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· Infection Control Measures in the Trauma Setting



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AWARDS / FUNDING

RAS-ACS Leadership Scholarship, American College of Surgeons
Outcomes Research Course, November 2010

UW K12 Comparative Effectiveness Research Training Program,
Agency for Healthcare Research and Quality (AHRQ), 2010-2013

Infections that develop in the course of supportive care, such as mechanical ventilation and vascular or urinary catheterization, are a resource-intensive problem associated with considerable morbidity and increased risk of mortality. It has been demonstrated that these health care-associated infections (HAIs) are more often associated with resistant organisms, such as methicillin-resistant *Staphylococcus aureus* (MRSA), that are more costly to treat and difficult to eradicate. Accordingly, resistant organism infection is linked to increased use of antibiotic therapy, longer intensive care unit (ICU) stays and longer hospitalizations, which increase the possibility of exposure and risk of transmission to other hospitalized patients. Prevention through multimodality infection control efforts has become the focus of our efforts to decrease the threat of HAIs.

Based on a strong interest in surgical infectious disease fostered during my surgical training at the University of Virginia under the mentorship of Dr. Robert Sawyer, I have focused my research primarily on the evaluation of the effectiveness of a variety of infection control measures. Funded by an individual National Research Service Award as a surgical resident, I earned a Master's of Health Evaluation Science degree, gaining essential methodological training in health services research and applied biostatistical modeling with the guidance of Dr. William Knaus and Frank Harrell. In 2007, I came to the University of Washington to complete my clinical training as a surgical critical care fellow, and I was able to continue to examine the impact of systematic infection control measures with Dr. Joseph Cuschieri in the trauma ICU at Harborview Medical Center. Additionally, building upon the past work of Dr. Eileen Bulger in pre-hospital intubation outcomes, we have begun to look at the key factors of field intubation related to the subsequent development of ventilator-associated pneumonia (VAP). This summer, I was awarded one of

the first UW K12 Fellowships in Comparative Effectiveness Research (CER), funded by the Agency for Healthcare Research and Quality (AHRQ) as a part of the new initiative to train investigators with specific tools to conduct high-quality patient-centered research. With a multidisciplinary group of mentors in surgery, pulmonary medicine, healthcare informatics and pharmacy, I intend to build my early projects at HMC into an independent line of investigation examining the use of information technology to improve compliance with existing diagnostic and therapeutic protocols for VAP, and evaluate the effectiveness of this intervention.

Chlorhexidine Gluconate Decontamination

At Harborview Medical Center, we serve a high volume of critically ill, multiply-injured patients, many of whom require more than a week of mechanical ventilation, as well as urinary and central venous catheterization. In 2006, the baseline rate of MRSA acquisition was 69 per 1000 patient days, despite use of standard infection control methods such as contact isolation. In the face of this strong colonization pressure, a novel infection control measure was initiated to attempt to curb the horizontal transmission of bacteria between patients. After the institution of daily bathing with antiseptic cloths impregnated with chlorhexidine gluconate for all trauma patients admitted to the ICU, we observed a 60% reduction in the rate of MRSA acquisition and significantly fewer catheter-related bloodstream infections and MRSA ventilator-associated pneumonias (*Arch Surg* 2010). Our results were commensurate with data from other investigators demonstrating a decrease in bloodstream infections and gram positive isolates in medical ICU patients. Along with UW Medicine-wide efforts to increase compliance with handwashing, chlorhexidine bathing has since become the standard of care throughout the ICUs at HMC, and we have seen a further decline in the rate of new MRSA acquisition in the past year.

Pre-Hospital Intubation, Aspiration and Ventilator-Associated Pneumonia

Published data from other institutions has suggested that pre-hospital intubation is associated with higher rates of aspiration, pneumonia, and mortality, particularly in head-injured patients. But in a system with an extremely high rate of successful intubation, owing to the rigorous paramedic training program of Seattle Medic One and continuous quality improvement measures, Dr. Bulger had previously observed better outcomes in traumatic brain-injured patients intubated with rapid sequence induction

Comparing the Effectiveness of Automated VAP Screening to Usual Clinical Care

The Institute of Medicine has identified reduction of health care-associated infections (HAIs) as one of the top quartile initial comparative effectiveness research priorities. Ventilator-associated pneumonia (VAP) is the most commonly diagnosed infection in critically ill patients; between 10 percent and 20 percent of patients receiving more than 48 hours of mechanical ventilation develop VAP. Early detection and treatment of this infection is important, as even short-term delays in appropriate antibiotic therapy

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prior to arrival at Harborview. In an effort to define the rates of VAP and associated morbidity and mortality in our emergently intubated trauma population, we conducted a retrospective review of all pre-hospital and emergency department intubations in trauma patients admitted for more than 24 hours over the course of a year. We discovered that there was no significant difference in the rates of VAP, nor the mortality rate, based on the location of intubation (*Arch Surg*, in press).

A subsequent subgroup analysis focusing on specific clinical signs and events immediately before and during intubation suggests that emesis found in the airway is associated with a significantly higher incidence of VAP than any other presentation, including blood present in the oropharynx. This preliminary work to define risk of pre-hospital intubation has laid the foundation to improve and standardize our data collection across pre-hospital provider groups and for the emergent in-hospital intubations throughout the UW Medicine system. In collaboration with Drs. Thomas Rea, Andreas Grabinsky and Sam Sharar, we seek to determine particular factors that may be modified to reduce risk of intubation under challenging conditions. Ultimately, we envision adapting the well-established ICU infection control methods to the pre-hospital setting to prevent VAP from the moment that care of the patient begins.

are associated with higher mortality rates, longer-term mechanical ventilation, and excessive hospital costs.

Early recognition of VAP requires frequent systematic examination of clinical data and an ongoing suspicion about the possibility of respiratory infection. The volume of patient data presented to the clinician in the ICU mandates time consuming, detailed and repetitive screening to identify key clinical events. Extraction and interpretation of meaningful information from the electronic medical record (EMR) at the point of care is complicated by lack of integrated data displays, which may obscure the subtle signs of early infection. One solution has been the implementation of automated screening for syndromes such as acute lung injury and sepsis. Clinicians are already making use of this approach to identify patients at risk for sudden decompensation, and checklists have been employed to minimize the number of days patients are exposed to devices such as central lines, urinary catheters and ventilators. But to date there is no systematic automated support for the diagnostic evaluation of the most common HAIs that arise in critically ill patients.

The next three years will afford me the chance to consider the integration of information technology in medical decision-making and its relation to effective protocol implementation. Recognizing the limitations of observational

studies, my ultimate aim is to acquire the expertise to design and conduct a pragmatic clinical trial to study two strategies of VAP diagnosis: 1) the standard approach in which clinicians use the EMR to look for clinical evidence of early VAP signs, and 2) a novel approach facilitated by an EMR decision aid triggered by automated screening prompts that warn clinicians of possible VAP. We hypothesize that compared to usual clinician-directed

diagnosis, automated screening for clinical features of VAP will reliably identify patients who qualify for bronchoalveolar lavage (BAL) at an earlier stage in their infection. Decision support reminders may facilitate earlier treatment and decrease overall antibiotic usage, length of hospital and ICU stay and costs through better protocol compliance compared to usual care.

RELATED PUBLICATIONS

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