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Evidence-Based Guidelines for Selected Hospital-Acquired Conditions

Final Report

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CONDITIONS

Final Report

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EXECUTIVE SUMMARY

The Centers for Medicare and Medicaid Services (CMS) 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 11 HACs as being reasonably preventable based on the application of published, evidence-based guidelines. Thus, CMS targeted these HACs for payment reductions under the Deficit Reduction Act Hospital Acquired Condition (DRA HAC) program. Selected HAC conditions must be:

- high volume and/or high cost;
- identified in the CMS Grouper as a complication or comorbidity (CC) or major complication or comorbidity (MCC) for purposes of MS-DRG assignment; and
- reasonably preventable using evidence-based guidelines (73 FR 48471-48491).

In addition to 11 categories of preventable HACs, there are six “previously considered conditions” and four candidate conditions under agency and public review (75 FR 50042-50677; 77 FR 53257-53750). The six “previously considered candidate conditions” that were discussed in prior rulemaking for the DRA HAC payment provision consisted of the following:

- a. Delirium
- b. Ventilator-Associated Pneumonia (VAP)
- c. Staphylococcus aureus Septicemia
- d. Clostridium difficile-Associated Disease (CDAD)
- e. Legionnaires’ Disease
- f. Methicillin-Resistant Staphylococcus aureus (MRSA)

The four candidate conditions that were discussed in prior rulemaking include

- a. Contrast–induced acute kidney injury
- b. Surgical site infection following hip and knee orthopedic procedures
- c. Iatrogenic pneumothorax with thoracentesis
- d. Accidental puncture/bleeding with abdominal paracentesis

These conditions are no longer under review and therefore, are not included in this report.

The purpose of this report is to identify and characterize the contemporary evidence-based guidelines available for each of the selected HACs that provide recommendations for the prevention of the corresponding condition in the acute hospital setting. Guidelines were primarily identified using the Agency for Healthcare Research and Quality (AHRQ) National Guidelines Clearinghouse (NGC) 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 in ten of the 11 elected conditions. In the absence of evidence-based guidelines, systematic reviews with specific prevention recommendations were cited. There were no U.S. guidelines for prevention of blood incompatibility. In this instance, four international guidelines citing evidence and providing specific prevention recommendations were included.

Only the CDC CAUTI 2009 guidelines for urinary catheter-related infection provide estimates of the effectiveness of the recommended in actions in preventing the condition of interest. Unlike prior editions of the ICSI Health Care Protocol: Perioperative protocol, the 5th edition of these guidelines (2014) does not provide estimates of the effectiveness of the recommended in actions in preventing surgical site infections following select procedures.

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') 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 11 HACs as being reasonably preventable based on the application of published, evidence-based guidelines. Thus, CMS targeted these HACs for program payment reductions. Selected HACs conditions must be:

- high volume and/or high cost;
- identified in the CMS grouper as a complication or comorbidity (CC) or major complication or comorbidity (MCC) for purposes of MS-DRG assignment; and
- reasonably preventable using evidence-based guidelines (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 component of 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) and a summary of the findings (Section 4). Note that, for clarity, the guidelines are referenced in the text according to the guideline developer. Tables in the appendices include identification of the guideline developer, and commentary on the evidence level and identification of appropriate actions for HAC prevention.

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SECTION 2 METHODS

2.1 Approach Used to Identify the Appropriate Guidelines

Our search for evidence-based guidelines was based on specific inclusion and exclusion criteria. In order to be included in this report, guidelines must be:

- focused on clinical recommendations for primary or secondary prevention of the specific condition of interest, and
- developed in the United States. International guidelines were accepted if no appropriate U.S. guidelines were located.

Guidelines were excluded if they had been withdrawn by guideline developers or were developed outside the US, except in the case listed above. In this final report, guidelines archived by the NGC but still listed as current on the developers website have been included if no other US guideline with updated information could be identified. Relevant systematic reviews that meet the above criteria were included only when evidence-based guidelines could not be identified. Documents that have a primary purpose other than provision of clinical guidance for HAC prevention (e.g. training manuals or presentations) are not considered guidelines. Please refer to Section 2.2 for further definition of “evidence-based guideline” as used in this report.

2.1.1 Search of Guidelines.gov (<http://www.guidelines.gov/>)

We began our systematic approach by searching the National Guideline Clearinghouse (NGC) website for guidelines representing each of the HACs. Alternative terms were used if we did not find the appropriate guidelines after searching for the condition as it is listed in the Federal Register. For example, for blood incompatibility, we used the terms ABO compatibility, transfusion, transfusion reaction, and administration of blood products to identify relevant guidelines. As we reviewed one guideline and it referred to another, we would investigate that guideline as well.

2.1.2 Search of CDC.gov

We also searched the CDC website for guidelines representing each HAC. CDC guidelines focus exclusively on infection-related HACs. For this report, we included all relevant guidelines, including those that have been archived by NGC but not withdrawn by guideline developers.

2.1.3 Search of Other Sources

In addition to the key sources listed above, we also searched the US Department of Veterans Affairs (VA/DOD) website, Medscape.com, and the Agency for Healthcare Research and Quality (AHRQ) website to locate HACs not found in the NGC. In each incident, we were referred back to the NGC. We also searched the Federal Register and used PubMed and employed a popular internet search engine to identify other guidelines as well as government and

professional clinical associations that may have relevant publications. For example, concerning the blood incompatibility HAC, we also searched the websites for the American Society of Transplantation, American Association of Blood Banks, and American Society of Clinical Pathology. For conditions with no available guidelines, we searched the Cochrane Database of Systematic Reviews in order to identify potentially applicable review articles. 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 and secondary sources of guidelines relies on the NGC and the CDC as primary sources of guidelines relevant to selected HACs. RTI recognizes that most, but not all, evidence-based guidelines are contained in the NGC. 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 NGC. 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 potentially applicable international guidelines. 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 non-U.S. guidelines for those HACs.

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. A comprehensive systematic review entails the *a priori* development of critical questions as well as study inclusion and exclusion criteria (I/E criteria), the use of standardized key words to search multiple databases, and step-by-step independent comparison of articles against the I/E criteria by two or more reviewers. The methods of each included study are assessed for scientific rigor using a standardized quality assessment tool. After results from included articles are compiled to form the evidence base, an explicit evidence-grading and strength-of-evidence designation is employed by subject matter experts (SMEs) based on the quality of the studies and the consistency of findings across studies. Results from high quality, well-designed clinical trials provide the strongest (most convincing, lowest risk of bias) evidence, followed by observational studies and clinical trials with poorer methodology, both of which have greater risk of biased results due to lower internal study validity. A “best evidence” approach refers to the exclusion of information from studies deemed to be of lower internal validity, which limits the confidence that can be drawn that a reported association of a treatment or other activity is causally related to the observed results. Included studies are only those studies that are most likely to demonstrate that the intervention caused the observed change in outcome and the exclusion of information from studies deemed to be of lower internal validity. The result of this process is that guideline recommendations rely only on the most scientifically sound evidence base. (Owens DK, Lohr KN, Atkins D, et. Al. Journal of Clinical Epidemiology. 2009. 63(5):513-523)

Despite increasing movement toward systematic evidence-based processes in guideline development, there continue to be important clinical areas for which there is no definitive clinical trial or other relevant high-quality evidence base. SMEs typically address this issue 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 SME clinical experience and reasoning from underlying scientific principles. To account for this evolution in “evidence-based guidelines,” we developed a 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 guideline-development processes, we have subdivided this level into **Level Ia** and **Level Ib**. **Level Ia** is defined as guidelines that used 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. **Level Ib** is defined as 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 or recommendations within 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 or recommendations within guidelines, that were based only on expert opinion, or that provided 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**. For guidelines with recommendations arising from a more mixed evidence base (e.g. “Ib and II”), we assigned the level pertaining to the predominate methodology used in that guideline.

Level of Evidence

- **Level Ia:** Good evidence-base (e.g. highest quality, most consistent evidence). Guideline recommendations are based on a comprehensive, systematic literature search and review, AND either a) description of the quality assessment of the studies or the overall body of literature or b) a “best evidence” approach.
- **Level Ib:** Fair evidence base. Guideline recommendations are based on a non-systematic literature review, or literature review using unspecified methods, AND either a) review of the quality of the studies or the overall body of literature or b) description of a “best evidence” approach.
- **Level II:** Poor evidence base or evidence base not well characterized. Evidence is cited, but guideline authors do not describe quality or strength of evidence
- **Level III:** No evidence base. Specific guideline recommendations are based only on expert opinion, or guideline authors provide no information on how recommendations were developed.

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SECTION 3 RESULTS

In this section, we present the current evidence-based guidelines identified through our searches that provide recommendations to prevent the 11 selected HACs:

- Foreign object retained after surgery
- Air embolism
- Blood incompatibility
- Pressure ulcers (Stage III and IV)
- Injuries from falls & trauma (fractures, dislocations, intracranial injuries, crushing injuries, burns, other injuries)
- Catheter-associated urinary tract infection
- Vascular catheter-associated infection
- Surgical site infection (SSI), Mediastinitis, Following Coronary Artery Bypass Graft (CABG)
- Manifestations of poor glycemic control (*Diabetic ketoacidosis, Hypoglycemic coma, Nonketotic hyperosmolar coma; Secondary diabetes with ketoacidosis or hyperosmolarity*)
- Deep vein thrombosis (DVT)/pulmonary embolism (PE) associated with total knee replacement or hip replacement
- Cardiac Implantable Electronic Device (CIED), bariatric surgery (*laparoscopic gastric bypass, gastroenterostomy, or laparoscopic gastric restrictive surgery*), or certain orthopedic procedures (*spine, neck, shoulder, or elbow*)
- Iatrogenic pneumothorax with venous catheterization

Only one of the identified guidelines included a statement of the anticipated magnitude of prevention of events anticipated with use of the guideline recommendations.

A. Foreign Object Retained after Surgery

1. Guidelines identified

We found five current guidelines relating to foreign object retained after surgery:

- Statement on the Prevention of Retained Foreign Bodies after Surgery. American College of Surgeons. ACS, 2005
- Society of Interventional Radiology position statement: prevention of unintentionally retained foreign bodies during interventional radiology procedures. SIR, 2011
- Health care protocol: Prevention of unintentionally retained foreign objects during vaginal deliveries. Institute for Clinical Systems Improvement (ICSI), 2012
- Health Care Protocol: Perioperative protocol. ICSI, 2014
- Prevention of Retained Surgical Items. Association of periOperative Registered Nurses (AORN), 2016

Please refer to *Appendix A, Table A-1*, for additional commentary on each guideline and links to each reference.

2. Guidelines considered “evidence-based”

The ACS and SIR statements cite evidence and expert opinion, but do not mention quality rating of individual studies or strength of evidence. The ICSI Health Care Perioperative Protocol is based on a systematic review and provides ratings for the strength of the body of evidence; the latest edition incorporates some of the GRADE methodology. The updated ICSI protocol for prevention of unintentionally retained foreign objects contains new recommendations based on a systematic review of articles published since the issuance of the previous guidelines. Both protocols are finalized based on consensus from a panel of experts. Recommendations in the AORN Prevention of Retained Surgical Items are based on a systematic literature review with strength-of-evidence grading that incorporates methodology used by the Johns Hopkins University Evidence-based Practice Center.

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

All 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 Patient Safety Indicators (PSIs), which are a set of indicators for measuring in-hospital complications and adverse events. The SIR statement provides recommendations for implementation during interventional radiology procedures only. The ICSI Health Care Protocol for Prevention of Unintentionally Retained Foreign Objects During Delivery and AORN Prevention of Retained Surgical Items describe specific procedures for use in the operating room and labor and delivery, in order to provide guidance on when, how, and why counts should be performed in the delivery room. The Protocol for Prevention of

Unintentionally Retained Foreign Objects during Vaginal Deliveries delineates differences in procedures between the operating arena and labor and delivery.

Common recommendations include establishing an accurate baseline count prior to surgery, minimizing distractions and interruptions during surgery, and methodical performance of wound exploration. The ICSI Perioperative Protocol provides three different sets of recommendations for use during the perioperative, intraoperative, and postoperative periods.

B. Air Embolism

1. Guidelines identified

We identified two guidelines for the prevention of air embolism.

- Access Device Guidelines-Recommendations for Nursing Practice and Education, 3rd ed. Oncology Nursing Society (ONS), 2011
- Guidelines for performing ultrasound guided vascular cannulation: recommendations of the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists (ASE/SCA), 2011

Please refer to *Appendix A, Table A-2*, for additional commentary on each guideline and links to each reference.

