

Costs and Length of Stay Associated with Hospital-Acquired
and Health Care-Associated Infections

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Introduction

Health care-associated or hospital-acquired* infections (HAIs) are infections patients acquire while already receiving medical or surgical treatment in a health care setting.¹ Counted among the leading causes of preventable death in the United States, estimates suggest that at any given time, one in every twenty or twenty-five hospitalized patients has an HAI.^{1, 2}

Several large, national actions have been taken in recent years to focus on reducing the rates of the most prevalent HAIs. In 2009, the recently established Federal Steering Committee for the Prevention of Health Care-Associated Infections released their first health care-associated infection action plan to reduce HAIs in acute care hospitals.¹ Nine five-year goals were set in the 2009 plan to which four more were added in 2013 with a second action plan including expansion to health care settings outside of acute care.¹ With similar goals, the Department of Health and Human Services (HHS) launched Partnership for Patients in 2012, bringing together hospital leaders, employers, physicians, nurses, and patient advocates with state and federal governments to decrease preventable hospital-acquired conditions, including HAIs.¹

Hospital reporting of HAIs is encouraged by the Centers for Medicare and Medicaid Services (CMS) which requires all hospitals receiving payment through the Medicare program to report data about select infections in all patients to the Centers for Disease Control and Prevention's (CDC's) National Healthcare Safety Network (NHSN).³ CMS also includes risk-adjusted measures of six types of HAI among those measures reported publicly on Hospital Compare,⁴ their hospital quality comparison site.

* Hospital-acquired infections, a term applying exclusively to an acute care hospital setting has largely been replaced by the more expansive health care-associated infections so both will be referred to collectively as HAI here.

Even with optimal care, complications like HAIs are not always preventable,⁵ but studies suggest adherence to current practice recommendations for prevention is sub-optimal, leaving room for dramatic reductions in some infection rates simply through adherence to current recommendations.¹ Increasing adherence to current practices or instituting interventions to prevent HAI can be costly. The prevalence of HAIs and the question of costs associated with preventing them have made the cost and outcomes of HAIs a popular area of study.

Studies examining the costs attributed to and outcomes of HAI face particular challenges. As an infection that, by definition, occurs in an individual who is already interacting with the healthcare system, looking at basic costs and charges includes those incurred for the patient's original medical condition or operation as well as the HAI. When determining the costs attributed specifically to the HAI, researchers must distinguish between costs incurred from the primary diagnosis and from the HAI. There are also risk factors, including disease severity and length of stay before HAI, which may have affected both the patient's risk of getting an HAI and its costs and outcomes.

This issue brief examines reviews of articles producing original estimates of the cost and length of stay (LOS) associated with hospital-acquired and/or health care-associated infections both in the United States of America (US) and in the world more broadly. LOS was chosen alongside cost, which can be difficult to compare across hospitals and health systems, because ideally it can be compared more directly across hospitals and health systems. It is also an important factor in the cost of a patient's stay because of the contribution of daily fixed costs associated with hospital care.

Reviews were found through systematic searches of PubMed, Scopus, and the Cochrane Library, a process detailed in the appendix. Of the 25 reviews meeting inclusion criteria, 13

were systematic reviews and/or Meta-analyses, one was a scoping review that did not assess the quality of the studies it gathered, and eleven were other reviews. A major limitation of focusing on reviews was that quality judgments for results of studies mentioned within the reviews relied heavily on the information provided by the review. Including only reviews also put an additional step between data collection and this synthesis, which excluded any very recent primary studies.

Findings

Generally across all reviews, several findings emerged. First, as many reviews noted, the majority of cost analysis studies of hospital-acquired and healthcare-associated infections (HAI) evaluate costs from the perspective of the hospital. None of the reviews produced estimates that considered in-direct costs to the hospital, patients, or society.

Second, the vast majority of cost of HAI estimates are from the US. With one exception,⁶ even reviews specifically interested in approaching HAIs from a European standpoint⁷⁻⁹ included a large number of studies from the US, choosing to convert their findings to European currencies^{6,7} rather than exclude the research.

Third, systematic reviews and meta-analyses trying to calculate cost of HAIs nationally or across studies were hampered by wide variances in methods of calculating and reporting costs between studies and by out-of-date estimates of both prevalence and cost. The quality requirements one article used when translating its systematic review of cost analyses and prevalence data into a national estimate of reasonably preventable HAI and their associated costs in the US introduced such large limitations that the authors asked the outcome of the study not be used for policy development.¹⁰ Although they did report the outcomes of the studies gathered, two systematic reviews primarily examined the transferability and variations in the cost estimate

