Chapter 29

The Costs of Healthcare-Associated Infections

Candace Friedman*

Key Points
• Healthcare-associated infections delay patient discharge and increase costs. • Healthcare-associated infections are accompanied by increasing numbers of laboratory and diagnostic investigations. • Healthcare-associated infections increase infection prevention and control costs, including epidemiological investigations, and medical, nursing and management time. • Economic evaluations can aid decision making for infection prevention and control programmes.

*Senior Project Manager
Office of Clinical Safety
University of Michigan Health System
Ann Arbor, Michigan, USA

Introduction

Healthcare-associated infections (HAI) are an important cause of morbidity and mortality and therefore should be rigorously controlled as part of the general duty of safe patient care. HAIs also have considerable economic impact on health care services and the cost of national health care. The members of the infection control team need to understand the financial burden of HAIs and how to evaluate the cost savings of any infection prevention intervention and provide information to support the infection prevention and control (IPC) programme.

Economic Consequences

Measuring the cost of HAIs is difficult and the financial impact varies between different health care systems. Nevertheless, HAIs can have the following economic results (Also see Table 1):

(1) HAIs delay patient discharge, resulting in increased 'hotel' costs. In addition, the patient suffers additional costs due to absence from work, and relatives/friends suffer costs of time and travel to visit the patient;
(2) Infections require increased treatment costs (for example, drug therapy and procedures, including repeat surgery). The patient may be discharged from hospital while infected and these costs then fall on General Practice or Community Services;
(2) HAIs involve increasing numbers of laboratory and diagnostic investigations;
(3) HAIs increase IPC costs, including epidemiological investigations and medical, nursing, and management time;
(4) A HAI is often the subject of litigation.

There may also be costs associated with blocked beds and closed wards or operating theatres, resulting in increased unit costs for admissions and procedures and lengthening waiting lists. Patient morbidity resulting from a HAI generates community and society costs that are difficult to quantify but may have considerable impact. Also difficult to measure in economic terms is loss of reputation – either for the facility or for individual units – which can have a significant impact on contracts and patient referral.

Overall Cost Estimates

Many studies have focused on the severity of HAIs and their risk for patient safety and have tried to analyse the economic impact of HAIs by various methods. These methods are often flawed by the failure to distinguish accurately between the type and amount of resources specifically associated with treating HAIs and those incurred by the original disease for which the patient was admitted.[2] It is important to focus not only on the HAI's incidence as the measure of effectiveness, but also on events that stem from the changes in its occurrence, such as use of antibiotics, length of stay, mortality, and costs.[3] Costs might be expected to be higher in tertiary referral hospitals. Costs will be different for various countries and will change with time; however the relative magnitudes will be similar.[2]

Table 1. Economic consequences of healthcare-associated infections[1]

Hospitalisation Costs	Use of antibiotics Increased length of hospitalisation Intensive care unit stay
Intervention Costs	Tests performed Barriers used (e.g., gown, gloves) Nurse/physician time Isolation room
Outpatient/Community Care Costs	Physician visits Use of antibiotics Home health visits Rehabilitation centre stay
Patient Costs/Outcomes	Mortality Morbidity Infections Lost wages Travel expenses

Although measuring the cost of HAIs is difficult, some studies have demonstrated the probable magnitude of the problem. HAIs were estimated to cost the United Kingdom's National Health Service approximately £1 billion a year; £56 million is estimated to be incurred after patients are discharged from hospital. In addition to increased costs, each one of these infections means additional use of resources, greater patient discomfort and a decrease in patient safety.[4]

One study in the United States noted that the direct hospital-related financial burden of HAIs was estimated to be between 25.0 and 31.5 billion dollars per year.[5] Another US study found that each HAI adds $12,197 in incremental costs to hospitals.[6]

In Mexico, Navarrete-Navarro and Armengol-Sanchez[7] estimated costs associated with HAIs in paediatric intensive care. Infected children had an extra hospital stay of 9.6 days. This was the major factor contributing to an average cost per infection of nearly US $12,000. Another study in Mexico[8] estimated that for case patients with catheter-associated bloodstream infections (CLABSI), the mean extra length of stay was 6.1 days, the mean extra cost of antibiotics was US $598 and the mean extra hospital cost was $11,591. Similarly, in Argentina[9], it was determined that the mean extra length of stay for patients with bloodstream infection compared with control patients was 11.9 days, the mean extra antibiotic cost was US $1,913, and the mean extra cost was $4,888.