2. Guidelines considered “evidence-based”

Both guidelines cite evidence, but do not mention the quality rating of individual studies or the strength of evidence. They are therefore given a rating of Level II.

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

The ONS guideline recommends an insertion technique with the patient in the Trendelenberg position to decrease the risk of air embolism, as does the ASE/SCA guideline .

C. Blood Incompatibility

1. Guidelines identified

No current U.S. guidelines and four current international guidelines were identified for blood incompatibility:

- Transfusion guidelines for neonates and older children, 2004. (2) Amendments and corrections to the transfusion guidelines for neonates and older children, 2005 and 2007. British Committee for Standards in Haematology (BCSH) Blood Transfusion Task Force
- Guideline on the Administration of Blood Components. British Committee for Standards in Haematology (BCSH) Transfusion Task Force. London (UK): 2009.

- Guidelines for Compatibility Procedures in Blood Transfusion Laboratories—Standards in Haematology. British Committee for Standards in Haematology (BCSH) Blood Transfusion Task Force, 2012
- Blood Transfusion: Indications and Administration. Finnish Medical Society Duodecim, 2012

Please refer to *Appendix A, Table A-3*, for additional commentary on each guideline and links to each reference.

2. *Guidelines considered “evidence-based”*

The Duodecim guideline is based on a systematic review with evidence grading, as well as expert opinion. The BCSH amended guidelines for transfusion of neonates and older children provide comprehensive graded recommendations for transfusion in infants younger than 4 months; these cite evidence but do not provide quality ratings of individual studies; strength of evidence is based solely on the number and type of studies. The BCSH guidelines for Administration of Blood Components were developed via a systematic literature search, classification of evidence levels based on study quality, and classification of grades of recommendations as well as expert opinion; however, only one of approximately 40 recommendations is graded. The BCSH guidelines for Compatibility Procedures in Blood Transfusion Laboratories are based on cited evidence.

3. *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 Finnish guideline recommends verification of the patient by asking the patient to state his or her own name and other identifying details, checking patient wristbands, and making sure that the blood group of the transfused patient matches the product to be transfused. The BCSH Guidelines for Compatibility Procedures in Blood Transfusion Laboratories delineate crucial patient identification information as the surname, first name in full, date of birth “(not age or year of birth),” and (in the UK) hospital number/accident, and recommends that any labels pre-printed away from the bedside should not be accepted for grouping or testing pretransfusion samples prior to transfusion. It also contains recommendations for crossmatching. The BCSH *Transfusion guidelines for neonates and older children* recommend that samples from “both mother and infant should be obtained for initial ABO and RhD group determination.” Note, however, that “an electronic cross-match may not select blood that is compatible with maternally derived ABO antibodies in the neonate's plasma. Therefore, it may not be appropriate to include neonatal samples in electronic cross-match protocols unless an appropriate algorithm has been created.” The guidelines for Administration of Blood Components recommend that “Patient identification is enhanced by using robust IT systems based on bar-code or radiofrequency identification (RFID). Level III Grade B”

D. Pressure Ulcers (Stage III and IV)

1. Guidelines identified

Six current U.S. guidelines, including one written in collaboration with an international advisory group, were identified relating to pressure ulcers:

- Pressure Ulcer Prevention and Treatment Following Spinal Cord Injury. Consortium for Spinal Cord Medicine, Paralyzed Veterans of America (PVA), 2001
- Early acute management in adults with spinal cord injury: a clinical practice guideline for health-care professionals. Consortium for Spinal Cord Medicine, PVA, 2008
- Health Care Protocol: Pressure Ulcer Prevention and Treatment Protocol. Institute for Clinical Systems Improvement (ICSI), 2012
- Preventing pressure ulcers & skin tears, In: *Evidence-based Geriatric Nursing Protocols for Best Practice*. Hartford Institute for Geriatric Nursing, 2012
- Guideline of Pressure Ulcer Guidelines. Association for the Advancement of Wound Care (AAWC), 2012.
- Prevention and Treatment of Pressure Ulcers: Clinical Practice Guidelines and Quick Reference Guide. National Pressure Ulcer Advisory Panel (NPUAP), European Pressure Ulcer Advisory Panel (EPUAP), and Pan Pacific Pressure Injury Alliance (PPPIA), 2014

Please refer to *Appendix A, Table A-4*, for additional commentary on each guideline and links to each reference.

Note: The *Clinical Practice Guideline—Prediction, Prevention, Early Treatment of Pressure Ulcers in Adults* (U.S. Preventive Services Task Force) has been withdrawn by AHRQ; the *Guide to the care of the hospitalized patient with ischemic stroke* (2nd Ed., 2014) by the American Association of Neuroscience Nurses is not currently available on the AANN website. Also included in prior years' reports but removed in this version is the WOCN guideline "Guideline for prevention and management of pressure ulcers, 2010," While WOCN offers this guidance in the form of a mobile application, it has been withdrawn from this report because it no longer meets the report inclusion criteria for clinical guidelines.

2. Guidelines considered "evidence-based"

All of the guidelines cite evidence, provide evidence grading and strength of recommendation, and use expert opinion for some recommendations. The NPUAP-EPUAP-PPPIA Clinical Guidelines and Quick Reference Guide incorporate individual study quality rating and strength of evidence using GRADE methodology. The Hartford Institute protocol uses 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 guideline recommendations for prevention of

pneumonia are graded Level IV. The ICSI protocol and PVA guidelines are based on systematic reviews with evidence grading and expert opinion.

The AAWC guideline collates and compares recommendations from previously published guidelines, including those presented here, and incorporates de-novo evidence grading and content validation. AAWC members compiled a list of 368 recommendations from other guidelines, examined the evidence base for these recommendations using de-novo literature searches, and rated the strength of evidence based on the scale used for the Agency for Health Care Policy and Research Pressure Ulcer Guidelines (1992). Strength of evidence was graded as A, B, or C depending on the number and types of studies from which the recommendations were drawn (Bolton, 2011; accessed 4/7/2016). In addition, thirty-two clinicians used an online survey to rate the relevance of each of the 368 recommendations with respect to best-practice PU care on a scale of 1 (not relevant) to 4 (very relevant and succinct). Researchers defined a valid recommendation as those with at least 75% of respondents rating the item as 3 (relevant) or 4 (very relevant).

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

The Hartford Institute guideline is targeted to “older adults with identified intrinsic and/or extrinsic risk factors for pressure ulcers,” and recommends that all individuals at risk should have a systematic skin inspection at least once a day, with results documented. It also describes the use of moisturizers on dry skin as part of a very detailed protocol. The Hartford Institute guidelines does not contain information specific only to Stage III and IV pressure ulcers. The ICSI guidelines recommend a head-to-toe skin assessment at admission in conjunction with a reliable risk assessment tool. Both guidelines from the Consortium for Spinal Cord Medicine, PVA, provide graded recommendations for risk assessment and prevention of pressure ulcers in patients with spinal cord injuries. The NPUAP-EPUAP-PPPIA Quick Reference Guide provides a comprehensive set of recommendations including pressure ulcer risk assessment, patient skin assessment, patient positioning, support surfaces, and recommendations specific to patients in the operating room. Most guidelines contain recommendations for nutrition and/or nutrition counseling.

E. Injuries from Falls and Trauma

1. Guidelines identified

Six U.S. guidelines relating to injuries from falls and trauma were identified:

- Fall Prevention. In: *Evidence-based Geriatric Nursing Protocols for Best Practice*. Hartford Institute for Geriatric Nursing, 2012
- Reducing Adverse Drug Events. In: *Evidence-based Geriatric Nursing Protocols for Best Practice*. Hartford Institute for Geriatric Nursing, 2012
- Health Care Protocol: Prevention of Falls (Acute Care). Institute for Clinical Systems Improvement (ICSI), 2012

- Recommended practices for a safe environment of care. In: 2013 perioperative standards and recommended practices. Association of periOperative Registered Nurses (AORN), 2016
- Practice Advisory for Prevention and Management of Operating Room Fires. American Society of Anesthesiologists Task Force (ASATF), 2013
- Health Care Protocol: Perioperative Protocol. Institute for Clinical Systems Improvement (ICSI), 2014

Please refer to *Appendix A, Table A-5*, for additional commentary on each guideline and links to each reference.

2. Guidelines considered “evidence-based”

All six of the guidelines use level-of-evidence levels and strength of recommendations, including expert opinion, for each recommendation opinion.

The Healthcare Association of New Jersey (HCANJ) Fall Management Guideline (2007), listed in previous editions of this report, has been replaced by the HCANJ Best Practice Guideline. This Best Practice Guideline provides tools for patient assessment and quality improvement but does not contain clinical recommendations, and therefore does not meet our definition of a clinical guideline for inclusion in this report.

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

All three fall-related guidelines provide detailed recommendations: the Hartford Institute “Fall Prevention” guideline; the ICSI falls guideline (protocol with 6 detailed annotations); and the Hartford Institute “Reducing Adverse Events” guidelines. Recommendations include familiarizing the patient to the environment, keeping patient’s personal possessions within patient reach, keeping floor surfaces clean and dry, setting up regular voiding schedules for patients who are bowel and/or bladder incontinent, and monitoring cognitively impaired patients on an hourly basis. Communication of patient risk among healthcare personnel is emphasized; both the ICSI and Hartford guidelines suggest using stickers on patients’ doors. 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 ICSI protocol contains a comparison of three common risk assessment tools, including the Morse Tool, and Hendrich II Tool, and the JHH (Hopkins) Tool. Periodic risk assessment is recommended regardless of the falls assessment tool selected. Identified risk factors include cognitive dysfunction, delirium, dementia, impaired mobility, medications, and physical hazards in the environs.

For burn prevention, the ASATF 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. The AORN guidelines contain recommendations related to hazard identification, communication, alarm systems, and avoidance of thermal injuries related to warming solutions, blankets, and patient linens in blanket- and solution-warming cabinets. The ICSI Perioperative Protocol contains five policy-level

recommendations for prevention of fire in operating rooms; all are strong recommendations based on low evidence.

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

1. Guidelines identified

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

- Preventing Venous Thromboembolic Disease in Patients Undergoing Elective Hip or Knee Arthroplasty, American Academy of Orthopaedic Surgeons (AAOS), 2011
- Venous thromboembolism prophylaxis in hospitalized patients: a clinical practice guideline from the American College of Physicians (ACP). ACP, 2011
- Antithrombotic therapy for VTE Disease: antithrombotic therapy and prevention of thrombosis. In: *The American College of Chest Physicians Evidence-based Clinical Practice Guidelines, (9th edition)*. American College of Chest Physicians (ACCP), 2012
- Prevention of venous thromboembolism in orthopedic surgery patients: antithrombotic therapy and prevention of thrombosis. In: *The American College of Chest Physicians evidence-based clinical practice guidelines, (9th edition)*. ACCP, 2012.
- The perioperative management of antithrombotic therapy: antithrombotic therapy and prevention of thrombosis. In: *The American College of Chest Physicians Evidence-Based Clinical Practice Guidelines (9th edition)*. ACCP, 2012
- Venous Thromboembolism Prophylaxis Guideline. ICSI, 2012

Please refer to **Appendix A, Table A-6**, for additional commentary on each guideline and links to each reference.

Only two of the above guidelines, the AAOS and ACCP Prevention of Venous Thromboembolism, are specific to total knee and hip replacement surgeries. The ACCP Perioperative Management of Antithrombotic Therapy contains recommendations for bridging procedures. In contrast to the prior edition, the recently released 5th edition of the ICSI Perioperative Protocol no longer contains specific recommendations for DVT/PE prevention; instead, it refers users to the ICSI Venous Thromboembolism Prophylaxis Guideline. It has therefore been removed from the list above.

AHRQ published an online document, *Preventing Hospital-Acquired Venous Thromboembolism: A Guide for Effective Quality Improvement*, as a general guide for quality improvement. (Maynard G, Stein J. AHRQ Publication No. 08-0075, August 2008. Agency for Healthcare Research and Quality, Rockville, MD. <http://www.ahrq.gov/qual/vtguide/>. (Accessed

12/3/2015.) While DVT-PE is used as an example preventable condition, this document provides a best practice example of guideline recommended prevention practices at two medical centers. The ACCP guidelines referenced by the AHRQ document are included in this report.

2. *Guidelines considered “evidence-based”*

All of the guidelines are evidence-based, and all but the ACCP guidelines also cite expert opinion. There are quality ratings of individual studies and strength of evidence for recommendations for all of the guideline recommendations. The AAOS guideline workgroup noted, “No data specific to hip or knee arthroplasty were found addressing many potential risk factors, and in many instances where it was found, it was of very low quality and it was contradictory.” (AAOS 2011, p 15). Of the 14 recommendations listed by AAOS, one was graded “Strong” and three were graded “moderate.” All others were graded “inconclusive,” “consensus,” or “weak.” The ACP rates quality of evidence as high, moderate, low, or insufficient evidence to determine net benefits or risks, and strength of recommendations as strong or weak.

