unresolved issue) and finally by no recommendation when there is insufficient evidence or no consensus regarding efficacy. This panel adapts the strength-of-recommendation ranking scales from the system developed by HICPAC and published in 2005. (McKibben L, Horan T, et al. Guidance on public reporting of healthcare associated infections: Recommendations of the Healthcare Infection Control Practices Advisory Committee. *AJIC*. 2005; 33: 217-226)

The IDSA-SHEA guidelines adapt the Canadian Task Force on the Periodic Health Examination. Their quality rating is based on three tiers: the highest level (Level I) requires evidence from one or more proper RCTs, followed by the second level (Level II) comprised of evidence from one or more well-designed non-randomized clinical trials or cohort, case-controlled, multiple-time-series studies or from “dramatic results of uncontrolled experiments.” Level III is expert opinion, consensus statements, or descriptive studies.

The AARC guidelines use a systematic review of the literature grading of the evidence and expert opinion.

The CDC levels of evidence are based on two levels/categories. Level I, the higher level consists of three categories: a) well-designed experimental, clinical, or epidemiologic studies, b) “certain” clinical or epidemiologic studies and by strong theoretical rationale, and c) mandated by federal or state regulation or standard. Category II evidence is suggestive clinical or epidemiologic studies or strong theoretical rationale. Insufficient evidence or no consensus is rated as “No recommendation” or “Unresolved Issue.”

iii. *Identification of the appropriate actions to be taken to prevent the condition*

The ATS guidelines cover the major points and recommendations for modifiable risk factors, general prophylaxis, diagnosis, clinical strategy, comparing diagnostic strategies, initial antibiotic therapy, optimal antibiotic therapy, selected multi-drug resistant pathogens, assessing response to therapy and performance indicators. Specific performance indicators include:

- Circulate hospital-acquired infection prevention guidelines to appropriate medical staff (administrators for quality and safety, physicians, and nurses) for review.
- Provide epidemiologic data on the prevalence and types of multi-drug resistant pathogens in intensive care unit patients and current antibiograms to select appropriate initial antibiotic therapy.
- Select specific parts of the guideline for implementation by the medical and surgical services, including the intensive care units, and monitor compliance with the guidelines in relation to patient outcomes.
- Identify modifiable risk factors and develop programs to reduce the risk of pneumonia through changing these risk factors.

The MDPH guidelines include basic practices for prevention and monitoring of ventilator-associated pneumonia in acute care hospitals. This includes components on education, surveillance, practice, accountability, and approaches for special circumstances. The IDSA-SHEA guidelines include special approaches for prevention of ventilator-associated pneumonia in hospitals with unacceptably high ventilator-associated pneumonia rates after following basic prevention procedures, such as “using an endotracheal tube with in-line, subglottic suctioning for all eligible patients, and ensure that all intensive care unit beds used for patients undergoing ventilation have a built-in tool to provide continuous monitoring of the angle of incline.” The guidelines also provide guidance on approaches that should not be considered a routine part of ventilator-associated pneumonia prevention, such as the following:

- Do not routinely administer intravenous immunoglobulin, white-cell-stimulating factors (filgrastim or sargramostim), enteral glutamine, or chest physiotherapy
- Do not routinely use rotational therapy with kinetic or continuous lateral rotational therapy beds
- Do not routinely administer prophylactic aerosolized or systemic antimicrobials or actions that are not consistently supported one way or another by evidence (referred to as unresolved issues)
- Avoidance of H2 antagonist or proton pump inhibitors for patients who are not at high risk for developing gastrointestinal bleeding
- Selective digestive tract decontamination for all patients undergoing ventilation

- Use of antiseptic-impregnated endotracheal tubes
- Intensive glyceic control.

The AARC guidelines make specific recommendations for the changing of ventilator circuits, suction procedures, and the use of humidifiers.