A study in Turkey suggested that a patient with a HAI spent an additional 23 days in the hospital compared with a patient not affected with a HAI. The extra cost for an infected patient was calculated as US $2,026.[10]

Al-Rawajfah, et al., studied bloodstream infections in a hospital in Jordan.[11] They found a mean length of stay of 12.1 days vs. 9.3 for controls. Inflation-adjusted charges for cases were US $7,426 vs. $3,274.

A study from Thailand[12] looked at the extra costs associated with surgical site infections. The excess cost was US $1,091 and the mean excess postoperative stay was 21.3 days.

Mathai, et al[13] in India, found that the attributable cost of ventilator-associated pneumonia (VAP) in an intensive care unit (ICU) was calculated to be US $5,200. The patients with VAP experienced significantly longer hospital stay [21 versus 11 days] and incurred greater hospital costs [US $6,250 versus $2,598].

Since the introduction of bundles of care to prevent infections, researchers started evaluating the cost-effectiveness of these measures. An Australian study[14] examined the cost-effectiveness of a central venous catheter care bundle. They found the bundle cost-effective without an antimicrobial catheter if nationwide implementation costs over an 18 month period are below AUS $4.3 million ($94,559 per ICU).

Types of Economic Evaluations

Several types of economic analyses can be employed, including: cost effectiveness, cost benefit, and cost utility. The most preferred analyses are cost-effectiveness and cost utility. See Table 2.

A cost-effectiveness analysis compares interventions or products with different costs and different levels of effectiveness. A cost utility analysis is similar, except the benefits of a specific intervention are adjusted by health preference scores. Cost utility analyses are useful when there are no expected mortality differences between interventions, only differences in physical well-being which can be expressed as QALY.[1] One example is a study on the use of vancomycin as prophylaxis for coronary artery bypass surgery.[16] There are various cost-effectiveness studies in the literature – see Table 3 for examples.

Table 2. Generic types of economic evaluation[15]

Cost-effectiveness analysis	A single clinical outcome expressed in natural units (e.g., postoperative infections prevented or life years gained) is used. If multiple clinical outcomes are used, cost-consequences analysis may be reported which includes all clinical outcomes and costs for each alternative.
Cost-utility analysis	Clinical outcomes (health states) are converted into utility scores using a utility measurement instrument to estimate quality-adjusted-life-years (QALYs)[1]. Alternatively other utility measures such as healthy-years-equivalent may be used.
Cost-benefit analysis	Clinical outcomes are converted into monetary units so that a net benefit (or cost) can be estimated. Methods used to convert health benefits to monetary values include willingness to pay and the human capital approach.

When data on costs used in analyses are from different years, they should be brought into current year values. A typical method is to inflate the amounts using a standard price index for the country.[1] The World Health Organization recommends that a threshold for calling an intervention cost-effective be three times the country's gross domestic product per capita.[29] Another method is to determine that the intervention dominated other relevant strategies (that is, it was both less costly in terms of resource use and more clinically effective compared with all the other relevant alternative strategies).[30]

Costs that can be measured include the health care facility costs, health care facility charges, resources used, and actual reimbursed charges. Hospital costs are a useful measure; they best reflect the actual economic burden to the institution. If the only information available is charges, the data can be adjusted using cost-to-charge ratios.[31]

The number of bed-days lost to a case of HAI may be an appropriate outcome to describe a large proportion of the cost to the facility.[32] This opportunity cost is typically much lower than the cost calculated with an accounting approach using the hospital budget for a given period divided by the total patient bed-days over the same period.[33]

Costs of Outbreaks

Several investigators have attempted to measure the costs associated with outbreaks of infection. Again, the costs are tentative and must be considered in relation to the health care system studied and the year of study. Nevertheless, costs are considerable.

