



## Original article

## Impact of self-reported guideline compliance: Bloodstream infection prevention in a national collaborative



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## Key Words:

Guidelines

Central line-associated bloodstream infections

Intensive care unit

Hospital-acquired infection

**Background:** We sought to examine self-reported compliance with 5 evidence-based central line-associated bloodstream infection (CLABSI) prevention practices and link compliance to CLABSI rates in a national patient safety collaborative.

**Methods:** We analyzed data from a national CLABSI prevention program. Adult ICUs participating in the program submitted their CLABSI rates and a Team Checkup Tool (TCT) on a monthly basis. The TCT responses provided self-reported perceptions about how reliably the unit team performed the evidence-based practices in the previous month. Monthly data were aggregated into quarters for the analysis. We analyzed a total of 2775 ICU quarters during the program.

**Results:** Chlorhexidine skin preparation and hand hygiene had the highest adherence. Avoidance of the femoral site and removal of unnecessary lines had the lowest compliance. Regression results showed that consistent performance of all practices was significantly associated with lower CLABSI rates. In terms of each practice's independent effect, femoral site avoidance for line placement and removal of unnecessary lines were independently associated with lower CLABSI rates after controlling for other factors.

**Conclusion:** Our findings suggest that uptake of the 2 low-compliance practices, avoidance of the femoral site and removal of unnecessary lines, is important for reducing CLABSI rates in conjunction with other practices.

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Patients in intensive care units (ICUs) are at high risk of contracting central line-associated bloodstream infections (CLABSIs).<sup>1</sup> CLABSIs in ICUs are associated with prolonged length of stay and substantial mortality.<sup>2</sup> As reported by the Centers for Disease Control and Prevention (CDC) in 2009, nearly 90,000 CLABSIs occur annually in the United States, with an average direct medical cost ranging from \$6461 to \$25,849 per patient.<sup>3</sup>

Based on scientific evidence, guidelines that provide comprehensive recommendations for monitoring and preventing CLABSIs are published and updated periodically.<sup>4-6</sup> Using a multifaceted CLABSI prevention intervention that includes recommended

evidence-based practices to reduce CLABSIs and a cultural component known as the Comprehensive Unit-based Safety Program (CUSP) to create a platform for patient safety efforts, large patient safety collaboratives have demonstrated significant and sustained CLABSI reductions.<sup>7-10</sup> Recently, the "On the CUSP: Stop BSI" national initiative, funded by the Agency for Healthcare Research and Quality and private philanthropists, adopted the same program and showed an overall 43% decrease in CLABSIs in a large and diverse cohort of adult ICUs in 44 states, the District of Columbia, and Puerto Rico.<sup>11</sup>

Despite the extensive nationwide promotion of the CLABSI prevention bundle, the extent of adoption and use of the bundle remains unclear. Moreover, it is not well explored which piece(s) or combination of the practices in the bundle contributes most to the considerable CLABSI reductions in the aforementioned collaboratives. Based on data from the National Healthcare Safety Network, Furuya et al<sup>12</sup> reported lower CLABSI rates in ICUs that demonstrated all of the following practices: (1) having a bundle policy, (2) monitoring bundle compliance, and (3) achieving  $\geq 95\%$  compliance. However, the study did not find an independent association of any of the practices with a lower CLABSI rate. Using a larger and

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more diverse cohort of ICUs from the On the CUSP: Stop BSI national program and longitudinal self-reports on compliance with the CLABSI bundle, the present study aimed to report the compliance with 5 evidence-based CLABSI prevention practices in adult ICUs, and to examine the links between the self-reported use of those prevention practices and reductions in CLABSI rates in the program.

## METHODS

### *On the CUSP: Stop BSI national program*

The On the CUSP: Stop BSI national program was led by 3 organizations: the Health Research and Educational Trust (HRET), Johns Hopkins Medicine's Armstrong Institute for Patient Safety and Quality (AI), and the Michigan Health and Hospital Association's (MHA) Keystone Center for Patient Safety and Quality. The program was organized in cohorts of state-level collaboratives. The recruitment of states began in the fall of 2008. The state hospital association or state patient safety agency coordinated the recruitment and involvement of local hospitals. Forty-four states, the District of Columbia, and Puerto Rico registered ICUs for participation in the program. The hospital participation rate ranged from 5.5% to 100% across the participating states. After registering in the program, participating states were assigned to a cohort. The first cohort began in May 2009; the last, in March 2011.