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

All guidelines describe actions to take to prevent DVT/PE. The AAOS guideline recommends against routine use of duplex ultrasonography screening of patients who have undergone elective hip or knee arthroplasty. The ICSI guidelines recommend that risk factor assessment be completed pre-operatively for every patient whose surgical admission is planned. The ACCP guideline “Prevention of venous thromboembolism” contains recommendations specific to various surgical procedures, including total hip replacement, hip fracture surgery, total knee replacement, and knee arthroscopy. “The perioperative management of antithrombotic therapy” (ACCP) lists recommendations for perioperative management of patients who are receiving: Vitamin K antagonists, bridging anticoagulation, or antiplatelet therapy, as well as those who require urgent surgical or other invasive procedures. The ACP guidelines provide three major recommendations: assess “risk for thromboembolism and bleeding in medical (including stroke) patients prior to initiation of prophylaxis of venous thromboembolism (Grade: strong recommendation, moderate-quality evidence); administer pharmacologic prophylaxis with heparin or a related drug for venous thromboembolism in medical (including stroke) patients unless the assessed risk for bleeding outweighs the likely benefits (Grade: strong recommendation, moderate-quality evidence); against the use of mechanical prophylaxis with graduated compression stockings for prevention of venous thromboembolism (Grade: strong recommendation, moderate-quality evidence).”

G. Manifestations of Poor Glycemic Control

1. *Guidelines identified*

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

- Use of intensive insulin therapy for the management of glycemic control in hospitalized patients: a clinical practice guideline from the American College of Physicians (ACP), 2011

- Management of hyperglycemia in hospitalized patients in non-critical care setting: an endocrine society clinical practice guideline. Endocrine Society, 2012
- Heath Care Protocol: Perioperative protocol. ICSI, 2014
- American Association of Clinical Endocrinologists Medical Guidelines for Clinical Practice for Developing a Diabetes Mellitus Comprehensive Care Plan. (AAACE), 2015
- Diabetes Care in the Hospital, Nursing Home, and Skilled Nursing Facility. The Standards of Medical Care in Diabetes. American Diabetes Association (ADA), 2016
- Diagnosis and Management of Type 2 Diabetes Mellitus in Adults. ICSI, 2014.

Please refer to *Appendix A, Table A-7*, for additional commentary on each guideline and links to each reference.

2. Guidelines considered “evidence-based”

All six of the guidelines are based on systematic reviews and use levels of evidence and strength of recommendation for each recommendation. The ACP, ICSI, and Endocrine Society guidelines employ GRADE methodology to assess the basis of evidence for each recommendation. Recommendations are either “strong” (level 1) or “weak” (level 2). The quality of the evidence base for each statement is graded as A (high), B (moderate), C (low), or D (very low). Some recommendations are based only on expert opinion (not graded). The AAACE guideline authors reviewed the strengths and weaknesses of multiple EBG methodologies and concluded that an “optimal... strategy might not be entirely evidence-based” due to cost, complexity, and rigidity. The AAACE 2015 guideline is therefore based upon a modified EBG approach that nonetheless assigns recommendations to one of four evidence grade levels, based on the quality and strength of supporting evidence. The ADA guidelines incorporate a 5-level grading system developed by ADA where they rank the evidence A-E. The rank A represents the highest level of evidence and the rank E represents expert consensus.

3. 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. All but the ACP guidelines include hospital-specific recommendations for appropriate monitoring and treatment of glucose levels to prevent hypoglycemia and hyperglycemia for primary and secondary causes of poor glucose control. The ADA guidelines provide a comprehensive list of recommendations for blood glucose management in the hospital setting among both critically ill and non-critically ill patients. The guidelines from the ACP provide recommendations specifically related to use of insulin therapy in both non-SICU/MICU and SICU/MICU patients, and as well as a target blood glucose levels. The ICSI guidelines also address treatment of ketoacidosis and hyperosmolar coma after they have developed. Based on evidence rated as high quality, the ICSI Perioperative protocol strongly recommends that “glycemic control should be directed at achieving blood glucose levels between 140 and 180 mg/dL and not be directed at more intensive goal targets (80-110 mg/dL).”

H. Catheter-Associated Urinary Tract Infection

1. Guidelines identified

Six guidelines were identified for catheter-associated urinary tract infection (CAUTI):

- Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force (HICPAC/SHEA/IDSA), 2002
- Guideline for Disinfection and Sterilization in Healthcare Facilities. Healthcare Infection Control Practices Advisory Committee, Centers for Disease Control and Prevention (CDC-HICPAC), 2008
- Best Practice Policy Statement on Urological Surgery Antimicrobial Prophylaxis. American Urological Association Education and Research, Inc. (AUA). 2008; reviewed and confirmed in 2010.
- Strategies to Prevent Catheter-Associated Urinary Tract Infection in Acute Care Hospitals: 2014 Update. Society for Healthcare Epidemiology of America and the Infectious Diseases Society of America (SHEA/IDSA) Compendium, 2014
- Guideline for Prevention of Catheter Associated Urinary Tract Infection 2009. Healthcare Infection Control Practices Advisory Committee (HICPAC), 2009.
- Strategies to Prevent Healthcare-Associated Infections Through Hand Hygiene. Society for Healthcare Epidemiology of America and the Infectious Diseases Society of America (SHEA/IDSA) Compendium, 2014.

Please refer to *Appendix B*, [Table B-1](#) and [Table B-2](#), for additional commentary on each guideline and links to each reference.

The HICPAC guidelines were identified through the CDC website, and the others were identified via the NGC.

2. Guidelines considered “evidence-based”

All of the guidelines cite evidence. The 2002 HICPAC/SHEA/IDSA guidelines for hand hygiene are based on a literature review with evidence grading. The HICPAC guidelines for prevention of CAUTI use systematic review with the GRADE system. The HICPAC guideline for sterilization and disinfection is also based on systematic evidence reviews. The remaining three guidelines use level-of-evidence grading for every recommendation, as well as expert opinion. Quality ratings for the evidence in the 2014 collaborative effort on strategies to prevent transmission (SHEA/IDSA) were adapted from the Canadian Task Force on the Periodic Health Examination and GRADE. Quality of evidence is based on three tiers: the highest level (Level I, High) indicates that the recommendation is based on multiple types of studies with little between-study variation in estimate of effect and a narrow confidence interval. Level II,

Moderate, indicates moderate confidence that the true effect is close to the estimated size and effect, but may be substantially different since these recommendations are based on fewer studies with increased limitations and between study variations than Level I. Level III, Low, is assigned to recommendations based on studies with significant flaws, a greater range of estimated effect sizes, or expert consensus statements

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

The HICPAC 2009 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.” The HICPAC CDC 2008 guideline contains recommendations for catheter sterilization. The HICPAC/SHEA/IDSA Guidelines for Hand Hygiene review indications for hand hygiene, agents, techniques, and glove use for infection prevention. The IDSA-SHEA guidelines provide comprehensive recommendations for prevention of CAUTI in acute care hospitals, as well as a list of approaches that should not be included among routine CAUTI prevention practices.

I. Vascular Catheter-Associated Infection

1. Guidelines identified

Ten current guidelines were identified for vascular catheter-associated infection:

- Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force (HICPAC/SHEA/IDSA). 2002
- NKF-KDOQI clinical practice guidelines for vascular access: update 2006. (National Kidney Foundation, Kidney Disease Outcomes Quality Initiative, Vascular Access Work Group)
- Guideline for Disinfection and Sterilization in Healthcare Facilities. Healthcare Infection Control Practices Advisory Committee, Centers for Disease Control and Prevention (CDC-HICPAC), 2008
- Preservation of peripheral veins in patients with chronic kidney disease. Association for Vascular Access (AVA) and the American Society of Diagnostic and Interventional Nephrology (ASDIN), 2008
- Strategies to Prevent Central Line-Associated Bloodstream Infection in Acute Care Hospitals: 2014 Update. Society for Healthcare Epidemiology of America and the Infectious Diseases Society of America (SHEA/IDSA) Compendium, 2014.
- Guidelines for the Prevention of Intravascular Catheter-related Infections 2011. Healthcare Infection Control Practices Advisory Committee (HICPAC), 2011.

- Access Device Guidelines-Recommendations for Nursing Practice and Education, 3rd ed. Oncology Nursing Society (ONS), 2011.
- Practice Guidelines for Central Venous Access. American Society of Anesthesiologists (ASA), 2012.
- Central venous catheter care for the patient with cancer. American Society of Clinical Oncology (ASCO), 2013

Please refer to *Appendix B*, [Table B-1](#) and [Table B-3](#), for additional commentary on each guideline and links to each reference.

2. Guidelines considered “evidence-based”

All ten guidelines cite evidence. The ASCO and ASA guidelines use level-of-evidence and strength-of-recommendation methodology and incorporated expert opinion, as did the SHEA-IDSA guideline, which incorporates methodology developed by GRADE and the Canadian Task Force on Preventive Health Care. The ONS guidelines and AVA statement cite evidence, but do not provide level of evidence and strength of recommendation. The CDC and NKF-DOQI guidelines use systematic review and provide for expert opinion.

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

The SHEA/IDSA guideline recommends use of a catheter checklist to ensure adherence to infection prevention practices at the time of CVC insertion. 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. The HICPAC/SHEA/IDSA guidelines for hand hygiene reviews indications for hand hygiene, agents, techniques, and glove use for infection prevention. NKF-KDOQI recommendations also contain recommendations for vascular catheter access and cleansing of catheter sites. The HICPAC 2008 guidelines contain recommendations for catheter sterilization, while the HICPAC 2011 recommendations cover staffing and training of healthcare personnel who insert and maintain catheters, catheter and site selection, hand hygiene, patient preparation, antibiotic ointment and prophylaxis, and catheter placement and replacement. Guideline authors recommend not replacing peripheral and midline catheters more frequently than every 72-96 hours in adults, and only when necessary in children. Central lines (including PICCS and hemodialysis catheters) should not be replaced routinely in an effort to prevent infection or on the basis of fever alone.

Other specific recommendations include: using “maximal sterile barrier precautions during central venous catheter insertion, using a > 0.5% chlorhexidine skin preparation with alcohol for antisepsis, and using antiseptic/antibiotic impregnated short-term central venous catheters and chlorhexidine impregnated sponge dressings if the rate of infection is not decreasing despite adherence to other strategies.” The ASA guidelines address multiple topics related to prevention of infectious complications, including intravenous antibiotic prophylaxis, aseptic techniques, selection of coated or impregnated catheters, selection of catheter insertion

site, catheter fixation method, insertion site dressings, catheter maintenance procedures, and aseptic techniques using an existing central venous catheter. The ACSO guidelines recommend the use of a catheter care bundle that incorporates general hygiene measures, skin antisepsis during catheter insertion, optimal catheter site selection, and assessment of catheter necessity. It also contains recommendations related to prophylactic use of systemic antibiotics (IV or oral) and use of antimicrobial/antiseptic-impregnated or -coated catheters (chlorhexidine and silver sulfadiazine [CH-SS] or minocycline/rifampin) and/or heparin-impregnated catheters. Guideline authors did not find sufficient evidence to recommend for or against the routine use of antibiotic-flush/antibiotic clock therapy.

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 Following Coronary Bypass Artery Graft (CABG), Bariatric Surgery for Obesity, CIED, and Certain Orthopedic Procedures

1. Guidelines identified

Eleven current guidelines were identified for surgical site infection, including general guidelines for SSI prevention applicable to all surgical categories.

- Guideline for Prevention of Surgical Site Infection. CDC, 1999
- Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force (CDC-HICPAC/SHEA/IDSA), 2002
- Guideline for Environmental Infection Control in Health-Care Facilities. Healthcare Infection Control Practices Advisory Committee, Centers for Disease Control and Prevention (CDC-HICPAC), 2003.
- Antibiotic prophylaxis in cardiac surgery, Part I: Duration. Society of Thoracic Surgeons (STS) Workforce on Evidence Based Surgery, 2007.
- Antibiotic prophylaxis in cardiac surgery, Part II: Antibiotic Choice. Society of Thoracic Surgeons (STS) Workforce on Evidence Based Surgery, 2007
- Strategies to Prevent Surgical Site Infection in Acute Care Hospitals: 2014 Update. Society for Healthcare Epidemiology of America and the Infectious Diseases Society of America (SHEA/IDSA) Compendium, 2014
- Medical Guidelines for Clinical Practice for the Perioperative Nutritional, Metabolic, and Nonsurgical Support of the Bariatric Surgery Patient. American Association of Clinical Endocrinologists, The Obesity Society, and American Society for Metabolic and Bariatric Surgery (AACE/TOS/ASMBS), 2013

- Antibiotic Prophylaxis in Spine Surgery. North American Spine Society (NASS), 2013 update. Clinical Practice Guidelines for Antimicrobial Prophylaxis in Surgery. American Society of Health-System Pharmacists (ASHP) the Surgical Infection Society (SIS), IDSA, and SHEA, 2013
- Health Care Protocol: Perioperative protocol. ICSI, 2014
- Strategies to Prevent Healthcare-Associated Infections Through Hand Hygiene. Society for Healthcare Epidemiology of America and the Infectious Diseases Society of America (SHEA/IDSA) Compendium, 2014.