For example, a 4-month outbreak of *Klebsiella pneumoniae* infection in a neonatal intensive care unit was estimated to cost a hospital more than US $300,000.[34] Kim et al[35] measured the costs of MRSA in their hospital and calculated that it cost all Canadian hospitals $42m - $59m annually. An epidemic of infections resulting from extended-spectrum β-lactamase-producing *Klebsiella pneumoniae* resulted in various changes in practice. A study[36] to evaluate the economic benefits of the changes was performed; the cost savings potentially associated with the interventions ranged from US $183,781 - $330,318. The authors estimated the costs potentially avoided as a result of changes in practices using the number of HAIs potentially prevented. They included expenditures that were incurred as a result of the improvement efforts.

Cost-benefit of Infection Prevention and Control

Determining whether there is an economic benefit to IPC activities is important to demonstrate the need for financial and administrative support. This type of evaluation also assists in setting priorities for IPC programs.[37]

In the iconic Study on the Efficacy of Nosocomial Infection Control (SENIC) of 1974-1983, US hospitals with one full-time infection control nurse (ICN) per 250 beds, an infection control doctor (ICD), moderately intense surveillance, and systems for reporting wound infection rates to surgeons reduced their HAI rates by 32%. In other hospitals the HAI rate increased by 18%.[38]

The SENIC study estimated the annual cost of HAIs in US hospitals was $1b (in 1975 dollars). The cost of IPC teams (0.2 ICD and 1 ICN per 250 beds) was $72m per year, only 7% of the infection costs. Therefore, if IPC programmes were effective in preventing only 7% of HAIs (normally distributed), the costs of the programmes would be covered. A 20% effectiveness would save $200m and 50% would save $0.5b (1975 US dollars).

Raschka, et al., evaluated the effect of regional consolidation of an IPC program on reduction of selected HAIs.[37] Regionalisation led to a 19% reduction in these HAIs over 4 years and a cost avoidance of at least CAD $9 million. Another Canadian study provided evidence that IPC programmes focused on haemodialysis-associated bloodstream infections yielded a benefit/cost ratio of 1-1.8:1.[39]

In a review on cost-effective measures that could be employed against HAIs in developing countries, Nyamogoba and Obala concluded that IPC programmes are cost-effective.[40] In particular, computer-assisted epidemiological surveillance appeared to be the most important aspect of IPC programmes; they identified changes in risk factors that may increase infection rates.

Herzer et al used a decision tree model to compare an IPC programme for bloodstream infection prevention with no programme.[41] The study found that such programmes prevent 42 CLABSIs per 1,000 patients and averts 6 deaths per 1,000 patients at no additional cost. The authors concluded that these programmes reduce unnecessary morbidity, mortality, and economic costs associated with CLABSIs.

A cost-effectiveness analysis of investments in HAI prevention in intensive care units in the US was performed by Dick et al. They found that on-going investment in an IPC programme focused on CLABSI and VAP prevention is cost-effective.[42]

A business case analysis is a type of cost utility analysis because it typically does not include patient outcomes.[1] The Association for Professionals in Infection Control & Epidemiology documented the business case for reducing HAIs from the perspective of the health care executive. Case studies of significant cost savings were presented along with a methodology for determining the cost of various categories of HAIs.[43] Similarly, guidelines on how to develop a business case for IPC were developed by the Society for Healthcare Epidemiology of America. This publication outlines steps for developing a business case analysis and explains economic concepts.[44]

Decreasing organisational revenues and efforts to reduce overall operating costs have had a direct impact on IPC programmes. Senior managers in health care organisations are focusing on achieving and maintaining revenues while controlling costs. IPC professionals must align themselves and their programs with these organisational goals by: (1) identifying areas in which the IPC programme can support and enhances revenues, (2) avoiding excess costs for care, especially those related to HAIs, (3) identifying opportunities for cost reduction through value analysis, and (4) participating in efforts to measure and prevent other adverse outcomes of care.[45]

Low Resource Issues

Improved data collection efforts would help estimate the burden of HAIs in low resource countries; drug resistance is a significant area where data are needed.[31] Computer-assisted epidemiological surveillance may be an important aspect of these IPC programmes. Costs of HAIs in one's own facility may be modelled on studies in the literature noted earlier.

Summary

The costs of HAIs are huge and include patient morbidity and mortality, hospital and community medical costs, the impact of blocked beds, and wider socio-economic costs. The costs of IPC programmes and staffing are relatively minor and with only a small degree of effectiveness they can pay for themselves. Investment in IPC is therefore highly cost-effective.