The CDC guidelines address the specifics on the type, care and monitoring of the equipment used. Use of certain medications is not covered, but education, surveillance, prevention of transmission, monitoring host risk for infection and performance indicators is addressed.

c. Clostridium Difficile – Associated Disease

i. Guidelines identified

Two U.S. guidelines were found that address strategies to prevent clostridium difficile infections (CDI) in acute care hospitals:

- Strategies to Prevent Clostridium Difficile Infections in Acute Care Hospitals, 2008 (IDSA-SHEA)
- Multidrug Resistant Organisms in Health Care Settings, 2006 (CDC)

The IDSA-SHEA recommendations are based on previously published guidelines from the HIPAC and the CDC; SHEA; ISDA; and the Association for Professionals in Infection Control and Epidemiology, as well as from other relevant literature more recently published after the other guidelines were released. The CDC guidelines address CDI prevention as well.

ii. Guidelines considered “evidence based”

The IDSA-SHEA quality-of-evidence approach is based on three tiers: Level I requires evidence from one or more RCTs; Level II is comprised of evidence from one or more well-designed non-randomized clinical trials or cohort, case-controlled, multiple-time-series studies or from “dramatic results of uncontrolled experiments; and Level III involves expert opinion, consensus statements, or descriptive studies. This approach was adapted from the Canadian Task Force on the Periodic Health Examination.

The CDC guidelines use a bi-level approach with specific categories. Level I, the highest level, consists of three categories: a) well-designed experimental, clinical, or epidemiologic studies, b) “certain” clinical or epidemiologic studies and by strong theoretical rationale, and c) mandated by federal or state regulation or standard. Category II evidence is suggestive clinical or epidemiologic studies or strong theoretical rationale. Insufficient evidence or no consensus is rated as “No recommendation” or “Unresolved Issue.”

iii. Identification of the appropriate actions to be taken to prevent the condition

Recommendations include components of a CDI prevention program, performing a CDI risk assessment; employment of routine prevention approaches, as well as approaches that should *not* be used for routine prevention; and a discussion of unresolved issues. Specifically, the components of a CDI prevention program should include the following:

- Use contact precautions for infected patients, with a single-patient room preferred
- Ensure cleaning and disinfection of equipment and the environment
- Implement a laboratory-based alert system to provide immediate notification to infection prevention and control personnel and clinical personnel about patients with newly diagnosed CDI
- Conduct CDI surveillance, and analyze and report CDI data
- Educate healthcare personnel, housekeeping personnel, and hospital administration about CDI
- Educate patients and their families about CDI, as appropriate
- Measure compliance with CDC or World Health Organization hand-hygiene and contact precaution recommendations.

d. Legionnaires' Disease

i. Guidelines identified

We found one guideline that specifically addressed Legionnaires' disease:

- Guidelines for Preventing Health Care–Associated Pneumonia, 2003 (CDC-HICPAC)

Published by the CDC in 2003, these recommendations were the combined effort of the CDC and HIPAC.

ii. Guidelines considered “evidence based”

The levels of evidence used are based on two levels, one with categories. Level 1, the higher level, consists of three categories: a) well-designed experimental, clinical, or epidemiologic studies, b) “certain” clinical or epidemiologic studies and by strong theoretical rationale, and c) mandated by federal or state regulation or standard. Category II evidence is suggestive clinical or epidemiologic studies or strong theoretical rationale. Insufficient evidence or no consensus is rated as “No recommendation” or “Unresolved Issue.”

iii. Identification of the appropriate actions to be taken to prevent the condition

Recommended actions include proper maintenance and testing of potable water and the water system and initiating investigations into sources of legionella; primary prevention efforts such as education, surveillance, and proper use and care of medical devices, equipment and environment; and many secondary prevention efforts.

e. Iatrogenic Pneumothorax

i. Guidelines identified

We found one guideline that addressed iatrogenic pneumothorax:

- PSI 6, Iatrogenic Pneumothorax (AHRQ)

AHRQ PSI 6 covers iatrogenic pneumothorax, but excludes cases associated with lung or pleural biopsy, or cardiac surgery. No professional society guidelines were found. The Heart Rhythm Society opposes the application of evidence-based guidelines for the prevention of iatrogenic pneumothorax. They state that “anatomical variation among all patients makes it possible that a pneumothorax could happen during a medical procedure regardless of the skill with which the procedure is performed.”