Please refer to *Appendix B*, [Table B-1](#) and [Table B-4](#), for additional commentary on each guideline and links to each reference.

The CDC guideline was identified through the CDC website, and the others were identified via searches of the NGC and professional organizations.

2. Guidelines considered “evidence-based”

Four of the 11 guidelines report using systematic literature review methodology; all twelve guidelines use a level-of-evidence grading system and strength-of-recommendation grade in conjunction with expert opinion. Quality ratings for the evidence in the 2014 collaborative effort on strategies to prevent transmission (SHEA/IDSA) were adapted from the Canadian Task Force on the Periodic Health Examination and GRADE. Quality of evidence is based on three tiers: the highest level (Level I, High) indicates that the recommendation is based on multiple types of studies with little between-study variation in estimate of effect and a narrow confidence interval. Level II, Moderate, indicates moderate confidence that the true effect is close to the estimated size and effect, but may be substantially different since these recommendations are based on fewer studies with increased limitations and between study variations than Level I. Level III, Low, is assigned to recommendations based on studies with significant flaws, a greater range of estimated effect sizes, or expert consensus statements

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

The SHEA/IDSA 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. This guideline also specifies 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 CDC 1999 guidelines provide comprehensive recommendations for prevention of SSI, including steps to be taken during the preoperative, intraoperative, and postoperative periods. The three CDC-HICPAC guidelines provide recommendations for disinfection of environmental surfaces, sterilization of surgical instruments, and proper hand hygiene procedures to avoid contamination of wound sites. All other guidelines except the AACE/TOS/ASMBS guideline consider the evidence for the most appropriate class of antibiotic for a specific surgical procedure, timeliness of administration, and duration of administration. The ASHP/SIS/IDSA/SHEA guidelines provide comprehensive

recommendations for both adult and pediatric patients; guidance includes recommendations for timing of pre-operative antibiotic prophylaxis (within 60 minutes of incision), weight-based dosing, and duration of prophylaxis with respect to surgery duration. The ICSI Perioperative protocol contains recommendations for general SSI prevention. The guidelines for prevention of surgical site infection among cardiac and bariatric patients focus on appropriate and timely preoperative prophylactic antibiotics. The revised AACE/TOS/ASMBS guidelines now contain 74 recommendations, compared with 164 original recommendations in 2008. The updated guidelines note briefly that cigarette use has been associated with increased risk of surgical site infection and recommending therefore that all bariatric patients cease smoking prior to surgery.

K. Iatrogenic Pneumothorax with Venous Catheterization

1. Guidelines identified

We found three guidelines that addressed iatrogenic pneumothorax, one in the setting of thoracic needle biopsy and two with respect to venous catheterization:

- ACR Appropriateness Criteria® Radiologic Management of Thoracic Nodules and Masses. American College of Radiology (ACR), 2015
- Guidelines for performing ultrasound guided vascular cannulation: recommendations of the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists (ASE/SCA), 2011
- Practice Guidelines for Central Venous Access. American Society of Anesthesiologists (ASA), 2012

Please refer to **Appendix A, [Table A-8](#)**, for additional commentary on each guideline and links to each reference.

2. Guidelines considered “evidence-based”

The ACR guideline is based on a literature review and expert opinion. The rating system was based on the based on the RAND/UCLA Appropriateness Method. Individual studies identified during the review were assigned “strength of evidence ratings” (quality assessment scores) from 1 to 4, with 1 defined as “The conclusions of the study are valid and strongly supported by study design, analysis and results”; 2 as “The conclusions of the study are likely valid, but study design does not permit certainty”; 3 as “The conclusions of the study may be valid but the evidence supporting the conclusions is inconclusive or equivocal”; and 4 as “The conclusions of the study may not be valid because the evidence may not be reliable given the study design or analysis.” Evidence grading for individual outcomes (e.g., pneumothorax) was not provided. The ASA and ASE/SCA guidelines used level-of-evidence and strength-of-recommendation methodology and incorporated expert opinion.

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

The ACR guideline states that “Using a steeper angle of the biopsy needle may decrease the risk of pneumothorax,” (from a study with a quality rating of “2”). These guidelines also note

that pneumothorax is most common complication of percutaneous lung biopsy requiring intervention, occurring in 10%–30% of these procedures. The ASA guidelines include recommendations for general prevention of mechanical trauma or injury associated with central venous access, including selection of catheter insertion site, patient positioning, needle insertion and catheter placement, and monitoring for placement of needles, guidewires, and catheters. With respect to pneumothorax, authors note that “Nonrandomized comparative studies report equivocal findings for arterial puncture, pneumothorax, hematoma, hemothorax, or arrhythmia when the internal jugular insertion site is compared with the subclavian insertion site (*Category C3 evidence*).” The ASE/SCA guidelines recommend that ultrasound screening of the subclavian vein in high risk patients, and notes that individual operators should not attempt cannulation more than twice, since doing so increases the risk of complications including pneumothorax.

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SECTION 4 SUMMARY

Summaries of the numbers of guidelines found for each selected condition are provided in **Table 1**. 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 Ib or Level II.

Table 1
Summary of the number and ratings of available guidelines for selected HACs

Condition	Guidelines with recommendations for prevention of the condition	Guidelines with Level Ia: Systematic review and evidence grading	Guidelines with Level Ib: evidence grading	Guidelines with Level II: evidence cited only	Guidelines with Level III: expert opinion
Foreign object retained after surgery	5	2	1	0	5
Air embolus	2	0	0	2	0
Blood incompatibility	4	2	1	1	2
Pressure ulcers (Stage III and IV)	6	6	0	0	6
Injuries from falls & trauma	6	5	1	0	6
Deep vein thrombosis pulmonary embolism for total knee or hip replacement	6	6	0	0	3
Manifestations of poor glycemic control	6	6	0	0	6
Catheter-associated urinary tract infection	6	2	4	0	6
Vascular catheter associated infection	10	4	4	2	8
Surgical site infection following selected cardiac, bariatric, or orthopedic surgeries	11	4	7	0	11
Iatrogenic pneumothorax with venous catheterization	3	1	2	0	3

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APPENDIX A
GUIDELINES FOR NON-INFECTION RELATED HACs

In **Tables A-1 through A-8** below, we present the current guidelines identified through our searches that provide recommendations to prevent the eight selected HACs not related to infection:

- Foreign object retained after surgery
- Air embolism
- Blood incompatibility
- Pressure ulcers (Stage III and IV)
- Injuries from falls & trauma (fractures, dislocations, intracranial injuries, crushing injuries, burns, other injuries)
- Deep vein thrombosis (DVT)/pulmonary embolism(PE) associated with total knee replacement or hip replacement
- Manifestations of poor glycemic control (*Diabetic ketoacidosis, Hypoglycemic coma, Nonketotic hyperosmolar coma; Secondary diabetes with ketoacidosis or hyperosmolarity*)
- Iatrogenic pneumothorax with venous catheterization

Table A-1
Identified guidelines for foreign object retained after surgery

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
Foreign object retained after surgery AORN. “Prevention of retained surgical items.” In: Guidelines for Perioperative Practices. Denver, CO: AORN, Inc; 2016. Association of periOperative Registered Nurses (AORN).	https://www.aornbookstore.org/Product/product.asp?sku=MAN016&dept_id=1 (Book available for purchase) (accessed 4/5/2016)	Levels Ia and III: Systematic review, evidence rating and expert opinion	First, the references of an AORN evidence rating is a two-step process involving appraisal of guideline references using the Johns Hopkins nursing evidence appraisal tools, followed by rating of practice recommendations using the Oncology Nursing Society model (accessed 4/5/2016) Additional information on AORN Evidence Rating processes is here: http://www.aorn.org/aorn-org/guidelines/about-aorn-guidelines/evidence-rating (accessed 4/5/2016)	Contains comprehensive recommendations for incorporating a multidisciplinary approach to retention of surgical items, item counts, and locating and retrieving missing items.
Institute for Clinical Systems Improvement (ICSI). Health Care Protocol: Prevention of Unintentionally Retained Foreign Objects During Vaginal Deliveries. January 2012.	http://www.ngc.gov/content.aspx?id=36060 (accessed 4/5/2016) https://www.icsi.org/_asset/3xvmi8/RFO.pdf (accessed 4/5/2016)	Levels Ib and III: Literature search, evidence rating and expert opinion	A list of changes from the previous version is here: https://www.icsi.org/_asset/zqjguv/RFOsofC.pdf (accessed 4/5/2016)	“The recommendations for prevention of unintentionally retained foreign objects during vaginal deliveries are presented in the form of a protocol and an algorithm with 12 components, accompanied by detailed annotations.”

Table A-1 (Continued)
Identified guidelines for foreign object retained after surgery

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
American College of Surgeons (ACS) and the Council of Surgical and periOperative Safety. Statement on the Prevention of Retained Foreign Bodies after Surgery, 2005; <i>Bulletin of the American College of Surgeons</i> Vol. 90, No. 10, October 2005.	http://www.facs.org/fellows_info/statements/st-51.html (accessed 4/5/2016)	Level III: Expert opinion	1 page statement available here: https://www.facs.org/about-acs/statements (accessed 4/5/2016)	“Consistent application and adherence to standardized counting procedures”
Statler JD, Miller DL, Dixon RG, Kuo MD, Cohen AM, Duncan JR, Gordon RL, Gross K, Saad WE, Silberzweig JE, Stecker MS, Suri R, Thornton RH, Bartal G, Society of Interventional Radiology Safety and Health Committee. Society of Interventional Radiology position statement: prevention of unintentionally retained foreign bodies during interventional radiology procedures. <i>J Vasc Interv Radiol.</i> 2011 Nov;22(11):1561-2	https://www.guideline.gov/content.aspx?id=48776 (accessed 4/5/2016) http://www.sirweb.org/clinical/cpg/PIIS1051044311011353%5B19%5D.pdf (accessed 4/5/2016; redirects to PDF)	Level III: Expert opinion	A brief literature review provides citations, but the recommendations do not reference any specific studies. Authors note that evidence is largely “anecdotal.”	Authors make recommendations with respect to sponge size, inspection of sponges and incision or cavity, type of sponges, and use of fluoroscopy for detection of needles or instruments.

Table A-1 (Continued)
Identified guidelines for foreign object retained after surgery

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
Institute for Clinical Systems Improvement (ICSI) Perioperative protocol. Health care protocol, 2014. 5 th edition.	NGC guideline summary. http://www.guideline.gov/content.aspx?id=48408 (accessed 4/6/2016) https://www.icsi.org/guidelines-more/catalog_guidelines_and_more/catalog_guidelines/catalog_patient_safetyreliability_guidelines/perioperative/ (accessed 4/6/2016)	Levels Ia and III: Systematic review, evidence rating and expert opinion	The 2014 update is in transition to GRADE methodology. A summary of changes from the previous version is here: https://www.icsi.org/_asset/5h7ypw/PeriopSoC.pdf (accessed 4/6/2016)	Contains detailed annotations for prevention of retained foreign bodies, including comprehensive descriptions of counting processes and recommendations for implementation.

Table A-2
Identified guidelines for air embolism

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
Air embolism				
Access Device Guidelines- Recommendations for Nursing Practice and Education, 3 rd ed. Oncology Nursing Society (ONS), 2011	http://www.ons.org/products/access-device-guidelines-recommendations-nursing-practice-and-education-third-edition (accessed 4/6/2016) Available for purchase	Level II: Evidence cited	Comprehensive guideline covering all types of vascular access devices	Includes recommendations for patient positioning during insertion to decrease risk of air embolism.
Guidelines for performing ultrasound guided vascular cannulation: recommendations of the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists (ASE/SCA), 2011	http://www.onlinejase.com/article/S0894-7317%2811%2900727-9/fulltext (accessed 4/6/2016)	Level II: Evidence cited	Although the major recommendations in this guideline are based on Levels Ia and III , systematic review, evidence rating, and expert opinion, the instructions for patient positioning are ungraded and only cite supporting literature. This “recommendation” is therefore rated as Level II.	“Patients should be placed in Trendelenburg position to increase the diameter of the jugular veins and reduce the risk for air embolism when cannulating the SC vein, unless this maneuver is contraindicated.”

