American Journal of Infection Control 42 (2014) 94-9

Contents lists available at ScienceDirect

American Journal of Infection Control

journal homepage: www.ajicjournal.org

Major article

State of infection prevention in US hospitals enrolled in the National Health and Safety Network

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Key Words:
Health care–associated infection
Policy
Quality
Staffing
Infection preventionist

Background: This report provides a national cross-sectional snapshot of infection prevention and control programs and clinician compliance with the implementation of processes to prevent health care–associated infections (HAIs) in intensive care units (ICUs).

Methods: All hospitals, except Veterans Affairs hospitals, enrolled in the National Healthcare Safety Network (NHSN) were eligible to participate. Participation involved completing a survey assessing the presence of evidence-based prevention policies and clinician adherence and joining our NHSN research group. Descriptive statistics were computed. Facility characteristics and HAI rates by ICU type were compared between respondents and nonrespondents.

Results: Of the 3,374 eligible hospitals, 975 provided data (29% response rate) on 1,653 ICUs, and there were complete data on the presence of policies in 1,534 ICUs. The average number of infection preventionists (IPs) per 100 beds was 1.2. Certification of IP staff varied across institutions, and the average hours per week devoted to data management and secretarial support were generally low. There was variation in the presence of policies and clinician adherence to these policies. There were no differences in HAI rates between respondents and nonrespondents.

Conclusions: Guidelines for IP staffing in acute care hospitals need to be updated. In future work, we will analyze the associations between HAI rates and infection prevention and control program characteristics, as well as the inplementation of and clinician adherence to evidence-based policies.

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Health care–associated infections (HAIs) are a serious patient safety problem. Many of these infections occur in the intensive care unit (ICU) setting and are associated with an invasive device (eg, central line, ventilator, indwelling urinary catheter).[1] The estimated annual costs associated with HAIs in the US are up to $33 billion.[2] Given the high pervasiveness of HAIs, which are largely preventable, and the associated costs, the US Department of Health and Human Services has placed a priority on the nationwide reduction of HAIs, with the goal of building a safer, more affordable health care system for all Americans.[3]

In the mid-1970s, the Centers for Disease Control and Prevention (CDC) undertook the national Study on the Effectiveness of Nosocomial Infection Control (SENIC), which provided strong evidence of lower HAI rates in hospitals with well-organized infection control programs.[4] Based on those results, for more than 30 years the Joint Commission has required a formal infection prevention and control program in each accredited hospital. Furthermore, in a jointly published position paper in 1998, a panel of experts outlined consensus requirements for infrastructure and essential activities of infection prevention and control in hospitals.[5,6] The major

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Conflict of interest: None to report.

This study was funded by the National Institute of Nursing Research (grant R01NR010107). The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institute of Nursing Research, the National Institutes of Health, or the Centers for Disease Control and Prevention. In addition, this research was supported in part by an appointment to the Research Participation Program at the Centers for Disease Control and Prevention, administered by the Oak Ridge Institute for Science and Education.

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http://dx.doi.org/10.1016/j.ajic.2013.10.003

functions outlined included surveillance of nosocomial infections, proper analysis of infection control data, capacity to detect and control outbreaks, written policies for infection control and prevention, collaboration with employee health programs, ongoing education programs, and adequate resources, including a trained hospital epidemiologist (HE), a certified infection preventionist (IP), and adequate computer and clinical microbiology laboratory support.

Despite these requirements, however, how to best organize infection prevention and control programs to help front-line clinicians deliver effective bedside care remains unclear given the contemporary context of mandatory reporting of HAIs, increased acuity of hospitalized patients, and increased incidence of multidrug-resistant organisms (MDROs) and *Clostridium difficile* infections (CDIs). Moreover, there are controversies surrounding published recommendations for important infection prevention, surveillance, and control processes.[7] Despite high infection rates and the need to implement clinically effective processes, there remain wide gaps in knowledge that call for further study.

To fill some of these gaps, and build on our previous research, we undertook the Prevention of Nosocomial Infections and Cost Effectiveness Refined (P-NICER) study.[8-11] The aims of this national study were to (1) qualitatively describe infection prevention and control in US hospitals, (2) examine the comparative effectiveness of various strategies used by infection control departments to improve clinician adherence to evidence-based practices and decrease HAIs in ICUs across the nation, and (3) examine the impact of state mandatory reporting on infection prevention processes and HAI rates. This report provides a cross-sectional snapshot of the structure and resources of infection prevention and control programs around the country, as well as clinician compliance with the implementation of processes to prevent device-associated infections. The larger P-NICER study includes all ICUs, but here we report only on adult settings.

