

## CONCISE COMMUNICATION

## The Impact of 2015 NHSN Catheter-associated Urinary Tract Infection (CAUTI) Definition Change on Central Line-associated Bloodstream Infection (CLABSI) Rates and CLABSI Prevention Efforts at an Academic Medical Center

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The 2015 changes in the catheter-associated urinary tract infection definition led to an increase in central line-associated bloodstream infections (CLABSIs) and catheter-related candidemia in some health systems due to the change in CLABSI attribution. However, our rates remained unchanged in 2015 and further declined in 2016 with the implementation of new vascular-access guidelines.

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Central line-associated bloodstream infections (CLABSIs) and catheter-associated urinary tract infections (CAUTIs) account for significant morbidity, mortality, and financial costs in hospitalized patients.<sup>1–4</sup> The National Healthcare Safety Network (NHSN) provides standardized surveillance definitions for CLABSI and CAUTI.<sup>5</sup> CLABSI attribution often relies on the exclusion of other sources; for example, bacteremia is considered central-line associated if no other source is identified. The NHSN CAUTI definition was revised in January 2015 to exclude yeast as a pathogen and to increase the urine culture bacterial threshold to  $\geq 10^5$  colony-forming units per milliliter (CFU/mL). This revised CAUTI definition resulted in a large reduction in nationwide CAUTI rates.<sup>6,7</sup> However, it also led to an increase in CLABSI rates in some health systems due to the exclusion of CAUTI secondary to *Candida* as an attributable source for candidemia.<sup>8</sup> We evaluated the effect of the 2015 NHSN changes in CAUTI definition on our CLABSI and catheter-related candidemia rates and the impact of CLABSI prevention efforts at our academic medical center.

### METHODS

#### Setting

This study was conducted in all inpatient units at the University of Alabama at Birmingham (UAB) Hospital, a 1,157-bed academic medical center, between January 2013 to December 2016. Our institutional vascular access policy was

updated early 2016 to improve insertion and maintenance practices. In addition, new guidelines for drawing blood cultures in the setting of central lines were introduced. These included recommendations to stop surveillance blood cultures in asymptomatic patients and to refrain from drawing blood cultures through central venous catheters.

#### Data Collection

This retrospective study included CAUTI and CLABSI surveillance data from January 1, 2013 to December 30, 2016. This surveillance program was performed by trained infection preventionists using the applicable NHSN definitions. The UAB Institutional Review Board deemed this study exempt from review.

#### Statistical Analysis

We analyzed both the reportable hospital-wide and the intensive care unit (ICU) CLABSI and CAUTI rates. We performed a review of organisms causing CLABSIs and CAUTIs from 2013 to 2016 and compared them for changes after the 2015 NHSN definition change. Descriptive statistics were calculated per 1,000 catheter days (CD). Changes in event rates were compared using the Z test, and a *P* value of  $< .05$  was considered statistically significant. Data analyses were performed using Stata version 12.0 software (StataCorp, College Station, TX).

### RESULTS

With the 2015 NHSN CAUTI definition, our hospital-wide CAUTI incidence rate (IR) decreased by  $> 75\%$  from 2014 to 2015: from 3.42 to 0.92 per 1,000 CD ( $P < .05$ ) (Table 1). This IR remained low in 2016: 0.80 per 1,000 CD. Our ICU CAUTI IR also decreased significantly from 2014 to 2015: from 2.54 to 0.78 per 1,000 CD ( $P < .05$ ) (Table 1). Our hospital-wide CAUTI rates decreased by 3.5% secondary to gram-positive bacteria and by 7.8% secondary to gram-negative bacteria in 2015 (Table 2). In addition, our ICU device utilization ratio decreased from 2013 to 2016, without any significant change in the number of urine cultures ordered (data previously reported).<sup>6</sup>

With the 2015 definition change, there was an initial increase in our hospital-wide CLABSI IR from 2014 to 2015: from 1.34 to 2.1 per 1,000 CD ( $P < .05$ ). However, this increase was followed by a significant decline from 2015 to 2016: from 2.1 to 1.31 per 1,000 CD ( $P < .05$ ) (Table 1). At the same time, a nonsignificant increase occurred in our ICU CLABSI IR from 2014 to 2015: from 1.59 to 1.83 per 1,000 CD ( $P = .10$ ) (Table 1). However, our CLABSI IR decreased significantly from 2015 to 2016: from 1.83 to 0.91 per 1,000 CD ( $P < .05$ ) (Table 1).