Table A-3
Identified guidelines for blood incompatibility

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
Blood incompatibility				
British Committee for Standards in Haematology (BCSH) Blood Transfusion Task Force. Guidelines for Pre-Transfusion Compatibility Procedures in Blood Transfusion Laboratories, 2012	http://www.bcsghguidelines.com/documents/Compat_Guideline_for_submission_to_TTF_011012.pdf (accessed 04/7/2016) (Redirects to PDF document)	Level II: Evidence cited	Included British and Finnish work due to lack of standards from USA.	“Errors in patient identification and sample labeling may lead to ABO incompatible transfusions.”
British Committee for Standards in Haematology (BCSH). (1) Transfusion guidelines for neonates and older children, 2004. (2) Amendments and corrections to the transfusion guidelines for neonates and older children, 2007. Boulton F, BCSH Transfusion Task Force. Amendments and corrections to the 'transfusion guidelines for neonates and older children'. London (UK): 2005 Dec 7.	http://www.ncbi.nlm.nih.gov/pubmed/14984493 (accessed 4/7/2016) 2004 guidelines: http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2141.2004.04815.x/pdf (accessed 04/7/2016) 2005 amendment: http://www.bcsghguidelines.com/documents/transfusion_neonates_amendments_bcsgh_091205.pdf (accessed 04/7/2016) 2007 amendment: http://www.bcsghguidelines.com/documents/FFP_neonate_Amendment_1_17_Oct_2007.pdf (accessed 04/7/2016)	Levels Ib and III: Literature review and expert opinion	British Guidelines	Blood and Blood Component Specification General Recommendations (Fetuses, Neonates, Infants and Children) Table: Choice of ABO Group for Blood Products for Administration to Children

Table A-3 (Continued)
Identified guidelines for blood incompatibility

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
British Committee for Standards in Haematology (BCSH). Guideline on the Administration of Blood Components. BCSH Transfusion Task Force. London (UK): 2009.	http://www.bcsguidelines.com/documents/Admin_blood_components_bcs_05012010.pdf (accessed 04/7/2016)	Levels Ia and III: Systematic review, evidence rating and expert opinion	British Guidelines	Provides suggestions and one graded recommendation related to positive patient identification, including use of information technology (IT), as well as staff education and documentation requirements. The formally graded recommendation is: "Patient identification is enhanced by using robust IT systems based on bar-code or radiofrequency identification (RFID). Level III Grade B"
Finnish Medical Society Duodecim. Blood transfusion: indications, administration, and adverse reactions. In: EBM Guidelines. Evidence-Based Medicine. Helsinki, Finland: Wiley Interscience, John Wiley & Sons; 2011 Aug 15	http://www.guideline.gov/content.aspx?id=34955 (accessed 04/7/2016)	Level Ia: Systematic review and evidence rating	Finnish Guidelines	"Verify the identity of the patient. Ask the patient to state his/her own identification details. If necessary, check them against the patient's identity wrist band.The blood group of the product to be transfused must correspond with the patient's blood group."

Table A-4
Identified guidelines for pressure ulcers (Stage III and IV)

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
<p>Pressure ulcers (Stage III and IV) Hartford Institute for Geriatric Nursing. Ayello EA, Sibbald RG. Pressure Ulcer Prevention. In: Boltz M, Capezuti E, Fulmer T, Zwicker D, editor(s). Evidence-based geriatric nursing protocols for best practice. 4th ed. New York (NY): Springer Publishing Company; 2012 Nov. p. 298-323.</p>	<p>http://www.guideline.gov/content.aspx?id=43935 (accessed 4/7/2016) Chapter available for purchase; corresponding protocol available here: https://consultgeri.org/geriatric-topics/pressure-ulcers-skin-tears (accessed 4/7/2016)</p>	<p>Level Ia and III: Systematic review, evidence rating, and expert opinion</p>	<p>Not specific to Stage III and IV pressure ulcer.</p>	<p>“Assess skin daily, use moisturizers on dry skin.”</p>
<p>Institute for Clinical Systems Improvement (ICSI). Health care protocol. Pressure ulcer prevention and treatment protocol, January 2012.</p>	<p>http://www.guideline.gov/content.aspx?id=36059 (accessed 4/7/2016) https://www.icsi.org/_asset/6t7kx/PressureUlcer.pdf (accessed 4/7/2016) (Redirects to PDF document)</p>	<p>Level Ia and III: Systematic review, evidence rating, and expert opinion</p>	<p>None.</p>	<p>“Avoid prolonged positional immobilization whenever possible.” “Full risk assessment includes determining a person’s risk for pressure ulcers.”</p>

Table A-4 (Continued)
Identified guidelines for pressure ulcers (Stage III and IV)

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
Consortium for Spinal Cord Medicine, Paralyzed Veterans of America: Early acute management in adults with spinal cord injury: a clinical practice guideline for health-care professionals. J Spinal Cord Med 2008;31(4):403-79.	http://www.ncbi.nlm.nih.gov/pubmed/18959359 (accessed 4/7/2016) Available for download (accessed 4/7/2016)	Levels Ia and III: Systematic review, evidence rating, and expert opinion	Not specific to Stage III and Stage IV pressure ulcer.	“Place the patient on a pressure reduction mattress or a mattress overlay, depending on the patient's condition. Use a pressure reducing cushion when the patient is mobilized out of bed to a sitting position. <i>(Scientific evidence—III; Grade of recommendation—C; Strength of panel opinion—5)</i> ”
Association for the Advancement of Wound Care (AAWC). Association for the Advancement of Wound Care guideline of pressure ulcer guidelines. Malvern (PA): Association for the Advancement of Wound Care (AAWC); 2010.	http://aawconline.org/wp-content/uploads/2011/08/AAWC-PressureUlcerGuidelineofGuidelinesAug11.pdf (accessed 4/7/2016)	Level Ia and III: Systematic review, evidence rating, and expert opinion	Includes evidence from original studies as well as previously published guidelines; incorporates de-novo evidence grading and content validation. Strength of evidence rating was based on the scale used for Agency for Health Care Policy and Research Pressure Ulcer Guidelines (1992). Evidence tables are available here: http://aawconline.org/professional-resources/resources/ (accessed 4/8/2016)	Comprehensive guidelines include recommendations for patient assessment, risk factor assessment, and preventive care, including positioning, hydration, and nutrition.

Table A-4 (Continued)
Identified guidelines for pressure ulcers (Stage III and IV)

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
Consortium for Spinal Cord Medicine, Paralyzed Veterans of America (PVA): Pressure ulcer prevention and treatment following spinal cord injury: a clinical practice guideline for health-care professionals. J Spinal Cord Med 2001 Spring;24(Suppl 1):S40-101.	http://www.ncbi.nlm.nih.gov/pubmed/11958176 (accessed 4/7/2016) Available for download (accessed 4/7/2016)	Level Ia and III: Systematic review, evidence rating, and expert opinion	Not specific to Stage III and Stage IV pressure ulcer. Recommendations are graded on a group level.	Contains recommendations for risk assessment, risk assessment tools, and prevention strategies
National Pressure Ulcer Advisory Panel (NPUAP), European Pressure Ulcer Advisory Panel (EPUAP), and Pan Pacific Pressure Injury Alliance (PPPIA). Prevention and Treatment of Pressure Ulcers: Clinical Practice Guidelines and Quick Reference Guide. 2014.	Full guideline available for purchase, http://www.npuap.org/resources/educational-and-clinical-resources/prevention-and-treatment-of-pressure-ulcers-clinical-practice-guideline/ ; (accessed 4/7/2016) Quick reference guide available free of charge, http://www.npuap.org/wp-content/uploads/2014/08/Updated-10-16-14-Quick-Reference-Guide-DIGITAL-NPUAP-EPUAP-PPPIA-16Oct2014.pdf (accessed 4/7/2016) (Redirects to PDF document)	Levels Ia and III: Systematic review evidence rating, and expert opinion	Jointly developed by NPUAP (USA), EPUAP (European), and PPPIA (Asia); evidence is assessed according to GRADE methodology. Only the Quick Reference guide is available free of charge. The authors note that it contains only excerpts and should be used in conjunction with the Clinical Practice Guidelines. Guideline support materials, including a methodology addendum, evidence, and abstraction tables, are available here: http://www.internationalguideline.com/guideline (accessed 11/25/2015)	Provides recommendations for risk assessment policy and practice, skin assessment, patient nutrition, patient repositioning techniques and practices, support surfaces. Includes some recommendations specific to patients in the operating room.

Table A-5
Identified guidelines for injuries from falls and trauma

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
Injuries from falls & trauma (fractures, dislocations, intracranial injuries, crushing injuries, burns, other injuries)				
Degelau J, Belz M, Bungum L, Flavin PL, Harper C, Leys K, Lundquist L, Webb B. Institute for Clinical Systems Improvement (ICSI). Prevention of Falls (Acute Care). Health care protocol, 23 rd April 2012.	http://www.guideline.gov/content.aspx?id=36906 (accessed 12/2/2015) https://www.icsi.org/_asset/dcn15z/Falls-Interactive0412.pdf (accessed 4/7/2016) (Redirects to PDF document)	Levels Ia and III: Systematic review evidence rating and expert opinion	None.	Protocol with 6 detailed annotations for fall reduction
Hartford Institute for Geriatric Nursing. Gray-Micelli D, Quigley PA. Fall Prevention. In: Boltz M, Capezuti E, Fulmer T, Zwicker D, editor(s). Evidence-based geriatric nursing protocols for best practice. 4 th ed. New York (NY): Springer Publishing Company; 2012 Nov. p. 268-97.	http://www.guideline.gov/content.aspx?id=43933 (accessed 4/7/2016) Chapter available for purchase; corresponding protocol available here: https://consultgeri.org/geriatric-topics/falls (accessed 4/7/2016)	Level Ia and III: Systematic review, evidence rating, and expert opinion	None	Includes recommendations for risk assessment and prevention of falls in older patients.

Table A-5 (Continued)
Identified guidelines for injuries from falls and trauma

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
American Society of Anesthesiologists (ASATF). Apfelbaum JL, Task Force on Operating Room Fires. Practice advisory for the prevention and management of operating room fires: an updated report by the American Society of Anesthesiologists Task Force on Operating Room Fires. <i>Anesthesiology</i> . 2013 Feb;118(2):271-90.	http://www.guideline.gov/content.aspx?id=43895 (accessed 4/7/2016) http://anesthesiology.pubs.asahq.org/Article.aspx?articleid=1918685 (accessed 4/7/2016)	Levels Ib and III: Literature review, evidence rating, and expert opinion	None	Comprehensive list of recommendations for fire prevention in the OR setting, including specific recommendations for “minimizing or avoiding an oxidizer-enriched atmosphere near the surgical site, safely managing ignition sources, and safely managing fuels.”
Hartford Institute for Geriatric Nursing . Zwicker D, Fulmer T. Reducing Adverse Drug Events in Older Adults. In: Boltz M, Capezuti E, Fulmer T, Zwicker D, editor(s). Evidence-based geriatric nursing protocols for best practice. 4 th ed. New York (NY): Springer Publishing Company; 2012 Nov p 324-62.	http://www.guideline.gov/content.aspx?id=43938 (accessed 4/7/2016) Chapter available for purchase; corresponding protocol available here: https://consultgeri.org/geriatric-topics/medication (accessed 4/7/2016)	Level Ia and III: Systematic review, evidence rating, and expert opinion	None	“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” that might lead to falls.