The constantly changing external environment, advancing technology, legislation, the introduction of government mandates, and a drive to maximise health care resources have made costing of IPC a management priority.[46] Economic evaluations play an increasingly important role in IPC. It is important for IPC advocates to partner with individuals from many different fields to give decision-makers the information they need to make choices.

References

1. Cosgrove SE, Perencevich EN. Economic Evaluation of Healthcare Associated Infections and Infection Control and Antimicrobial-Stewardship Interventions. In: *Bennett & Brachman's Hospital Infections*, 6th edition, ed. WR Jarvis, Lippincott Williams & Wilkins, Philadelphia, 2014: 220-229.
2. Gianino MM, Vallino A, Minniti D, et al. A model for calculating costs of hospital-acquired infections: an Italian experience. *J Health Organization Mngt* 2007; 21 (1): 39.
3. Zilberberg MD, Shorr AF. Ventilator-associated pneumonia as a model for approaching cost-effectiveness and infection prevention in the ICU. *Current Opinion Infect Dis* 2011; 24:385–389.
4. *Reducing healthcare associated infections in hospitals in England*. National Audit Office. HC 560 Session 2008-2009. London: The Stationery Office. Available from: http://www.nao.org.uk/publications/0809/reducing_healthcare_associated.aspx [Accessed 19 May 2015]
5. Scott II R. The Direct Medical Costs of Healthcare-Associated Infections in U.S. Hospitals and the Benefits of Prevention. Division of Healthcare Quality Promotion National Center for Preparedness, Detection, and Control of Infectious Diseases, Coordinating Center for Infectious Diseases, Centers for Disease Control and Prevention; 2009. http://www.cdc.gov/hai/pdfs/hai/scott_costpaper.pdf [Accessed 19 May 2015]
6. Kilgore ML, Ghosh K, Beavers CM, Wong, DY, Hymel PA, Brossette SE. The Costs of Nosocomial Infections. *Medical Care* 2008; 46 (1):101-104.
7. Navarrete-Navarro S, Armengol-Sanchez G. Secondary costs due to nosocomial infections in 2 pediatric intensive care units. *Salud Publica de Mexico* 1999; 41 (Suppl 1):S51-8.
8. Higuera F, Rangel-Frausto MS, Rosenthal VD, et al. Attributable cost and length of stay for patients with central venous catheter-associated bloodstream infection in Mexico City intensive care units: a prospective, matched analysis. *Infect Control Hosp Epidemiol* 2007; 28:31-5.
9. Rosenthal VD, Guzman S, Migone O, Crnich CJ. The attributable cost, length of hospital stay, and mortality of central line-

associated bloodstream infection in intensive care departments in Argentina: A prospective, matched analysis. *Am J Infect Control* 2003; 31:475-80.

