

Prevention of Cross Transmission of Microorganisms Is Essential to Preventing Outbreaks of Hospital-Acquired Infections

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Introduction

Hospital-acquired infection outbreaks may be prevented by providing single-patient-use disposable blood pressure cuffs that will remain with that patient from admission until discharge from the hospital before being discarded. Single-patient-use disposables may prevent hospital-acquired infections that result from use of devices by multiple patients.

Background

Hospital-acquired infections (HAIs) are becoming increasingly common worldwide and occur during more than two million hospitalizations in the United States each year¹. Due to an increase in invasive procedures and a growing resistance to antibiotics, HAIs have increased by 36% in the last 20 years and are consuming more health care dollars each year. The burdens these infections place on our health care system can be divided into three categories: the cost of quality, the cost of human lives and the financial impact. The human cost is over 99,000 deaths per year in the United States, which represents a 5% death rate for HAIs.² Quality costs include increased ICU stays by 8 days, and increased average hospital stay between 7.4 and 9.4 days.^{3,4,5} Total dollar costs added to the health care system are between \$4.5 and \$5.7 billion annually, with the average cost per infection of \$13,973 and an increased cost to patients (who survived) of approximately \$40,000.⁶ Specifically, methicillin-resistant *Staphylococcus aureus* (MRSA) has become endemic, even epidemic in many U.S. hospitals and added 2.7 million extra days in the hospital with an average cost of \$35,367.⁶

Where do the funds come from to pay for HAIs? Do they come from third-party payers, Medicare/Medicaid, hospitals, or patients? Haley et al analyzed 9423 nosocomial infections and found that only 5-18% of nosocomial infections would have caused the admission to be reclassified to a higher diagnosis related group (DRG).⁷ Of those hospitalizations able to be reclassified to a higher DRG, the extra payment only funded 5% of the total cost to treat the infection.⁷ That leaves 95% of the financial burden of HAIs to hospitals and patients.

Problem

Common HAIs include pneumonia, catheter-associated urinary tract infections, intravascular device-related infections, and surgical site infections from various bacteria, viruses and fungi. The sources of infection, modes of transmission, and rates of transmission vary based on setting, immune status of patients, and adherence of staff to infection control procedures. Because of the multifactorial nature of HAIs, tendency to affect immunosuppressed patients, and often multi-drug resistant organisms, the primary method to avoid morbidity/mortality and costs associated with these infections is through prevention. Harbath et al found that at least 20% and as much as 70% of HAIs are preventable, depending on the setting and type of infection.⁸ To prevent HAIs it is necessary to identify sources and modes of transmission of the infection and to implement prevention guidelines and practices. The modes of transmission of HAIs include direct-contact transmission (direct contact between two people) and indirect-contact transmission (transfer of an infectious agent through a contaminated intermediate object).

HAIs are the result of a high prevalence of pathogens with susceptible hosts and efficient transmission mechanisms from patient to patient. Unfortunately, these pathogens tend to become incorporated into the normal flora of hospital workers and are

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- Average cost per infection of \$13,973
- Increased total cost per patient who survived approximately \$40,000

readily transmitted through direct-contact transmission. Although less common, medical devices such as sphygmomanometers, thermometers, and stethoscopes have been implicated in the spread of HAIs through indirect-contact transmission. In a study by Base-Smith, sphygmomanometer cuffs from various inpatient settings were found to have bacterial colonization rates of 81-100%.⁹ Also, 45.7% of the “clean” cuffs were contaminated with organic and/or inorganic substances. The patient contact sides of cuffs were contaminated twice as often as the nonpatient sides. Stemicht et al found similar colonization rates of re-used disposable blood pressure cuffs.¹⁰ Myers et al identified a single blood pressure cuff as the common source of a nosocomial infection outbreak in a neonatal intensive care unit.¹¹

Similarly, Livornese et al found an electronic thermometer as the vehicle which caused an outbreak of vancomycin-resistant *Enterococcus faecium* in a med-surg intensive care unit and ward of a university hospital.¹² Marinella et al found that 100% of stethoscopes were contaminated with coagulase negative staphylococcus and 38% were contaminated with *Staphylococcus aureus*.¹³ In general, physicians tended to have a higher bacterial load on their stethoscopes than nurses.

