

## Health care quality and hospital acquired infection in Intensive care: Bundles and checklists

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Hospital acquired infections (HAI) are one of the most common complications involving hospital care and are the leading cause of death in U.S. Central line associated Blood stream Infection (CLABSI), Ventilator Associated Pneumonia (VAP), Surgical site infection (SSI) and Catheter associated urinary tract infection (CAUTI) represent 75% of all HAI<sup>1</sup>. HAI prevention is one of the 20 'priority areas' identified in the Institute of Medicine (IOM) 2003 report 'transforming health care quality'<sup>2</sup>. Certain HAI are preventable, but as the prevention efforts become more defined, there remains a lack of evidence of a strong return of investment for hospitals and health care payers in preventing these infections. This lack of evidence presents potential obstacles in advancing efforts to prevent infections.

### Central Line Associated Blood Stream Infection (CLABSI)

CLABSI is a primary blood stream infection that develops in a patient with a central line in place within the 48 hour period before the onset of blood stream infection, which is not related to infection at another site. Central line associated blood stream infection occurs up to 80,000 times per year resulting in 28,000 deaths among patients in the Intensive Care unit (ICU). Average cost of CLABSI is approximately \$ 45,000 per incidence<sup>3</sup>. CLABSI reduction is also one of the success story of how inexpensive interventions, grouped as a checklist could reduce the rate of nosocomial infections to a median rate of zero. Although quality control interventions in many areas of ICU have been studied, the idea of integrating quality indicators with group of interventions known as bundles has been validated in the ICU most successfully in CLABSI. The landmark study on reduction of CLABSI was the 'Keystone ICU' project funded by the Agency for Health care Research and Quality (AHRQ)<sup>4</sup>. One hundred and three ICUs in Michigan participated in this state wide safety initiative. The study intervention recommended five evidence based procedures that were identified as having the greatest effect on the rate of catheter related BSI and the lowest barriers to implementation. The interventions were remarkably successful, nearly eliminating CLABSI entirely in most ICUs over an 18 month follow up period.

Although in short term intensive training and monitoring can lead to improved outcomes, in long term the biggest impact on decreasing HAI, is of the safety climate of the unit. Studies have linked safety climate to clinical and patient outcomes in addition to showing that the safety climate is responsive to interventions. A large study targeting the culture of safety was a follow up of the Michigan Keystone study. The study was a prospective cohort study to improve quality of care and safety culture by implementing and evaluating patient safety interventions in participating ICUs and showed large scale improvements in safety climate among diverse organizations<sup>5</sup>. As part of the national effort to reduce the HAI, the Department of Health and Human Services (HHS) launched the HHS action plan to reduce the health care associated infections in 2009. The project was titled 'On the cusp: Stop BSI', designed to apply the principles of comprehensive unit based safety program (CUSP) to improve the culture of patient safety and implement evidence based best practices to reduce the risk of infection. The initiative ultimately reduced mean rates of CLABSI in participating units by an average of 40%, preventing more than 2000 CLABSI, saving more than 500 lives and avoiding more than \$34 million in excess health care costs<sup>6</sup>.

### Ventilator Associated Pneumonia

Optimizing the care of mechanically ventilated patients is an important goal of health care providers and hospital administrators. An easily acquired and reliable marker for medical quality has been elusive for this patient population. VAP has historically been used as a marker of the quality of care associated with mechanically ventilated patient and is associated with worse outcomes<sup>7</sup>. However the diagnosis of VAP is non-specific, the clinical diagnosis by the widely used American College of Chest Physicians (ACCP) criteria includes a new progressive consolidation on chest radiography plus at least two of the following clinical criteria: fever > 38, leucocytosis or leucopenia and purulent secretions. Unfortunately, all these findings alone or in combination can occur in other non-infectious conditions, making the diagnosis of VAP subjective and prone to bias. In fact, for the last many years, the surveillance rates of VAP are decreasing, whereas the clinical

diagnosis of VAP and tracheobronchitis as well as antibiotic prescribing remains prevalent. External reporting pressures may be encouraging stricter interpretation of the subjective signs that can cause artifactual lowering of the VAP rates. The result is that, it is almost impossible to detangle the relative contribution of quality improvement efforts in the ICU versus surveillance efforts as explanation for the currently observed lower rates of VAP<sup>8</sup>.