10. Esatoglu AE, Agirbas I, Onder OR, et al. Additional cost of hospital-acquired infection to the patient: a case study in Turkey. *Health Serv Manage Res* 2006; 19:137–143.
11. Al-Rawajfah OM, Cheema J, Hewitt JB, Hweidi IM, Musallam E. Laboratory-confirmed health care- associated bloodstream infections in Jordan: A matched cost and length of stay study*. Am J Infect Control* 2013; 41: 607-611.
12. Kasatpibal N, Thongpiyapoom S, Narong M, Suwalak N, Jamulitrat S. Extra charge and extra length of postoperative stay attributable to surgical site infection in six selected operations. *J Med Assoc Thai* 2005; 88:1083–91.
13. Mathai AS, Phillips A, Kaur P, Isaac R. Incidence and attributable costs of ventilator-associated pneumonia (VAP) in a tertiary-level intensive care unit (ICU) in northern India. *J Infect Public Health* 2015; 8:127-135.
14. Halton KA, Cook D, Paterson DL, et al. Cost-effectiveness of a central venous catheter care bundle. PLoS One 2010; 5:e12815. http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0012815 [Accessed May 22 2015]
15. *CRD's guidance for undertaking reviews in health care*. Centre for Reviews and Dissemination, University of York, 2009. York Publishing Services Ltd. http://www.york.ac.uk/media/crd/Systematic_Reviews.pdf [Accessed 19 May 2015]
16. Zanetti G, Goldie SJ, Platt R. Clinical Consequences and Cost of Limiting Use of Vancomycin for Perioperative Prophylaxis: Example of Coronary Artery Bypass Surgery. *Emerg Infect Dis* 2001; 7: 820-827.
17. Baykasog˘lu A, Dereli T, Yılankırkan N. Application of cost/benefit analysis for surgical gown and drape selection: A case study. *Am J Infect Control* 2009; 37:215-26.
18. Shorr AF, Zilberberg MD, Kollef M. Cost-Effectiveness Analysis of a Silver-Coated Endotracheal Tube to Reduce the Incidence of Ventilator-Associated Pneumonia. *Infect Control Hosp Epidemiol* 2009; 30:759-763.
19. van Rijen MML, Kluytmans JAJW. Costs and benefits of the MRSA Search and Destroy policy in a Dutch hospital. *Eur J Clin Microbiol Infect Dis* 2009; 28:1245–1252.
20. Fraher MH, Collins CJ, Bourke J, Phelan D, Lynch M. Cost-effectiveness of employing a total parenteral nutrition surveillance nurse for the prevention of catheter-related bloodstream infections. *J Hosp Infect* 2009; 73 (2): 129-134.
21. Holmes C, Cervia JS, Ortolano GA, Canonica FP. Preventive efficacy and cost-effectiveness of point-of-use water filtration in a subacute care unit. *Am J Infect Control* 2010; 38:69-71.
22. Murthy A, De Angelis G, Pittet D, Schrenzel J, Uckay I, Harbarth S. Cost-effectiveness of universal MRSA screening on admission to surgery. *Clin Microbiol Infect* 2010; 16: 1747–1753.
23. Boroumand MA, Anvari MS, Pourgholi L, et al. Local factors affecting cost/benefit of methicillin-resistant *Staphylococcus aureus* screening, a study from a low-income country. *Am J Infect Control* 2011; 39: 703-5.
24. Ye X, Rupnow M, Bastide P, Lafuma A, Ovington L, Jarvis WR. Economic impact of use of chlorhexidine-impregnated sponge dressing for prevention of central line-associated infections in the United States. *Am J Infect Control* 2011; 39:647-54.
25. Courville XF, Tomek IM, Kirkland KB, Birhle M, Kantor SR, Finlayson SRG. Cost-Effectiveness of Preoperative Nasal Mupirocin Treatment in Preventing Surgical Site Infection in Patients Undergoing Total Hip and Knee Arthroplasty: A Cost-Effectiveness Analysis*. Infect Control Hosp Epidemiol* 2012; 33:152-159.
26. Balegar V KK, Azeem MI, Spence K, Badawi N. Extending total parenteral nutrition hang time in the neonatal intensive care unit: Is it safe and cost effective? *J Paediatrics Child Health* 2013; 49: E57-E61.
27. Farbman L, Avni T, Rubinovitch B, Leibovici L, Paul M. Cost–benefit of infection control interventions targeting methicillin-resistant *Staphylococcus aureus* in hospitals: systematic review. *Clin Microbiol Infect* 2013; 19: E582–E593.
28. Lorente L, Lecuona M, Jiménez A, et al. Cost/benefit analysis of chlorhexidine-silver sulfadiazine-impregnated venous catheters for femoral access. *Am J Infect Control* 2014; 42: 1130-1132.
29. World Health Organization. *Threshold values for intervention cost-effectiveness by Region.* www.who.int/choice/costs/CER_levels/en/index.html [Accessed 26 May 2015]
30. *Infection: prevention and control of healthcare-associated infections in primary and community care*. National Institute for Health and Clinical Excellence. National Clinical Guideline Centre, 2012. http://www.nice.org.uk/guidance/cg139/evidence/cg139-infection-control-full-guideline3 [Accessed 19 May 2015]

31. Howard D, Cordell R, McGowan JE, Packard RM, Scott RD, Solomon SL. Measuring the economic costs of antimicrobial resistance in hospital settings: summary of the Centers for Disease Control and Prevention-Emory Workshop. *Clin Infect Diseases* 2001; 33(9):1573-8.