Table A-5 (Continued)
Identified guidelines for injuries from falls and trauma

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
AORN. Guideline for a safe environment of care, part 1. In: Guidelines for Perioperative Practice by Byron Burlingame, Bonnie Denholm, Terri Link, Mary J. Ogg, Lisa Spruce, Cynthia Spry, Sharon A. Van Wicklin, and Amber Wood. Edited by Ramona Conner. Vol. 1. 2016.	https://www.aornbookstore.org/Product/product.asp?sku=MAN016&dept_id=1 (Book available for purchase) (accessed 4/5/2016)	Level Ia and III: Systematic review, evidence rating, and expert opinion	Methods are described online here: http://www.aornstandards.org/content/1/SEC12.extract (accessed 4/27/16)	Recommendations include steps for <ul style="list-style-type: none"> • identification of hazards and precautions for minimizing risk of injury due to: musculoskeletal injury, • fire safety, • electrical equipment, • clinical and alert alarms, • blanket- and solution-warming cabinets, • medical gas cylinders, • waste anesthesia gases

Table A-5 (Continued)
Identified guidelines for injuries from falls and trauma

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
Institute for Clinical Systems Improvement (ICSI) Perioperative Protocol. Health care protocol, 2014. 5 th edition.	NGC guideline summary. http://www.guideline.gov/content.aspx?id=48408 (accessed 4/7/2016) https://www.icsi.org/guidelines_more/catalog_guidelines_and_more/catalog_guidelines/catalog_patient_safetyreliability_guidelines/perioperative/ (accessed 4/7/2016)	Levels Ia and III: Systematic review, evidence rating and expert opinion	The 2014 update is in transition to GRADE methodology. A summary of changes from the previous version is here: https://www.icsi.org/asset/5h7ypw/PeriopSoC.pdf (accessed 4/7/2016) This guideline references a drug(s) for which important revised regulatory and/or warning information has been released. FDA has added a new Warning and Precaution about this risk to the labels of all medicines classed as dipeptidyl peptidase-4 (DPP-4) inhibitors: August 28, 2015 – DPP-4 Inhibitors for Type 2 Diabetes . (accessed 4/7/2016)	Contains recommendations for policies related to prevention of operating room fires.

Table A-6
Identified guidelines for deep vein thrombosis/pulmonary embolism for total knee or hip replacement

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
Deep vein thrombosis (DVT)/pulmonary embolism(PE) for total knee replacement or hip replacement American Academy of Orthopaedic Surgeons (AAOS). Preventing Venous Thromboembolic Disease in Patients Undergoing Elective Hip or Knee Arthroplasty, 2011.	http://www.guideline.gov/content.aspx?id=35173 (accessed 4/7/2016)	Levels Ia and III: Systematic review, evidence rating, and expert opinion	Links to supplemental information including responses to peer reviews and a quality of studies report can be found here: http://www.aaos.org/Research/guidelines/VTE/VTE_guideline.asp (accessed 4/7/2016)	Provides 14 specific recommendations in ten statements for determining risk classification, screening, and prevention therapy, including a recommendation against routine post-operative duplex ultrasonography screening of patients who undergo elective hip or knee arthroplasty. (Grade of Recommendation: Strong)
Institute for Clinical Systems Improvement (ICSI). Venous Thromboembolism Prophylaxis Guideline, Tenth edition, 2012.	http://www.guideline.gov/content.aspx?id=39350 (accessed 4/7/2016) https://www.icsi.org/asset/ht2bhd/VTEProphy-Interactive1112.pdf (accessed 4/7/2016)	Level Ia and III: Systematic review. evidence rating and expert opinion	List of changes in the updated version is provided here: https://www.icsi.org/asset/2cb7ug/VTEProphySoC1112.pdf (accessed 4/7/2016) (Redirects to PDF document)	Specific recommendations for prevention in patients undergoing hip replacement or knee replacement

Table A-6 (Continued)
Identified guidelines for deep vein thrombosis/pulmonary embolism for total knee or hip replacement

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
Kearon C, Akl EA, Comerota AJ, Prandoni P, Bounameaux H, Goldhaber SZ, Nelson ME, Wells PS, Gould MK, Dentali F, Crowther M, Kahn SR. Antithrombotic therapy for VTE disease: antithrombotic therapy and prevention of thrombosis, 9th ed. American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest 2012 Feb;141(2 Suppl):e419S-94S.	http://www.guideline.gov/content.aspx?id=35268 (accessed 4/7/2016) http://journal.publications.chestnet.org/article.aspx?articleid=1159520 (accessed 4/7/2016)	Level Ia: Systematic review and evidence rating	None	Addresses treatment of DVT to prevent PE
Falck-Ytter Y, Francis CW, Johanson NA, Curley C, Dahl OE, Schulman S, Ortel TL, Pauker SG, Colwell CW Jr. Prevention of venous thromboembolism in orthopedic surgery patients: antithrombotic therapy and prevention of thrombosis. American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest 2012 Feb;141(2 Suppl):e278S-325S.	http://www.guidelines.gov/content.aspx?id=35265 (accessed 4/7/2016) Publication link: http://journal.publications.chestnet.org/article.aspx?articleid=1159591&resultClick=1 (accessed 4/7/2016)	Level Ia: Systematic review and evidence rating	None	Anticoagulant prophylaxis during Elective Hip Replacement and elective Knee Replacement, in patients with and without a high risk of bleeding

Table A-6 (Continued)
Identified guidelines for deep vein thrombosis/pulmonary embolism for total knee or hip replacement

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
Douketis JD, Spyropoulos AC, Spencer FA, Mayr M, Jaffer AK, Eckman MH, Dunn AS, Kunz R. The perioperative management of antithrombotic therapy: antithrombotic therapy and prevention of thrombosis, 9 th ed: American College of Chest Physicians Evidence-Based Clinical Practice Guidelines. Chest 2012 Feb;141(2 Supple):2326S-50S.	http://www.guideline.gov/content.aspx?id=35266 (accessed 4/7/2016) http://journal.publications.chestnet.org/article.aspx?articleid=1159479 (accessed 4/7/2016)	Level Ia: Systematic review and evidence rating	None	Recommended procedures for bridging of anticoagulation therapy
Qaseem A, Chou R, Humphrey LL, Starkey M, Shekelle P, for the Clinical Guidelines Committee of the American College of Physicians. Venous thromboembolism prophylaxis in hospitalized patients: a clinical practice guideline from the American College of Physicians. Ann Intern Med. 2011 Nov 1;155(9):625-32.	http://www.guideline.gov/content.aspx?id=34969 (accessed 4/7/2016) http://annals.org/article.aspx?articleid=1033137 (accessed 4/7/2016)	Level Ia and III: Systematic review, evidence rating, and expert opinion	None.	ACP provides three major recommendations related to risk assessment prior to prophylaxis, prophylaxis with heparin or a related drug in some circumstances, and against the use of graduated compression stockings.

Table A-7
Identified guidelines for manifestations of poor glycemic control

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
<p>Manifestations of poor glycemic control</p> <p><i>Diabetic ketoacidosis, Hypoglycemic coma, Nonketotic hyperosmolar coma; Secondary diabetes with ketoacidosis or hyperosmolarity</i></p> <p>American Association of Clinical Endocrinologists medical guidelines for clinical practice for developing a diabetes mellitus comprehensive care plan. 2015.</p>	<p>https://www.aace.com/files/dm-guidelines-ccp.pdf (accessed 4/7/2016)</p>	<p>Levels Ia and III: Systematic review, evidence rating, and expert opinion</p>	<p>This guideline replaces the 2011 guidelines of the same name.</p>	<p>Recommendations for the routine glucose monitoring and a plan for treatment of 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. Recommendation 32 is focused on control of hyperglycemia in hospitalized patients. Responses to question 7.5 and 9 provide justification and also recommendations for prevention of hypoglycemia, respectively. Response to question 11.1 summarized findings related to glycemic control in cardiovascular patients.</p>

Table A-7 (Continued)
Identified guidelines for manifestations of poor glycemic control

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
Institute for Clinical Systems Improvement (ICSI) Perioperative protocol. Health care protocol, 2014. 5 th edition.	NGC guideline summary. http://www.guideline.gov/content.aspx?id=48408 (accessed 4/7/2016) https://www.icsi.org/guidelines_more/catalog_guidelines_and_more/catalog_guidelines/catalog_patient_safetyreliability_guidelines/perioperative/ (accessed 4/7/2016)	Levels Ia and III: Systematic review, evidence rating and expert opinion	The 2014 update is in transition to GRADE methodology. A summary of changes from the previous version is here: https://www.icsi.org/_asset/5h7ypw/PeriopSoC.pdf (accessed 4/7/2016)	“Glycemic control should be directed at achieving blood glucose levels between 140-180 mg/dL and not be directed at more intensive goal targets (80-110 mg/dL) (<i>Strong Recommendation, High Quality Evidence</i>).”
Qaseem A, Humphrey LL, Chou R, Snow V, Shekelle P, Clinical Guidelines Committee of the American College of Physicians. Use of intensive insulin therapy for the management of glycemic control in hospitalized patients: a clinical practice guideline from the American College of Physicians. <i>Ann Intern Med</i> 2011 Feb 15;154(4):260-7.	http://www.ngc.gov/content.aspx?id=34168 (accessed 4/7/2016) http://annals.org/article.aspx?articleid=746815 (accessed 4/7/2016)	Levels Ia and III: Systematic review, evidence rating and expert opinion	Uses GRADE methodology	ACP recommends against the use of intensive insulin therapy to strictly control blood glucose in certain hospital settings and patient groups. Contains a discussion of target blood glucose levels if insulin therapy is used in SICU/MICU patients

Table A-7 (Continued)
Identified guidelines for manifestations of poor glycemic control

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
American Diabetes Association. Diabetes Care in the Hospital, Nursing Home, and Skilled Nursing Facility. In: Standards of Medical Care in Diabetes, 2015. Diabetes Care. 2015;38(Suppl 1):S80-85.	http://care.diabetesjournals.org/site/misc/2016-Standards-of-Care.pdf (accessed 4/7/2016)	Levels Ia and III: Systematic review, evidence rating and expert opinion	Summary of revisions from 2014 version is available here: http://care.diabetesjournals.org/site/misc/2016-Standards-of-Care.pdf (accessed 4/7/2016)	Recommendations for the monitoring and treatment of patients to prevent and treat manifestations of hypoglycemia and hyperglycemia. Section 13 presents recommendations specific to patients in the hospital setting. The 2016 guidelines were updated to focus solely on hospital care.
Redmon B, Caccamo D, Flavin P, Michels R, Myers C, O'Connor P, Roberts J, Setterlund L, Smith S, Sperl-Hillen J. Institute for Clinical Systems Improvement. Diagnosis and Management of Type 2 Diabetes Mellitus in Adults. Updated July 2014.	https://www.icsi.org/guidelines_more/catalog_guidelines_and_more/catalog_guidelines/catalog_endocrine_guidelines/diabetes/ (accessed 4/7/2016) NGC summary: http://www.guideline.gov/content.aspx?id=48544 (accessed 4/7/2016)	Levels Ia and III: Systematic review, evidence rating, and expert opinion	Although the recommendations in this document were developed using GRADE methodology, there are no formal recommendations specific to management of inpatient diabetes. The provided algorithm provides citations in support of the suggested steps.	Suggestions for the monitoring, treatment of glucose to prevent and treat manifestations of hypoglycemia and hyperglycemia in diabetic inpatients.

Table A-7 (Continued)
Identified guidelines for manifestations of poor glycemic control

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
Endocrine Society. Management of hyperglycemia in hospitalized patients in non-critical care setting: an Endocrine Society clinical practice guideline. Umpierrez GE, Hellman R, Korytkowski MT, Kosiborod M, Maynard GA, Montori VM, Seley JJ, Van den Berghe G. J Clin Endocrinol Metab. 2012 Jan;97(1):16-38.	http://jcem.endojournals.org/content/97/1/16.full.pdf+html (accessed 4/7/2016) NGC link: http://www.guideline.gov/content.aspx?id=35255 (accessed 4/7/2016))	Levels Ia and III: Systematic review, evidence rating, and expert opinion	Uses GRADE methodology.	“Implementing a standardized sc insulin order set promoting the use of scheduled basal and nutritional insulin therapy is a key intervention in the inpatient management of diabetes. We provide recommendations for practical, achievable, and safe glycemic targets and describe protocols, procedures, and system improvements required to facilitate the achievement of glycemic goals in patients with hyperglycemia and diabetes admitted in non-critical care settings.”

