Health Care-associated Infections: Prevention & Management

Introduction
Treatments failures due to antibiotic resistance are increasingly common with potentially dire consequences for the individuals who are infected and for the community at large. It was estimated that in 2002 there were 1.7 million health care associated-infections (HAI) in US hospitals with an associated 99,000 deaths. Of these infections, an estimated 274,098 were surgical site infections (SSI) or roughly two infections for every 100 procedures. There were also an estimated 424,060 urinary tract infections (UTI), 129,519 pneumonias, and 133,368 blood stream infections. The costs associated with these HAI estimates were calculated to be from $5.7 - $6.8 billion to as high as $25 - $31.5 billion (2007 dollars). In addition, as of 2008, the Centers for Medicare and Medicaid Services does not reimburse for certain HAI, including catheter-associated UTIs (or CAUTIs) and central line-associated bloodstream infections (CLABSIs).

On July 12, 2010, the Association for Professionals in Infection Control and Epidemiology (APIC) released the results of a survey of their members concerning CLABSIs. Respondents indicated that the greatest challenges to implementing best practices with respect to infection control were failure to enforce policy, lack of education, and paper-based surveillance systems. Many felt that so much time was devoted to surveillance that there was not sufficient time for prevention. Only 30% of respondents felt that their institutions were willing to spend the money necessary to control infection. Leading causes of infection were believed to be failure to properly prepare and maintain lines or ports, failure to remove lines when no longer needed, and failure to perform proper hand hygiene.

Health care providers are the key to both treating and preventing HAI and limiting antibiotic resistance. As we will show, processes involved in providing care and knowledge of appropriate use of antibiotics are essential elements to limiting the risk of infection and preventing antibiotic resistance while effectively treating patients. As a part of a continuing education program, XXX proposes to provide a thorough review of the current knowledge relating to effective antibiotic use and guidelines and procedures necessary to limit infection. In addition, XXX will review the successful elements of model health care programs in which HAI were effectively controlled and in some cases eliminated. This knowledge will give providers the tools with which to limit HAI and effectively treat patients infected with either sensitive or resistant microbes while preserving the effectiveness of available antibiotics.

XXX has conducted a thorough needs assessment for clinicians who treat patients in settings in which HAI occur to aid them in achieving the following learning objectives:

1. Describe current and emerging strategies to limit HAI and antibiotic resistance.
2. Evaluate clinical data from current and emerging studies of interventions designed to limit HAI and antibiotic resistance.
This needs assessment incorporates information from a detailed review of the most current evidence-based literature, clinician survey data, expert opinion, and information from national and government databases. The following gap analysis table outlines the goals of this activity.

<table>
<thead>
<tr>
<th>Gap</th>
<th>Data Source</th>
<th>Educational Need/Intervention</th>
<th>Learning Objectives</th>
<th>Outcome Measurement Levels*</th>
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</thead>
<tbody>
<tr>
<td>Clinicians lack knowledge of available guidelines to limit HAI and competence in applying them in daily practice</td>
<td>Literature review; Clinician survey; Expert opinion</td>
<td>• Review epidemiology of HAI including risk factors, disease burden, and associated costs  • Discuss importance of evidence- and guideline-based care using case scenarios</td>
<td>Describe current and emerging strategies and guidelines to limit HAI and antibiotic resistance</td>
<td>Levels 3/4 (Knowledge/Competence)</td>
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<tr>
<td>Clinicians lack knowledge of successful strategies to limit HAI and antibiotic resistance</td>
<td>Literature review; Clinician survey; Expert opinion</td>
<td>• Discuss current knowledge with respect to antibiotic resistance and appropriate antibiotic use • Discuss interventions that have been successful in limiting HAI</td>
<td>Evaluate clinical data from studies of interventions designed to limit HAI and antibiotic resistance</td>
<td>Levels 3/4 (Knowledge/Competence)</td>
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**Risk Factors for HAI**

A point prevalence survey of HAI was conducted in 2006 in four countries (England, Wales, Northern Ireland, and the Republic of Ireland). The authors of the report analyzed the resulting data for risk factors related to HAI. Of 75,694 patients, 5743 or 7.6% had an HAI. Men had higher rates of infection than women. Risk of infection increased with age. Increasing risk with increasing age held true for both pneumonia and UTI, while the ages at greatest risk for primary bloodstream infection (PBSI) and SSI were ages 35 through 84.

The strongest associations with HAI were antibiotic use, mechanical ventilation, central IV catheter use, and parenteral nutrition. PBSI, specifically, had a similar set of risk factors with the strongest associations being current antibiotic use, central IV catheter use, current mechanical ventilation, urinary catheter use, and non-surgical invasive procedures. Risk factors for pneumonia included mechanical ventilation, antibiotic use, central IV catheter use, parenteral nutrition, current urinary catheter use, and peripheral IV catheter use. SSIs clearly were associated with a history of surgery and also with antibiotic use, parenteral nutrition, mechanical ventilation, and central IV catheter use. UTIs were most strongly associated with urinary catheter use and current antibiotic use.