32. Graves N, Harbarth S, Beyersmann J, Barnett A, Halton K, Cooper B. Estimating the cost of health care-associated infections: mind your p's and q's. *Clin Infect Dis* 2010; 50:1017-21.

33. Stewardson AJ, Harbarth S, Graves N, TIMBER Study Group. Valuation of hospital bed-days released by infection control programs: a comparison of methods. *Infect Control Hosp Epidemiol* 2014; 35:1294-7.

34. Stone PW, Gupta A, Loughrey M, et al. Attributable costs of an extended spectrum Beta-lactamase *Klebsiella pneumoniae* outbreak in a NICU*. Infect Control Hosp Epidemiol* 2003; 24, 601-606.

35. Kim T, Oh PI, Simor AE. The economic impact of methicillin-resistant *Staphylococcus aureus* in Canadian hospitals. *Infect Control Hosp Epidemiol* 2001; 22:99-104.

36. Piednoir E, Thibon P, Borderan G-C, et al. Long-term clinical and economic benefits associated with the management of a nosocomial outbreak resulting from extended spectrum beta-lactamase-producing *Klebsiella pneumoniae*. *Crit Care Med* 2011; 39:2672–2677.

37. Raschka S, Dempster L, Bryce E. Health economic evaluation of an infection prevention and control program: Are quality and patient safety programs worth the investment? *Am J Infect Control* 2013; 41:773-7.

38. Haley RW, Culver DH, White JW, et al. The efficacy of infection surveillance and control programs in preventing nosocomial infections in US hospitals. Study on the Efficacy of Nosocomial Infection Control (SENIC). *Amer J Epidemiol* 1985; 121:182-205.

39. Hong Z, Wu J, Tisdell C, et al. Cost–Benefit Analysis of Preventing Nosocomial Bloodstream Infections among Hemodialysis Patients in Canada in 2004. *Value in Health* 2010; 13: 42-45.

40. Nyamogoba H, Obala AA. Nosocomial infections in developing countries: cost effective control and prevention. *East Afr Med J* 2002; 79(8):435-41.

41. Herzer KR, Niessen L, Constenia DO, Ward WJ Jr, Pronovost PJ. Cost-effectiveness of a quality improvement programme to reduce central line-associated bloodstream infections in intensive care units in the USA. *BMJ open* 2014; 4 (9): e006065.

42. Dick A, Perencevich E, Pogorzelska-Maziarz M, Zwanziger J, Larson E, Stone PW. A decade of investment in infection prevention: A cost effectiveness analysis*. Am J Infect Control* 2015; 43(1):4-9.

43. Murphy D, Whiting J. *Dispelling the Myths: The True Cost of Healthcare-Associated Infections.* Association for Professionals in Infection Control & Epidemiology, Inc. Washington, DC. 2007.

44. Perencevich E, Stone PW, Wright S, Carmeli Y, Fisman DN, Cosgrove S. Raising Standards While Watching the Bottom Line Making a Business Case for Infection Control Intervention. *Infect Control Hosp Epidemiol* 2007; 28:1121-1133.

45. Rhinehart E. Watching the bottom line: enhancing the role and impact of infection control in a managed care environment. *Amer J Infect Control* 2000; 28(1):25-9.

45. Wilcox MH, Dave J. The cost of hospital-acquired infection and the value of infection control. *J Hosp Infect* 2000; 45:81-4.

Further Reading

1. Magee G, Strauss ME, Thomas SM, Brown H, Baumer D, Broderick KC. Impact of *Clostridium difficile*-associated diarrhea on acute care length of stay, hospital costs, and readmission: A multicentre retrospective study of inpatients, 2009-2011. *Am J Infect Control* 2015: 43: 1148-1153.

2. Roberts RR, Scott RD, Hota B, et al. Costs Attributable to Healthcare-Acquired Infection in Hospitalized Adults and a Comparison of Economic Methods. *Medical Care* 2010; 48 (11):1026-1035.