Table A-8
Identified guidelines for iatrogenic pneumothorax with venous catheterization

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
<p>Iatrogenic pneumothorax with venous catheterization</p> <p>English BS, Ray CE Jr, Chang JY, Crabtree TD, Gaba RC, Gipson MG, Iannetoni MD, Kouri BE, Marshalleck FE, Mohammed TL, Pinchot JW, Saleh AG, Willers H, Hohenwalter EJ, Expert Panel on Interventional Radiology. ACR Appropriateness Criteria® radiologic management of thoracic nodules and masses. Reston (VA): American College of Radiology (ACR); 2015. 14 p. [64 references]</p>	<p>http://www.guideline.gov/content.aspx?id=49909 (accessed 4/7/2016)</p> <p>https://acsearch.acr.org/docs/69343/Narrative (accessed 4/7/2016) (redirects to PDF)</p> <p>Updated Guideline Link</p>	<p>Levels Ib and III: Literature search and expert opinion</p>	<p>Individual studies were categorized into ranks 1-4. The rating system was based on the based on the RAND/UCLA Appropriateness Method. Individual studies were assigned “strength of evidence” quality scores, but no ratings of evidence strength across studies were provided.</p>	<p>“Using a steeper angle of the biopsy needle may decrease the risk of pneumothorax.”</p> <p>“The most common complication requiring intervention is pneumothorax (10% to 30%).”</p>
<p>Practice guidelines for central venous access: a report by the American Society of Anesthesiologists Task Force on Central Venous Access. Anesthesiology. 2012 Mar;116(3):539-73</p>	<p>http://www.guideline.gov/content.aspx?id=36196 (accessed 4/7/2016)</p> <p>http://www.asahq.org/~media/Sites/ASAHQ/Files/Public/Resources/standards-guidelines/practice-guidelines-for-central-venous-access.pdf (accessed 4/7/2016) (redirects to PDF)</p>	<p>Levels Ib and III: Literature search, evidence rating and expert opinion</p>	<p>Evidence grading is based on the number and type of studies.</p>	<p>Recommendations focus on preparation of the surgical environment and intravenous antibiotic prophylaxis, but include recommendations for patient positioning.</p>

Table A-8 (Continued)
Identified guidelines for iatrogenic pneumothorax with venous catheterization

Evidence-based guideline and publishing organization	Location	Evidence level	Comments	Prevention recommendations
Guidelines for performing ultrasound guided vascular cannulation: recommendations of the American Society of Echocardiography and the Society of Cardiovascular Anesthesiologists, 2011.	http://journals.lww.com/anesthesia-analgesia/pages/articleviewer.aspx?year=2012&issue=01000&article=00007&type=Fulltext (accessed 4/7/2016)	Levels Ia and III: Systematic review, evidence rating, and expert opinion	None.	“Individual operators should not attempt cannulation more than twice, as the incidence of complication, particularly pneumothorax, rises significantly with additional attempts. High-risk patients may benefit from ultrasound screening of the SC vein before attempted cannulation to identify vessel location and patency and to specifically identify thrombus before attempted cannulation. The recommendation for ultrasound guidance during SC vein cannulation is based on category A (supportive), level 3 evidence.”

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APPENDIX B
GUIDELINES FOR INFECTION-RELATED HACs

B.1 Guidelines With Recommendations for Prevention of Multiple Infection-Related HACs

In **Table B-1** below, we present the current guidelines identified through our searches that provide recommendations to prevent multiple infection-related HACs.

Table B-1
Identified guidelines for multiple infection-related conditions

Evidence-based guideline and publishing organization	Location	Relevant HACs	Evidence level	Comments	HAC-Specific Recommendations
Multiple HACs HICPAC, CDC. Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008.	http://www.cdc.gov/hicpac/Disinfection_Sterilization/acknowledgment.html (accessed 4/8/2016) http://www.cdc.gov/hicpac/pdf/guidelines/Disinfection_Nov_2008.pdf (accessed 4/8/2016) (Redirects to PDF document)	CAUTI CLABSI	Level Ia and III: Systematic review, evidence rating and expert opinion	Addresses sterilization for a broad range of pathogens A partial update related to environmental fogging for norovirus control is here: http://www.cdc.gov/hicpac/Disinfection_Sterilization/17_00_Recommendations.html#a8	CAUTI and CLABSI : Describes disinfection and sterilization techniques for surgical and medical devices, including catheters.

Table B-1 (Continued)
Identified guidelines for multiple infection-related conditions

Evidence-based guideline and publishing organization	Location	Relevant HACs	Evidence level	Comments	HAC-Specific Recommendations
Guideline for Hand Hygiene in Health-Care Settings. Recommendations of the Healthcare Infection Control Practices Advisory Committee and the HICPAC/SHEA/APIC/IDSA Hand Hygiene Task Force. <i>MMWR Recomm Rep</i> 2002 Oct; 51(RR16):1-44.	http://www.cdc.gov/hicpac/pubs.html (accessed 4/11/2016) http://www.cdc.gov/mmwr/PDF/rr/rr5116.pdf (redirects to PDF) (accessed 4/11/2016)	CAUTI CLABSI S-SSI	Levels Ib and III: Literature review, evidence rating, and expert opinion	Although the recommendations are graded, this report received a grade of Ib because the literature review was not described as systematic. Authors of this report could not locate a historic description of CDC/HICPAC guideline development methods in use at that time.	CAUTI and CLABSI: “Decontaminate hands before donning sterile gloves when inserting a central intravascular catheter (IB). Decontaminate hands before inserting indwelling urinary catheters, peripheral vascular catheters, or other invasive devices that do not require a surgical procedure (IB).” S-SSI: The guideline contains graded recommendations for hand hygiene during procedures included in both the selected and candidate surgical site infection HACs.

Table B-1 (Continued)
Identified guidelines for multiple infection-related conditions

Evidence-based guideline and publishing organization	Location	Relevant HACs	Evidence level	Comments	HAC-Specific Recommendations
IDSA/SHEA. Strategies to Prevent Healthcare-Associated Infections Through Hand Hygiene. <i>Infect Control Hosp Epidemiol</i> 2014; 35(8):937-960	http://www.jstor.org/stable/10.1086/677145 (accessed 4/11/2016)	CAUTI CLABSI S-SSI	Levels Ib and III: Literature search, evidence rating and expert opinion	From: SHEA/IDSA Compendium of Strategies to Prevent Healthcare-Associated Infections in Acute Care Hospitals, http://www.shea-online.org/PriorityTopics/CompendiumofStrategiestoPreventHAIs.aspx (accessed 4/11/2016) Evidence grading is based on Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) and the Canadian Task Force on Preventive Health Care	CAUTI, CLABSI, and S-SSI: Contains recommendations for basic hand hygiene for all acute-care hospitals, including timing of hand hygiene performance and selection of cleansing agents, as well as recommendations for approaches that should not be considered part of routine hand hygiene: “Perform hand hygiene with an ABHR or, alternatively, an antimicrobial or nonantimicrobial soap for the following indications (quality of evidence: II). a. Before direct patient contact. c. Before inserting an invasive device d. Before and after handling an invasive device, including before accessing intravenous devices for medication administration.”

B.2 Guidelines for Selected Infection-Related HACs

In **Tables B-2** through **B-4** below, we present the current guidelines identified through our searches that provide recommendations to prevent specific selected infection-related HACs:

- Catheter-associated urinary tract infection (CAUTI)
- Vascular catheter-associated infection (CLABSI)
- Surgical site infection (SSI), Mediastinitis, following Coronary Artery Bypass Graft (CABG), Cardiac Implantable Electronic Device (CIED), bariatric surgery (laparoscopic gastric bypass, gastroenterostomy, or laparoscopic gastric restrictive surgery), or certain orthopedic procedures (spine, neck, shoulder, or elbow). (S-SSI)

Table B-2
Identified guidelines for catheter-associated urinary tract infection

Evidence-based guideline and publishing organization	Location	Relevant HACs	Evidence level	Comments	HAC-Specific Recommendations
<p>Catheter-associated urinary tract infection</p> <p>HICPAC, CDC. Guideline for Prevention of Catheter Associated Urinary Tract Infection (CAUTI), 2009.</p>	<p>http://www.cdc.gov/hicpac/pdf/CAUTI/CAUTI_guideline2009final.pdf (accessed 4/11/2016) (Redirects to PDF document)</p> <p>Web content: http://www.cdc.gov/hicpac/cauti/002_cauti_toc.html (accessed 4/11/2016)</p>	CAUTI	Level Ia and III: Systematic review, evidence rating, and expert opinion	<p>Appendices here: http://www.cdc.gov/hicpac/pdf/CAUTI/CAUTI_GuidelineAppendices2009final.pdf (accessed 4/11/2016) (Redirects to PDF document)</p>	Recommendation for the appropriate use and procedures for insertion and maintenance of urinary catheters to minimize the occurrence of urinary tract infection
<p>Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America (IDSA/SHEA). Strategies to Prevent CAUTI in Acute Care Hospitals. <i>Infect Control Hosp Epidemiol</i> 2014 35(5):464-479.</p>	<p>http://www.jstor.org/stable/10.1086/675718 (accessed 4/11/2016)</p>	CAUTI	Levels Ib and III: Literature search, evidence rating and expert opinion	<p>From: SHEA/IDSA Compendium of Strategies to Prevent Healthcare-Associated Infections in Acute Care Hospitals, http://www.shea-online.org/PriorityTopics/CompendiumofStrategiestoPreventHAIs.aspx (accessed 4/11/2016)</p> <p>Evidence grading is based on Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) and the Canadian Task Force on Preventive Health Care</p>	Recommendations for preventing and monitoring catheter-associated urinary tract infection

Table B-2 (Continued)
Identified guidelines for catheter-associated urinary tract infection

Evidence-based guideline and publishing organization	Location	Relevant HACs	Evidence level	Comments	HAC-Specific Recommendations
American Urologic Association Education and Research, Inc. Best Practice Policy Statement on Urological Surgery Antimicrobial Prophylaxis. 2008. (Reviewed and validity confirmed 2010; updated February 2012).	http://www.auanet.org/education/guidelines/anti-microbial-prophylaxis.cfm (accessed 4/11/2016)	CAUTI	Levels Ib and III: Literature search, evidence rating and expert opinion	None.	Prophylactic antibiotic recommendations for urologic instrumentation. Including catheters to prevent systemic infections in select patients

Table B-3
Identified guidelines for vascular catheter-associated infection

Evidence-based guideline and publishing organization	Location	Relevant HACs	Evidence level	Comments	HAC-Specific Recommendations
Vascular catheter-associated infection Association for Vascular Access (AVA), American Society of Diagnostic and Interventional Nephrology (ASDIN). Preservation of peripheral veins in patients with chronic kidney disease. 2008.	AVA position statement: http://www.avainfo.org/website/download.asp?id=193195 (accessed 4/11/2016) (Redirects to PDF document)	CLABSI	Level II: Evidence cited	Association website: http://www.avainfo.org/website/article.asp?id=1441 (accessed 4/11/2016)	Recommendations address the need for specialized venous access care in patients with chronic kidney disease.
Clinical Practice Guidelines for Vascular Access, Update 2006. National Kidney Foundation, Kidney Disease Outcomes Quality Initiative Vascular Access Work Group (NFK-DOQI), 2006 <i>Am J Kidney Dis</i> 2006 Jul;48 Suppl 1:S248-73	https://www.kidney.org/site/default/files/docs/12-50-0210_jag_dcp_guidelines_va_oct06_sectionc_ofc.pdf (accessed 4/11/2016) (redirects to PDF)	CLABSI	Levels Ia and III: Systematic review, evidence rating, and expert opinion	Detailed guidelines. NFK-DOQI clinical guidelines are here: https://www.kidney.org/professionals/KDOQI/guidelines_commentaries (accessed 4/11/2016)	Includes recommendations for “Infection-control measures that should be used for all HD catheters and port catheter systems”

Table B-3 (Continued)
Identified guidelines for vascular catheter-associated infection

Evidence-based guideline and publishing organization	Location	Relevant HACs	Evidence level	Comments	HAC-Specific Recommendations
IDSA/SHEA. Strategies to Prevent Central Line-Associated Bloodstream Infection in Acute Care Hospitals, 2014 Update. Infect Control Hosp Epidemiol 2014, 35(7):753-771 .	http://www.jstor.org/stable/10.1086/676533 (accessed 4/11/2016)	CLABSI	Level Ib and III: Systematic review, evidence rating and expert opinion	From: SHEA/IDSA Compendium of Strategies to Prevent Healthcare-Associated Infections in Acute Care Hospitals, http://www.shea-online.org/PriorityTopics/CompendiumofStrategiesToPreventHAIs.aspx (accessed 4/11/2016) Evidence grading is based on Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) and the Canadian Task Force on Preventive Health Care	CLABSI: Comprehensive recommendations for the insertion and maintenance of central line catheters
Oncology Nursing Society. Access Device Guidelines- Recommendations for Nursing Practice and Education, 3 rd ed. 2011	http://www.ons.org/products/access-device-guidelines-recommendations-nursing-practice-and-education-third-edition (accessed 4/11/2016) (Available for purchase)	CLABSI	Level II: Evidence cited	Evidence not specific to each recommendation	CLABSI: Addresses peripheral and central lines for administration of chemotherapy.