ii. Guidelines considered “evidence based”

AHRQ PSI 6 is based on expert opinion

iii. Identification of the appropriate actions to be taken to prevent the condition

AHRQ PSI 6 focuses primarily on identification and tracking.

f. Staphylococcus Aureus Sepsis

i. Guidelines identified

We did not identify any recent guidelines that specifically addressed staphylococcus aureus sepsis. Most identified references from the searches were for methicillin-resistant staphylococcus (MRSA), which is another candidate HAC. The CDC guidelines for prevention of central line infections address prevention strategies to prevent bacterial infection.

ii. Guidelines considered “evidence based”

The CDC guidelines use a systematic review strategy and provide for expert opinion (“supported by suggestive clinical or epidemiologic studies or a theoretical rationale”).

iii. Identification of the appropriate actions to be taken to prevent the condition

The CDC guidelines for prevention of intravascular catheter-related infection recommend the use of aseptic technique including the use of a cap, mask, sterile gown, sterile gloves, and a

large sterile sheet for the insertion of CVCs, including peripherally inserted central catheters, or guide-wire exchanged.

g. Methicillin Resistant Staphylococcus Aureus (MRSA)

i. Guidelines identified

Four U.S. guidelines were identified that address MRSA:

- Strategies to Prevent Transmission of Methicillin-Resistant Staphylococcus Aureus in Acute Care Hospitals (IDSA - Medical Specialty Society- SHEA)
- SHEA Guideline for Preventing Nosocomial Transmission of Multidrug Resistant Strains Of Staphylococcus Aureus and Enterococcus (SHEA)
- Management of Multidrug-Resistant Organisms in Healthcare Settings (CDC)
- Community Associated Methicillin-resistant Staphylococcus Aureus: Guidelines for Clinical Management and Control Of Transmission (Wisconsin Division of Public Health [WDPH])

The most recent guideline, released in 2008 by the IDSA – Medical Specialty Society, and SHEA, covers strategies to prevent transmission of MRSA in acute care hospitals. It is the first MRSA guideline developed by this group and was not adapted from any other source. A new guideline is expected in the spring of 2010 by the IDSA.

MRSA is also a condition that may be acquired in the community. The transmission of MRSA in the hospital is therefore significantly impacted by the level of asymptomatic carriers in the community. Thus the WDPG guideline, which addresses community control and prevention, was also included.

ii. Guidelines considered “evidence based”

Quality ratings for the evidence in the 2008 collaborative effort on strategies to prevent transmission (IDSA-SHEA) were adapted from the Canadian Task Force on the Periodic Health Examination. Quality of evidence is based on three tiers: the highest level (Level I) requires evidence from one or more proper RCTs, followed by the second level (Level II) comprised of evidence from one or more well-designed non-randomized clinical trials or cohort, case-controlled, multiple-time-series studies or from “dramatic results of uncontrolled experiments.” Level III is expert opinion, consensus statements or descriptive studies. The SHEA guidelines for preventing transmission used also used a systematic review strategy with evidence ratings.

The CDC guideline used a bi-level approach with specific categories. Level 1, the higher level consists of three categories: a) well-designed experimental, clinical, or epidemiologic studies, b) “certain” clinical or epidemiologic studies and by strong theoretical rationale, c) mandated by federal or state regulation or standard. Category II evidence is suggestive clinical or epidemiologic studies or strong theoretical rationale. Insufficient evidence or no consensus is rated as “No recommendation” or “Unresolved Issue.” The WDPH guidelines cite references, but do not provide the search strategy or an evidence rating strategy.

iii. Identification of the appropriate actions to be taken to prevent the condition

Each practice recommendation is associated with both strength of recommendation and quality of evidence grade. Components of a MRSA Transmission Prevention Program include risk assessment, monitoring, compliance with CDC and World Health Organization hand hygiene recommendations, use of contact precautions, cleaning and disinfection of equipment and environment, education, personnel, alert systems, special approaches and unresolved issues. The CDC guideline suggests implementing systems to communicate information about MRSA, among other reportable multi-drug resistant organisms, education and training, use of antimicrobial agents, surveillance, infection control procedures, and environmental and administrative measures.