Patients under the care of a critical care consultant or in a critical care medical area had the highest prevalence of infection at 23.2% and 23.3%, respectively. Pneumonia was the most common infection affecting 11% of patients under the care of a critical care
consultant. Cardiothoracic surgery and neurosurgery also had high rates of infection. Prevalence for SSI among general surgery and trauma/orthopedics patients was 2.9% and 3.2%, respectively.

PBSI modifiable risk factors were identified as aseptic technique during catheter insertion, appropriate subsequent care, and minimizing catheter duration.

**Proper Use of Antibiotics**

Health care providers must grapple with an especially difficult problem when selecting antibiotics in that cultures to identify microbial agents of infection require 48 hours or more for analysis, yet data indicate\(^8\)\(^{10}\) that delays in prescribing an appropriate antibiotic, including prescribing an effective antibiotic after initial use of an ineffective one, increases the risk of mortality. Thus, empirical antibiotic use may be associated with increased risk of mortality if an inappropriate antibiotic is selected. Data from ICU populations suggest that a delay of 24 hours in initiating therapy can increase the risk of mortality. In addition, a review of septic shock indicated that every hour of delay in the initiation of therapy was associated with a 7.6% increase in mortality. In this latter study, 37% of patients had pneumonia. Delay of therapy for patients with bacteremia has also indicated that a delay in effective treatment is associated with increased mortality.\(^8\)

A common approach to limiting treatment delays is to treat initially with a broad-spectrum antibiotic followed by de-escalation once the causative agent has been identified.\(^11\),\(^12\) This approach, however, is likely to increase the risk of antibiotic resistance. Brito and Niederman\(^12\) have proposed an algorithm to address the variability of causative agents and treatment populations to aid in the selection of an appropriate antibiotic while limiting the use of broad spectrum antibiotics.

Decision-support systems, like that proposed by Brito and Niederman, can provide essential support to physicians attempting to limit treatment delays.\(^10\),\(^11\) These systems may be computerized to facilitate ease of use. TREAT is an example of such a system. A cluster, randomized trial, showed that hospital wards using TREAT were more likely to prescribe the appropriate empirical treatment than those that did not use the system.\(^10\)

**Successful Initiatives in Limiting HAI**

Recently, there have been reports of several initiatives of varying effectiveness, which addressed issues related to HAI. A review of several education interventions\(^13\) indicated that education can result in a significant reduction in HAI. The reported estimated annual cost savings related to the prevention of infections associated with these interventions ranged from $42,000 to $1.87 million.

The 5 Million Lives Campaign\(^14\) focuses on transmission of infection, including SSI, ventilator-associated pneumonia (VAP), and central line bloodstream infections, in the hospital setting. More specifically, the campaign’s focus is to prevent transmission of MRSA in hospitals. The program recommends five key components to limit MRSA transmission. While it is recognized that additional issues can be factors in transmission, it is felt that these five elements are necessary components to limit methicillin-resistant
Staphylococcus aureus (MRSA) and other hospital infections. The components are hand hygiene, decontamination of the environment and equipment, active surveillance meaning screening patients for colonization at admission, contact precautions including universal precautions and isolation of affected patients, and device bundles. The campaign specifically recommends central line and ventilator bundles to reduce infection.

Another successful intervention program is the Keystone ICU Project.15, 16 This program produced sustained reductions in catheter-related bloodstream infections. The focus of the program is to improve clinician adherence to five evidence-based recommendations to reduce rates of catheter-induced bloodstream infections. The recommendations include a device bundle to address CLBSI, hand hygiene, maximal sterile barriers, chlorhexidine for skin asepsis, avoidance of femoral lines, and avoidance and removal of unnecessary lines. The program was implemented in 90 intensive care units in Michigan. A 66% reduction in infection rates was seen in the first 18 months of the program. An even greater reduction was achieved during the “sustainability” period of 34 to 36 months. This program is notable for its focus on obtaining senior executive level commitment and for the use of feedback mechanisms to achieve continuous improvement. The program relies on self-identified areas for improvement and utilizes the Learn From a Defect tool to analyze factors contributing to adverse events.

Summary

Health care-associated infections contribute substantially to mortality and health care expenses. Intervention studies have shown that prevention is possible and can result in substantial reductions in infection rates and their associated costs. In some cases, investigators have shown that it is possible to completely eliminate health care-associated infections for substantial periods of time. Many believe these infections are entirely avoidable. In addition, inappropriate use of antibiotics is leading to a wide array of resistant microbes threatening to overwhelm our ability to treat infection. Numerous guidelines have been published, which outline health care processes that can substantially limit health care-associated infections and antibiotic resistance.

Proposed Learning Objectives

After completing this activity, the participant will demonstrate the ability to:

1. Describe current and emerging strategies to limit HAI and antibiotic resistance.
2. Evaluate clinical data from current and emerging studies of interventions designed to limit HAI and antibiotic resistance.

Proposed Agenda

I. Introduction: Disease Burden and Costs of HAI
II. Current Status of Antibiotic Resistance
III. Guidelines to Prevent HAI and Antibiotic Resistance
IV. Successful Intervention Strategies
V. Conclusions and Future Directions

References