Table B-3 (Continued)
Identified guidelines for vascular catheter-associated infection

Evidence-based guideline and publishing organization	Location	Relevant HACs	Evidence level	Comments	HAC-Specific Recommendations
Schiffer, C. A., P. B. Mangu, et al. (2013). "Central venous catheter care for the patient with cancer: American Society of Clinical Oncology clinical practice guideline." <i>J Clin Oncol</i> 31(10): 1357-1370	http://www.asco.org/quality-guidelines/central-venous-catheter-care-patient-cancer-american-society-clinical-oncology (accessed 4/11/2016)	CLABSI	Levels Ia and III: Systematic review, evidence rating, and expert opinion	Supplemental materials including an evidence table are available at http://www.asco.org/site/www.asco.org/files/cv_c_ds_3.4.13_0.pdf (Redirects to PDF) (accessed 4/11/2016)	Contains recommendations for use of central venous catheter clinical care bundles and use of antimicrobial/antiseptic-impregnated or -coated CVCs (CH-SS or minocycline/rifampin) and/or heparin-impregnated Catheters; recommends against prophylactic use of systemic antibiotics (IV or oral) before insertion of long-term catheters.
Practice guidelines for central venous access: a report by the American Society of Anesthesiologists Task Force on Central Venous Access. <i>Anesthesiology</i> . 2012 Mar;116(3):539-73	http://www.guideline.gov/content.aspx?id=36196 (accessed 4/11/2016) http://www.asahq.org/~media/Sites/ASAHQ/Files/Public/Resources/standards-guidelines/practice-guidelines-for-central-venous-access.pdf (accessed 4/11/2016) (redirects to PDF)	CLABSI	Levels Ib and III: Literature search, evidence rating and expert opinion	Evidence grading is based on the number and type of studies.	CLABSI: Recommendations cover preparation of the surgical environment, intravenous antibiotic prophylaxis, aseptic preparation and selection of antiseptic solution, and selection of catheter insertion sites.

Table B-3 (Continued)
Identified guidelines for vascular catheter-associated infection

Evidence-based guideline and publishing organization	Location	Relevant HACs	Evidence level	Comments	HAC-Specific Recommendations
CDC. Guidelines for the Prevention of Intravascular Catheter-related Infections, 2011.	http://www.cdc.gov/hicpac/BSI/BSI-guidelines-2011.html (accessed 4/11/2016) http://cid.oxfordjournals.org/content/early/2011/03/30/cid.cir257.full.pdf+html (accessed 4/11/2016)	CLABSI	Levels Ia and III: Systematic review, evidence rating, and expert opinion	Work on the <i>Guidelines for the Prevention of Intravascular Catheter-Related Infections</i> was initiated prior to implementation of CDC's revised methodology for guideline development. Therefore, this guideline reflects the development methods that were used for guidelines produced prior to 2009.	CLABSI: Detailed recommendations for prevention of infection during central venous line and vascular access catheter insertion and maintenance in adults and children.

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Table B-4
Identified guidelines for selected surgical site infections

Evidence-based guideline and publishing organization	Location	Relevant HACs	Evidence level	Comments	HAC-Specific Recommendations
<p>Surgical site infection (S-SSI) <i>following CABG (mediastinitis), CIED, bariatric surgery (laparoscopic gastric bypass, gastroenterostomy, or laparoscopic gastric restrictive surgery), or certain orthopedic procedures (spine, neck, shoulder, or elbow).</i> North American Spine Society (NASS). Antibiotic Prophylaxis in Spine Surgery, 2013 update.</p>	<p>https://www.spine.org/Documents/ResearchClinicalCare/Guidelines/AntibioticProphylaxis.pdf (accessed 4/11/2016) (Redirects to PDF document)</p>	S-SSI	<p>Levels Ia and III: Literature search, evidence rating and expert opinion</p>	<p>Supplemental technical material is here: https://www.spine.org/Documents/ResearchClinicalCare/Guidelines/AntibioticProphylaxisTechnicalReport.pdf (accessed 4/11/2016) (Redirects to PDF document)</p>	<p>“Patients undergoing spine surgery should receive preoperative prophylactic antibiotics.”</p>

Table B-4 (Continued)
Identified guidelines for selected surgical site infections

Evidence-based guideline and publishing organization	Location	Relevant HACs	Evidence level	Comments	HAC-Specific Recommendations
Society of Thoracic Surgeons Workforce on Evidence Based Surgery. Antibiotic prophylaxis in cardiac surgery, Part I: Duration. 2005.	http://www.sts.org/sites/default/files/documents/pdf/guidelines/AntibioticProphylaxisinCardiacSurgeryPartIDuration.pdf (accessed 4/11/2016) (Redirects to PDF)	S-SSI	Levels Ib and III: Literature search, evidence rating and expert opinion.	The type of evidence is identified and graded for major recommendations. Antibiotic guidelines are available here: http://www.sts.org/resources-publications/clinical-practice-credentialing-guidelines/antibiotic-guidelines (accessed 4/11/2016)	Contains recommendations with respect to antibiotic duration and catheterization, single dose prophylaxis, and duration of administration.
Society of Thoracic Surgeons Workforce on Evidence Based Surgery. Antibiotic prophylaxis in cardiac surgery, Part II: Antibiotic Choice. 2007.	http://www.guideline.gov/content.aspx?id=10411 (accessed 4/11/2016) http://www.sts.org/sites/default/files/documents/pdf/guidelines/AntibioticProphylaxisinCardiacSurgeryPartIIAntibiotic_Choice.pdf (accessed 4/11/2016) (redirects to pdf)	S-SSI	Levels Ib and III: Literature search, evidence rating and expert opinion.	The type of evidence is identified and graded for major recommendations. Guideline developers reaffirmed the currency of this guideline in 2011.	Major recommendations for prevention of surgical site infections following cardiac surgery—soft tissue sterna infections and suppurative mediastinitis—include those application of topical antibiotics, choice of primary prophylactic antibiotic, and appropriate dosing.

Table B-4 (Continued)
Identified guidelines for selected surgical site infections

Evidence-based guideline and publishing organization	Location	Relevant HACs	Evidence level	Comments	HAC-Specific Recommendations
American Association of Clinical Endocrinologists, The Obesity Society, and American Society for Metabolic and Bariatric Surgery. Medical Guidelines for Clinical Practice for the Perioperative Nutritional, Metabolic, and Nonsurgical Support of the Bariatric Surgery Patient. 2013 update. <i>Endocr Pract</i> 19 (2): 337-372.	http://www.ncbi.nlm.nih.gov/pubmed/23529351 (accessed 4/11/2016) http://s3.amazonaws.com/publicASMBS/GuidelinesStatement/s/Guidelines/AACE_TOS_ASMBS_Clinical_Practice_Guidlines_3.2013.pdf (redirects to PDF) (accessed 4/11/2016)	S-SSI	Levels Ia and III: Literature search, evidence rating and expert opinion	Minimal mention of surgical site infection.	“Tobacco use should be avoided at all times by all patients. In particular, patients who smoke cigarettes should stop, preferably at least 6 weeks before bariatric surgery (<i>Grade A; BEL 2, upgraded by consensus</i>). Also, tobacco use should be avoided after bariatric surgery given the increased risk for of poor wound healing, anastomotic ulcer, and overall impaired health (<i>Grade A; BEL 1</i>).” Authors note that, “The relative risk conferred by cigarette smoking on the incidence of infections in post-bariatric surgery patients undergoing body contouring abdominoplasty is 14, with a cutoff of 8.5 pack-years (185 [EL 3, SS]).”
Institute for Clinical Systems Improvement (ICSI) Perioperative protocol. Health care protocol, 2014. 5 th edition.	https://www.icsi.org/guidelines_more/catalog_guidelines_and_more/catalog_guidelines/catalog_patient_safetyreliability_guidelines/perioperative/ (accessed 4/11/2016)	S-SSI	Levels Ia and III: Systematic review, evidence rating and expert opinion	The 2014 update is in transition to GRADE methodology. A summary of changes from the previous version is here: https://www.icsi.org/asset/5h7ypw/PeriopSoC.pdf (accessed 4/11/2016)	“Prophylactic antibiotic should be discontinued within 48 hours after surgery end-time for all coronary artery bypass graft (CABG)/cardiac procedures.”

Table B-4 (Continued)
Identified guidelines for selected surgical site infections

Evidence-based guideline and publishing organization	Location	Relevant HACs	Evidence level	Comments	HAC-Specific Recommendations
Guidelines for Environmental Infection Control in Health-Care Facilities, 2003; CDC and the Healthcare Infection Control Practices Advisory Committee <i>MMWR Recomm Rep.</i> 2003 June 6; 52(RR10);1-42	http://www.cdc.gov/hicpac/pdf/guidelines/eic_in_HCF_03.pdf (accessed 4/11/2016) The main repository page is: http://www.cdc.gov/hicpac/2007IP/2007isolationPrecautions.html (accessed 4/11/2016)	S-SSI	Levels Ib and III: Literature review and expert opinion.	Errata here: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5242a9.htm (accessed 4/11/2016)	Contains recommendations for general prevention of surgical site infection through surgical and disinfection procedures, including “Remove bird roosts and nests near air intakes to prevent mites and fungal spores from entering the ventilation system.” <i>Category IB</i>
Bratzler DW, Dellinger EP, Olsen KM, Perl TM, Auwaerter PG, Bolon MK, Fish DN, Napolitano LM, Sawyer RG, Slain D, Steinberg JP, Weinstein RA. Clinical practice guidelines for antimicrobial prophylaxis in surgery. <i>Am J Health Syst Pharm.</i> 2013 Feb 1;70(3):195-283.	http://www.guideline.gov/content.aspx?id=39533 (accessed 4/11/2016) http://www.ashp.org/DocLibrary/BestPractices/TGSurgery.aspx (accessed 4/11/2016) (Redirects to PDF)	S-SSI	Levels Ia and III: Systematic review, evidence rating and expert opinion	Next review scheduled for 2016. Guideline authors note that the system of evidence grading used in this guideline is the same as that used by AHRQ, ASHP, IDSA, SIS, and SHEA. The authors state that “the strength of evidence represents only support for or against prophylaxis and does not apply to the antimicrobial choice, dose, or dosage regimen.”	Includes recommendations for preoperative-dose timing, selection and dosing, duration of prophylaxis, and principles common across various types of surgical procedures, including cardiac and cardiac device insertion, certain orthopedic procedures, and total joint replacements..

Table B-4 (Continued)
Identified guidelines for selected surgical site infections

Evidence-based guideline and publishing organization	Location	Relevant HACs	Evidence level	Comments	HAC-Specific Recommendations
Guideline for Prevention of Surgical Site Infection, 1999; CDC Infect Control Hosp Epidemiol. 1999 Apr;20(4):250-78	http://www.cdc.gov/hicpac/pdf/guidelines/SSI_1999.pdf (accessed 4/11/2016)	S-SSI	Levels Ib and III: Evidence rating and expert opinion	Detailed recommendations for infection prevention before, during, and after all surgical procedures. CDC is still revising the SSI guidelines, based on public comments received in spring 2014. Draft guidelines: http://www.regulations.gov/#!docketDetail;D=CDC-2014-0003 (accessed 12/2/2015)	Comprehensive recommendations for prevention of surgical site infections, including antimicrobial prophylaxis for cardiac surgeries, certain orthopedic surgeries and total joint replacements.

Table B-4 (Continued)
Identified guidelines for selected surgical site infections

Evidence-based guideline and publishing organization	Location	Relevant HACs	Evidence level	Comments	HAC-Specific Recommendations
<p>IDSA/SHEA. Strategies to Prevent Surgical Site Infections in Acute Care Hospitals: 2014 Update. 2014.</p> <p><i>Infect Control Hosp Epidemiol</i> 2014, 35(6):605-627 .</p>	<p>http://journals.cambridge.org/download.php?file=%2F2881_9F3FE76DAA1D09C06FE9B99264E94A61_journals_ICE_ICE35_06_S0195941700093267a.pdf&cover=Y&code=7ff398071f24918fa22b52fd9ff5084a (accessed 4/11/2016)</p>	S-SSI	Levels Ib and III: Literature search, evidence rating and expert opinion	<p>From: SHEA/IDSA Compendium of Strategies to Prevent Healthcare-Associated Infections in Acute Care Hospitals, http://www.shea-online.org/PriorityTopics/CompendiumofStrategiesToPreventHAIs.aspx (accessed 4/11/2016)</p> <p>Evidence grading is based on Grades of Recommendation, Assessment, Development, and Evaluation (GRADE) and the Canadian Task Force on Preventive Health Care</p>	<p>General recommendations for prevention of surgical site infection. Includes some recommendations related to cardiac surgery: “Stop prophylaxis within 24 hours after the procedure for all procedures except cardiac surgery; for cardiac surgery, antimicrobial prophylaxis should be stopped within 48 hours” as well as total joint replacement</p>