Program implementation was also structured at the state level around the state hospital association or other state sponsor; however, education, data collection, and coordinator functions were centralized and provided by the national team. Each state had a "state lead" who worked directly with the unit-level improvement teams in the state as well as the national team from the HRET, AI, and MHA. Each state was assigned a project coordinator from the HRET, a data expert from the MHA, and a team consisting of a research coordinator and a quality improvement researcher from the AI to coach improvement teams and provide support. Unit-level improvement teams in each state received training together through regular conference calls, semiannual 1-day face-to-face meetings, and periodic supplemental expert calls. Details of the program's collaborative model have been published elsewhere.<sup>11,13,14</sup>

### *Intervention*

The intervention has 3 primary components.<sup>13</sup> The first component is a model including approaches and tools for promoting the CLABSI prevention bundle, which comprises 5 evidence-based practices: (1) appropriate hand hygiene, (2) chlorhexidine skin preparation, (3) full barrier precautions, (4) avoidance of femoral line placement, and (5) removal of unnecessary lines. The second component is the CUSP, designed to improve teamwork and the patient safety culture. The CUSP includes 5 steps: (1) educating staff on the science of improving patient safety, (2) identifying patient safety defects in the unit, (3) partnering with a senior executive to help prioritize safety defects and provide resources, (4) learning from at least one defect per quarter using a structured tool, and (5) implementing teamwork and communication tools. The third component is a data collection system to measure, monitor, and provide feedback on CLABSI data to the improvement teams and senior executives.

### *Data collection*

All improvement teams were required to report their number of CLABSIs and number of catheter-days for up to 12 months before the program began and then monthly throughout the duration of the program (at least 18 months). They were trained to use the

**Table 1**

Questions in the TCT to rate compliance with the CLABSI prevention bundle

| Question   | Response option                               | Quarterly response rate |
|--|---|-------------------------|
| TCT, version 1   |   | 38.3%                   |
| What proportion of staff on the unit consistently uses the following?              |   |                         |
| Appropriate hand hygiene   | <input type="checkbox"/> Few                  |                         |
| Chlorhexidine skin preparation   | <input type="checkbox"/> Some                 |                         |
| Full-barrier precautions during line insertion (maintaining a sterile field)       | <input type="checkbox"/> Most                 |                         |
| Avoiding femoral site for placement  | <input type="checkbox"/> All                  |                         |
| Removing unnecessary lines   |   |                         |
| TCT, version 2   |   | 25.4%                   |
| In the past month, for what proportion of line insertions did the following occur? |   |                         |
| Central line cart or kit was used  | <input type="checkbox"/> Never/rare           |                         |
| Central line checklist was used  | <input type="checkbox"/> Under 1/2 the time   |                         |
| Appropriate hand hygiene   | <input type="checkbox"/> 1/2 the time         |                         |
| Appropriate staff gloves, mask, gown, or hat                                       | <input type="checkbox"/> Over 1/2 the time    |                         |
| Chlorhexidine skin preparation of patient  | <input type="checkbox"/> Almost always/always |                         |
| Full drape of patient  |   |                         |
| Femoral site avoided in adults   |   |                         |

standardized definitions from the CDC's National Healthcare Safety Network with standardized data collection tools. The MHA Keystone Center used a central database to collect data. No data on individual patients (eg, catheter-days for individual patients, location of catheter insertion) were collected.

Improvement team leaders completed a Team Checkup Tool (TCT) on a monthly basis throughout the program. We requested that these team leaders consult with other CUSP team members when filling out the TCT. The team leader was typically a nurse manager from the unit, a nurse educator, or an infection preventionist. The TCT is a validated tool designed to help teams evaluate progress, address barriers, and communicate with senior executives.<sup>15</sup> The TCT included a set of questions measuring perceptions of the proportion of unit staff consistently performing each of the 5 evidence-based practices in the past month (Table 1). Two versions of the TCT were used in the program. The first version was used from the beginning of the program in May 2009 up to October 2010, for 18 months. Based on the feedback from the improvement teams in the early cohorts, the national team then modified the instrument to obtain more information.

The second version of the TCT was used from December 2010 to the end of the project in September 2012, a total of 22 months. In version 1 of the TCT, the team leaders were asked how many unit staff consistently used the practice, rated as 1, few; 2, some; 3, most; or 4, all. Version 2 of the TCT measured the use of evidence-based practices differently by asking what proportion of line insertions were done using the desired practices. The response set included 5 options: 1, never/rarely; 2, less than half the time; 3, half the time; 4, over half the time; and 5, almost always/always. This second version measured the use of full barrier precautions by asking about full drape of the patient and appropriate staff gloves, mask, gown, and hat separately. Moreover, it assessed whether line necessity was reviewed every day, rather than whether unnecessary lines were removed. Version 2 also collected data on the use of a central line cart and central line checklist.

### *Statistical analysis*

Only adult ICUs were included in our analysis. A total of 1185 adult ICUs from 866 hospitals participated in the program. We excluded units that did not submit unit characteristics data, any

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