h. Surgical Site Infection Following Cardiac Device Procedures

i. Guidelines identified

Three guidelines were identified that address surgical site infection following cardiac device procedures:

- Update on Cardiovascular Implantable Electronic Device Infections and Their Management. A Scientific Statement From the American Heart Association, 2010 (American Heart Association [AHA])
- Strategies to Prevent Surgical Site Infections in Acute Care Hospitals, 2008 (IDSA-SHEA)
- Infection Control Guidelines for the Cardiac catheterization Laboratory: Society Guidelines Revisited, 2006 (Society for Cardiovascular Angiography and Interventions [SCAI])

The AHA guideline specifically addresses the prevention and management of surgical site infection. The IDSA-SHEA strategies provide general guidelines for the prevention of surgical site infection. Many of the prevention recommendations are included in the American Heart Association guidelines. The SCAI guideline addresses general infection-control practices for the cardiac catheterization laboratory, where most device implants are done. It does not specifically address antibiotic prophylaxis guidelines for devices, but does reference the surgical site infection literature

ii. Guidelines considered “evidence based”

The AHA and IDSA-SHEA guidelines both rely on evidence and include expert opinion. Quality ratings of individual studies and strength-of-evidence methodology were employed. The SCAI guidelines cite references, but do not employ an evidence rating system or strength of recommendation approach.

iii. Identification of the appropriate actions to be taken to prevent the condition

The appropriate selection and timely initiation and discontinuation of antibiotics and general infection control practices for the cardiac catheterization laboratory or operating room

setting are recommended. The SCAI guidelines provide specific recommendations for a sterile cardiac catheterization laboratory environment and information on post-procedure.

SECTION 4 DISCUSSION

Summaries of the numbers of guidelines found for each selected and candidate condition are provided in Tables 3 and 4, respectively. The number of guidelines with Level Ia: Systematic Reviews; Level Ib: Evidence-grading system Level II: Evidence Cited; Level III: Expert Opinion are also summarized by condition. Note that guidelines may employ Level III: Expert Opinion in addition to Level Ia, Level 1B or Level II. The tables also include the number of guidelines by condition, that provide specific recommendations for prevention of the HAC.

4.1 Selected Conditions

Table 3
Summary of the number and ratings of available guidelines

Condition	Guidelines found	Guidelines with Level Ia: Systematic review and evidence grading,	Guidelines with Level Ib evidence rating	Guidelines with Level II: Evidence cited only	Guidelines with Level III: Expert opinion	Guidelines with recommendations for prevention of the condition
Foreign object retained after surgery	2	0	0	1	2	2
Air embolus	1	0	0	1	0	1
Blood incompatibility	3	0	0	2	1	3
Pressure Ulcers (Stages III and IV)	5	0	5	0	5	5
Injuries from falls & trauma	7	0	5	1	7	5
Deep vein thrombosis pulmonary embolism for total knee or hip replacement	4	1	3	0	3	2
Manifestations of poor glycemic control	3	1	2	0	2	3
Catheter-associated urinary tract infection	3	1	2	0	2	3
Vascular catheter associated infection	4	1	2	0	2	4
Surgical site infection	3	0	3	0	3	3

4.2 Candidate Conditions

Table 4
Summary of the number and ratings of available guidelines

Condition	Guidelines found	Guidelines with Level Ia: Systematic review and evidence grading,	Guidelines with Level Ib evidence rating	Guidelines with Level II: Evidence cited only	Guidelines with Level III: Expert opinion	Guidelines with recommendations for prevention of the condition
Delirium	3	0	3	0	3	3
Ventilator Associated Pneumonia	4	1	3	0	4	4
Clostridium <i>Difficile</i> associated disease	2	0	2	0	2	2
Legionnaires disease	1	0	1	0	1	1
Iatrogenic pneumothorax	1	0	0	0	1	1
Staphylococcus aureus septicemia	1	1	0	0	1	1
Methicillin resistant staphylococcus aureus	4	1	2	1	3	4
Surgical site infection after cardiac device implantation	3	0	2	1	2	3