METHODS

This was a mixed-methods study that included both qualitative and quantitative approaches. The qualitative results, which are reported elsewhere, informed the quantitative approach described here.[12] Specifically, based on the qualitative results, we adapted the survey from our previous research (which was originally adapted from the SENIC study).[8-11]

All hospitals, except for Veterans Affairs hospitals, were eligible to participate if they were enrolled in the National Healthcare Safety Network (NHSN). We considered opening eligibility to all hospitals nationwide, but decided against this option because the exclusive use of NHSN hospitals maximized the quality and validity of the data collected. To enroll hospitals while protecting the confidentiality of the participating NHSN hospitals, the CDC e-mailed an invitation letter and posted it on the NHSN website. A modified Dillman technique was used for recruitment in the fall of 2011, with weekly reminder e-mails and a last chance communication. In addition, respondents were entered into lotteries, with $100 incentives to increase participation rates.

We invited the hospitals to complete a Web-based survey and join the P-NICER NHSN research group. By joining the P-NICER research group, hospitals provided the research team with access to data from the NHSN annual survey and up to 6 years (2006-2011) of ICU-level data for the device-associated module (eg, central line–associated bloodstream infection [CLABSI] rates) and hospital-wide data for the MDRO/CDI module (data not discussed here). Data on various hospital characteristics were collected from the annual NHSN survey and the P-NICER survey, including setting (urban, suburban, rural), medical school affiliation (major, graduate, limited, nonteaching), location (northeast, midwest, south, west, other), ownership (for profit, not for profit/other), and size (captured by the number of patient days, admissions, ICU beds, specialty beds, all other beds). Hospital staffing questions asked about the use of hospitalists (yes, no, don't know) and use of intensivists (yes, no, don't know).

Infection prevention and control program characteristics assessed in the P-NICER survey included department to which infection prevention and control reports (medicine, nursing, other); use of electronic surveillance systems (yes, no) and if present, commercially available system or custom developed; and presence of feedback mechanism of HAI rates to senior management, physicians, and nursing units (yes, no, don't know for each item). Detailed staffing data were elicited, including presence of a physician HE (yes, no), number of IP full-time equivalents per 100 beds, proportion of IPs with certification (none, some, all), and hours of data management and secretarial support per week. The percentage of total IP hours spent in various locations (inpatient wards, office, other) and percentage of IP time spent on various activities (surveillance, teaching, other) were assessed as well.

The adult ICUs were defined based on NHSN definitions as burns, medical, medical cardiac, medical/surgical, neurologic, neurosurgical, respiratory, surgical, surgical cardiothoracic, and trauma. The P-NICER survey inquired about the implementation of evidence-based infection prevention policies, and clinician adherence to these policies, for the prevention of device-associated HAIs for the largest ICU of each type. For CLABSI prevention, these policies included the use of an insertion checklist and 5 individual recommended evidence-based processes (ie, monitoring hand hygiene at insertion, using maximal barrier precautions for insertion, applying chlorhexidine at the insertion site, selecting an optimal catheter site, and checking the line daily for necessity). Ventilator-associated pneumonia (VAP) prevention involved the use of a ventilator bundle checklist and the 5 processes included on most checklists (ie, raising the head of the bed to 30-45 degrees, providing a daily sedation vacation and assessment of readiness to extubate, administering medications to prevent stomach ulcers, providing deep venous thrombosis prophylaxis, and using chlorhexidine for mouth care).[13]

For prevention of catheter-associated urinary tract infections (CAUTIs), 4 processes were assessed: using a urinary catheter reminder or stop order, allowing nurse-initiated urinary catheter discontinuation, using portable bladder ultrasound to measure postvoid residual volume, and, for men, using condom catheters.[14] Based on previous research showing that clinician adherence to these policies needs to be consistently high to impact HAI rates, we dichotomized these variables into those that achieved $\geq$95% adherence the last time the policy was monitored versus other (lower compliance, no monitoring, or don't know).[10,11]

Descriptive statistics for the hospital and infection prevention and control program characteristics were computed using Stata version 11 (StataCorp, College Station, TX). Cross-tabulations with the χ^2 or Fisher's exact test, as appropriate, were used to examine the presence of the different evidence-based policies overall and by ICU type. In these analyses, only those ICUs with complete policy data were included. Owing to small cell sizes, clinician adherence was examined only in the medical, medical cardiac, medical/surgical, surgical, and surgical cardiothoracic ICUs. To assess the generalizability of our sample to the nation at large, the CDC compared our respondents (those who completed the P-NICER survey and/or joined our NHSN research group) with nonrespondents (nonparticipants in both the P-NICER survey and the NHSN research group) on the facility characteristics from the NHSN

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