studies themselves.^{11,12} While the total number of articles using analytical methods that can adjust for confounding factors to estimate cost of HAI increased each decade between 1980 and 2006, so too did the total number of studies estimating cost of HAI, from 10 studies between 1980 and 1989 to 58 studies between 2000 and 2006.¹¹ Between 2000 and 2006, 55.2% of studies of the cost of HAIs were found to use matched comparison analyses,¹¹ an analytic method that matches HAI cases with controls based on patient characteristics. Researchers performing matched comparison analyses choose which patient characteristics to match and more rigorous studies may include disease severity or a measure to control for time at risk pre-infection. Unfortunately, the review examining analytic methods between 1980 and 2006 found less than half of matched comparison studies used disease severity as a matching characteristic.¹¹ Length of stay, which we are interested in as an outcome, can also be used to indicate time at risk before acquiring the HAI, but only 30.3% of studies estimating cost of HAI examined between 1980 and 2006 included LOS as a factor in their estimations.¹¹ This variance in methods and factors adjusted for makes it difficult to transfer results across studies. One review of the variation in estimates and transferability suggested because no significant difference was found in citation frequency between studies of costs that could be easily transferred and those that could not, the publishing and analysis environment itself contributes to large variations and low transferability in studies.¹²

Finally, although there were large variations in cost both across infection type and within a single type of infection, urinary tract infections (UTIs) were the least expensive per case overall. Estimates of attributable costs per UTI case ranged from \$896 to \$1006 in high quality studies.^{13,14} A study of catheter-associated UTIs that did not estimate costs found a mean of 12 additional ICU days and 21 additional hospital days attributable to the HAI. Other infections saw

larger ranges of cost estimates, often when cases from the intensive care unit (ICU) and Methicillin Resistant Staphylococcus Aureus (MRSA) and other drug resistant infections were counted together with non-ICU, non-drug resistant cases. Cost estimates for blood stream infections, both catheter related and unspecified, illustrate this with a range of \$1,822/case to \$110,800/case.^{10,13,14} Generally infections associated with ventilators, catheters, or drug resistant infections were more costly than the others. Ventilator and catheter use are both associated with the ICU, where fixed daily costs are higher. Studies looking at the ICU population specifically showed generally higher costs. In contrast, the higher cost of treatment for drug-resistant pathogens, rather than a higher daily fixed cost, is likely driving costs higher for drug-resistant HAIs.

Table 1 (attached) provides a full list of attributable cost and length of stay from the studies reviewed sorted by hospital-acquired/healthcare-associated infection.

Setting Payment Policies to Encourage HAI Reduction

Traditional payment systems in the United States provide little economic incentive to hospitals and providers to decrease HAIs by allowing them to shift costs associated with HAIs to third party payers.⁵ Both CMS and the state of Maryland have begun to implement changes to payment systems that actively encourage reductions in HAI by implementing rewards and penalties or by shifting the costs of HAI back to health care providers.

CMS' Preventable Hospital-acquired Condition (HAC) provision modifies portions of the Inpatient Prospective Payment System (IPPS) to discourage select HAC by preventing those conditions from triggering higher payment when acquired during hospitalization.¹ Under the current Medicare Severity Diagnosis-Related Group (MS-DRG) payment system, payment is

made for a complete incident of care at a pre-determined amount based on diagnosis. The presence of complicating conditions or major complicating conditions (CC/MCC) increases payment. On October 1, 2007 CMS began requiring hospitals to submit “present on admission” indicators¹ which allow distinctions to be made between CC/MCC present at admission and those that develop during hospitalization. In 2008, ten conditions were chosen as HAC, high cost and/or high volume conditions that would normally trigger a higher payment when present as a secondary diagnosis and were determined reasonably preventable through evidence based guidelines.¹ In cases where the only CC/MCC triggering higher payment is one of the identified HAC and is acquired during hospitalization, increased reimbursement is prevented.¹ In fiscal years 2012-2015, this list includes catheter-associated urinary tract infections, vascular catheter-associated infection and four categories of surgical site infections.¹⁵

Further, beginning in fiscal year 2015, applicable hospitals with risk-adjusted HAC rates in the top quartile will have their discharge payments from CMS reduced.¹

Because CMS’ Preventable HAC provision modifies the IPPS, several hospitals are exempt, including Maryland waiver hospitals.¹⁶ Maryland is unique among states for its hospital rate regulation. Since 1977, Maryland’s Health Services Cost Review Commission has set hospital rates for all payers, including Medicare and Medicaid.¹⁷ In 2009, eleven Maryland hospital acquired conditions were chosen from potentially preventable conditions (PPC), developed by 3M.¹⁸ These MHACs were part of a case-specific system developed to adjust payments around PPCs, including HAIs.¹⁸ In fiscal year 2012, Maryland had about 58,000 PPCs state-wide that accounted for almost \$700 million in hospital care costs.¹⁹ Prompted by concerns about the case specific nature and narrow focus of the program, in 2014 MHACs were revised to include 65 PPCs linking hospitals’ performance to payment. MHAC payment incentives now

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