Solution

Numerous organizations worldwide including the World Health Organization (WHO) and the Infection Control Practices Advisory Committee at the Centers for Disease Control and Prevention (CDC) have developed recommendations on protecting patients and health care workers from HAIs. The foundation of HAI prevention is proper hand-hygiene technique, and the CDC 2002 guidelines explicitly cover indications for handwashing and hand antisepsis, hand-hygiene technique, surgical hand antisepsis, and selection of hand-hygiene agents.¹⁴ If health care workers achieved 100% compliance with proper hand-hygiene techniques it would significantly reduce the spread of HAIs. Unfortunately, studies have found hand-hygiene compliance rates to be consistently less than 50%.^{15,16} Perceived barriers to hand hygiene include skin irritation, inaccessible supplies, interference with worker-patient relation, patient needs perceived as priority, wearing gloves, forgetfulness, ignorance of guidelines, insufficient time, high workload and understaffing, and lack of scientific information demonstrating impact of improved hand hygiene on hospital infection rates. Eliminating perceived barriers to hand hygiene is an important first step in improving hand-

hygiene compliance rates and reducing HAIs. The CDC has also published clear guidelines for isolation precautions, prevention of hospital-acquired pneumonias, intravascular device-related infections, surgical site infections, and catheter-related urinary tract infections, and these guidelines must also be closely followed to achieve maximum patient safety.

CDC recommendations regarding indirect transmission through patient care devices and environmental reservoirs are less specific than the recommendations listed and require some interpretation. The recommendations include:¹⁷

1. Establish policies and procedures for containing, transporting, and handling patient-care equipment and instruments/devices that may be contaminated with blood or body fluids.
2. Remove organic material from critical and semi-critical instruments/devices, using recommended cleaning agents before high-level disinfection and sterilization to enable effective disinfection and sterilization processes.
3. Wear personal protective equipment (PPE), such as, gloves and gowns, according to the level of anticipated contamination when handling patient-care equipment and instruments/devices that are visibly soiled or may have been in contact with blood or body fluids.

Because it has been shown that patient care devices such as blood pressure cuffs and thermometers are frequently colonized with bacteria and have been implicated in various outbreaks of HAIs, it is necessary to reduce the possibility of cross contamination with these devices. A simple solution would be to provide each patient with a new disposable blood pressure cuff that remains with the patient during his/her hospital stay and is disposed of when the patient is discharged from the hospital. By providing a single-patient-use disposable blood pressure cuff, the possibility of an outbreak from cross contamination would be greatly reduced. This solution does not eliminate the possibility of a HAI from the cuff, because the cuff will become colonized with the patient's flora and be a potential source of a future HAI. It is necessary to maintain hospital recommendations for disinfection and sterilization procedures for these devices. However, this solution does eliminate the possibility of cross contamination from a blood pressure cuff from multiple patient contact and will possibly prevent HAI outbreaks from a colonized blood pressure cuff.

Conclusion

Hospital-acquired infections represent an increasing financial burden and declining quality of health care in the United States. Approximately 95% of the estimated \$5 billion total health care cost from hospital-acquired infections falls on the shoulders of the hospitals and patients. The need for strict prevention guidelines is essential. One possible strategy for the prevention of hospital-acquired infection outbreaks can be achieved by providing each patient with a disposable blood pressure cuff that will remain with them during their hospital stay and be disposed of when the patient is discharged. Likewise, providing medical devices (thermometers) in each patient room that are appropriately sanitized between patients can prevent outbreaks of HAIs. Strict adherence to CDC guidelines regarding handwashing, hand-hygiene, and use of standard precautions also remains critical to preventing future HAIs.

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