Table 3. Cost Effectiveness Studies

Reference	Evaluation	Conclusion
17	Compare reusable and single-use surgical gowns and drapes	Single-use gown and drape sets provide the highest benefit rates
18	Economic outcomes of VAP prevention associated with silver-coated endotracheal tubes versus uncoated endotracheal tubes	Silver-coated endotracheal tubes yielded savings (US $9,630–$16,356) per case of VAP prevented
19	Determine the costs and benefits of the MRSA Search and Destroy policy in a Dutch hospital during 2001 through 2006	Application of the policy resulted in a transmission rate of 0.30 and was estimated to prevent 36 cases of MRSA bacteraemia per year, resulting in annual savings of €427,356 for the hospital and ten lives per year
20	Measure the cost-effectiveness of the reduction in catheter-related bacteraemia after the introduction of a total parenteral nutrition (TPN) surveillance clinical nurse manager (CNM)	Introduction of TPN surveillance CNM saved the hospital at least 78,300€ per annum and led to a significant decrease in bacteraemia in TPN patients
21	Determine whether point of use water filtration decreases the risk of colonisation and infection with waterborne pathogens in a sub-acute care unit , and whether existing filtration technology can be easily and cost-effectively implemented in such a setting	Total patient care costs were reduced by US $248,136 during the study period. Subtracting the $17,100 cost of filtration, the net cost savings was $231,036
22	Assessed the cost-effectiveness of universal MRSA polymerase chain reaction (PCR) screening on admission to surgery	Compared to no screening, the PCR strategy resulted in higher costs (CHF 10,503 vs. 10,358) but a lower infection probability (0.0041 vs. 0.0088), producing a base-case incremental cost-effectiveness ratio of CHF 30,784 per MRSA infection avoided
23	Determine the hospital policy for routine MRSA screening strategies	Used US $30 MRSA PCR screening costs per test and $1,808.87 +/- $16.93 excess cost for each patient with hospital-acquired infection, screening of potential MRSA carriers at admission can reduce the nosocomial MRSA infection rate to approximately 50% of its baseline level. Screening requires a great MRSA prevalence to be cost beneficial, and, in the hospitals with a low MRSA prevalence, screening does not prevent an adequate number of cases to cover the costs of the program

Reference	Evaluation	Conclusion
24	Economic impact of adding chlorhexidine gluconate (CHG)-impregnated sponge dressing to standard care (i.e., CHG-impregnated sponge dressing skin preparation and transparent film dressing vs skin preparation and transparent film dressing) for the prevention of central-line infections was evaluated	Based on model calculations, a hypothetical 400-bed hospital inserting 3,078 central venous catheters (CVCs) per year is expected to avoid an average of 35 CR-BSIs, 145 local infections, and 281 intensive care unit days annually with the systematic use of CHG-impregnated sponge dressing. Potential hospital net cost savings (mainly because of reduced CR-BSIs with use of the dressing) would be $895,000 annually.
25	Evaluate preoperative use of mupirocin in patients undergoing total joint arthroplasty	The treat-all and screen-and-treat strategies both had lower costs and greater benefits, compared with the no-treatment strategy
26	Investigate the effects of prolonging hang time of total parenteral nutrition (TPN) fluid on CLABSI, TPN-related cost and nursing workload	Extending TPN hang time from 24 to 48 hours did not alter CLABSI rate - Annual cost saving using 48-hour TPN was AUD 97,603.00. By using 48-hour TPN, 68.3% of nurses indicated that their workload decreased and 80.5% indicated that time spent changing TPN reduced
27	Examine the cost and cost–benefit of IPC interventions against MRSA and to examine factors affecting economic estimates	Higher save/cost ratios observed in the intermediate to high endemicity setting compared with the low endemicity setting, in hospitals with <500-beds and with interventions of >6 months. IPC intervention showed a favourable cost/benefit ratio
28	Determine the immediate central venous catheter (CVC)-related costs (including only the cost of the CVC itself, the diagnosis of CLABSI, and the antimicrobial agents used to treat the CLABSI) when second generation chlorhexidine-silver sulfadiazine (CHSS)-impregnated or standard catheters were used for femoral venous access	CHSS-impregnated catheters were associated with a lower risk of CLABSI when catheter duration was controlled for. CHSS-impregnated catheters were associated with lower CVC-related costs per catheter day than standard catheters

Published by the International Federation Of Infection Control
47 Wentworth Green
Portadown, BT62 3WG, N Ireland, UK
www.theific.org