To eliminate the subjectivity and inaccuracy and to create an objective, streamlined and potentially automatable criteria, Center of Disease Control (CDC) now recommends surveillance of ventilator associated events (VAE) as a more general marker and defines it as sustained increase in patient's ventilator settings after a period of stable or decreasing support. There are three definition tiers within the VAE algorithm; 1) Ventilator Associated Condition (VAC); 2) Infection Related Ventilator Associated Complication (IVAC); and 3) Possible and probable VAP. The screening for VAC captures a similar set of complications to traditional VAP surveillance, but it is faster, more objective and potentially a superior predictor of clinical outcomes<sup>9</sup>. In a CDC funded study of 597 mechanically ventilated patients on use of VAC as an outcome predictor, it was noted that 9.3% of the study population had a VAP, whereas 23% had VAC. VAC was associated with increased mortality (odds ratio of 2.0) but VAP was not. VAC assessment was also faster (mean 1.8 minutes vs 3.9 minute per patient)<sup>10</sup>.

Similar to the CLABSI bundles, prevention of VAP by utilization of evidence-based bundles of care has proved to be a very successful. Heimes and colleagues recently conducted a study examining 696 consecutive ventilated patients in a level 1 trauma center to evaluate a VAP prevention bundle with 7 elements. They found a VAP rate of 5.2/1000 days of ventilator support in the pre intervention phase, while a 2.4 /1000 and 1.2/1000 days ( $p= 0.085$ ) in the implementation and enforcement periods respectively<sup>11</sup>.

### Catheter Associated Urinary Tract Infection (CAUTI)

Health care associated UTI account for up to 40% of infections in hospitals and 23% of the infections in the ICU. The vast majority of UTIs are related to indwelling urinary catheters. CAUTI result in as much as \$ 131million excess direct medical costs nationwide annually<sup>12</sup>. Since October 2008, Center of Medicare Services (CMS) no longer reimburses hospitals for the extra costs of managing a patient with hospital acquired CAUTI.

There are certain factors like Diabetes mellitus, old age or severe underlying illness that places patients at a greater risk of CAUTI, but there also are modifiable factors like non adherence to aseptic catheter care recommendations and duration of catheterization that can be targeted by quality improvement efforts, to decrease the risk<sup>13</sup>. The key strategies

for prevention of CAUTI include avoiding insertion if possible, early removal by implementation of checklists, nurse based interventions or daily electronic reminders, utilization of proper techniques for insertion and maintenance and considering alternatives to indwelling catheters like intermittent catheterization, condom catheters and portable bladder ultrasound scanner. Most of these strategies have been utilized in quality improvement efforts to decrease CAUTI. Assessment of the need is essential as Munasinghe et al have found urinary catheter placed in 21 to 50% of patients for inappropriate reasons<sup>14</sup>. A nurse based reminder to physician to remove unnecessary urinary catheters in a Taiwanese hospital resulted in reduction of CAUTI from 11.5 to 8.3 /1000 catheter days<sup>15</sup>. Similarly utilization of electronic urinary catheter reminders system and stop orders have been shown to reduce the mean duration of catheters by 37% and CAUTI by 2%<sup>16</sup>. Utilization of condom catheter has also been shown to be effective in reducing bacteriuria, symptomatic UT and mortality as compared to indwelling catheter<sup>17</sup>.

### Final word

Health care is often compared with airline industry with six sigma efficiency. This would translate to 0.002 defective parts or errors/million, obviously we are not close to that and may not be realistic. However this also cannot be an excuse to rationalize poor practice culture. As in any industry, in health care to establish change it is essential to regulate interpersonal interactions. With behaviors change leading to changes in processes of care, change is not only possible, it is sustainable.

### Competing Interests

None declared

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