The initial increase in our CLABSI rates in 2015 was mainly due to gram-positive bacteria (+1.6%;  $P < .001$ ) (Table 2). Despite the exclusion of *Candida* spp as pathogens from the 2015 CAUTI definition, our catheter-related candidemia rates remained relatively unchanged in 2015 (+0.1%;  $P = .30$ ). In fact, our catheter-related candidemia rates decreased significantly by 1.9% in 2016 ( $P < .001$ ) (Table 2, 42.2% relative reduction). Additionally, we also saw a significant decline in our CLABSI rates secondary to gram-positive and gram-negative bacteria in 2016 (-5.6% and -1.7% absolute reduction, 40% and 29.3% relative reduction, respectively).

DISCUSSION

The revised 2015 NHSN CAUTI definition resulted in a significant decline in CAUTI rates, with a paradoxical increase in CLABSI rates related to *Candida* spp in some health systems.<sup>7,8</sup> However, we did not see the same increase in catheter-related candidemia or a sustained increase in the CLABSI rates. The opposite trend was observed as both CLABSI rates and catheter-related candidemia rates decreased significantly in 2016 when vascular access guidelines were updated.

TABLE 1. Incidence Rate (IR) per 1,000 Catheter Days Using the Applicable National Health Safety Network Definition

Year	Hospital-wide CLABSI IR	Hospital-wide CAUTI IR	ICU CLABSI IR	ICU CAUTI IR
2013	1.54	4.95	2.02	3.75
2014	1.34	3.42	1.59	2.54
2015	2.1	0.92	1.83	0.78
2016	1.31	0.80	0.91	1.06

NOTE. CAUTI, catheter-associated urinary tract infections; CLABSI, central line-associated bloodstream infections; ICU, intensive care unit.

At our institution, we found that the current 2015 NHSN CAUTI definition resulted in a >75% decline in reportable CAUTIs.<sup>6</sup> There was an initial increase in our CLABSI IR in 2015, but it was not driven by yeast, which suggests that these changes were likely unrelated to changes in the CAUTI definition. This increase was due to gram-positive organisms, most likely contaminants. In 2016, a concerted effort was made to decrease CLABSI rates, which resulted in a significant decline in our hospital-wide and ICU CLABSI rates. We attributed this decline to a developing a vascular access policy that restricted surveillance blood cultures in asymptomatic patients and restricted drawing blood cultures from central lines, similar to that reported by Boyce et al.<sup>9</sup> Reducing the number of contaminated blood cultures may have contributed to a significant reduction in our reported CLABSIs similar to other studies.<sup>10</sup>

With the 2015 NHSN CAUTI definition change, other health systems noted a paradoxical increase in their CLABSI rates, specifically catheter-related candidemia and enterococemia. Fakhir et al<sup>8</sup> reported a >40% decrease in ICU CAUTI rates with a corresponding 30% increase in ICU CLABSI rates in their healthcare system with this change in definition. Their catheter-related candidemia and enterococemia rates increased by 100% in 2015 compared to 2014. These candidemia and enterococemia cases accounted for 40% of CLABSI events in 2015 compared to 25% in 2014.<sup>8</sup> The increase in their catheter-related candidemia was assumed to be due to exclusion of CAUTI as an attributable source. However, candiduria is rarely clinically significant. Drogari-Apiranthitou et al<sup>11</sup> conducted a 5-year clinical and molecular analysis of cases with candidemia and candiduria and found that concomitant candiduria is rare in hospitalized patients with candidemia, confirming previous reports. Hence, the 2015 NHSN

TABLE 2. Organisms Causing CAUTI and CLABSI Events From 2014 to 2016

	2014			2015			2014 vs 2015		2016			2015 vs 2016	
	Observed Events	Device Days	Rate <sup>a</sup>	Observed Events	Device Days	Rate <sup>a</sup>	Absolute Change, %	P Value	Observed Events	Device Days	Rate <sup>a</sup>	Absolute Change, %	P Value
<b>CLABSI Organisms</b>													
Gram-positive bacteria	89	72,548	1.23	117	83,841	1.39	+1.6	<.001	70	83,785	0.83	-5.6	<.001
Gram-negative bacteria	45	72,548	0.55	49	83,841	0.58	+0.3	.01	34	83,785	0.41	-1.7	<.001
Fungi	32	72,548	0.44	38	83,841	0.45	+0.1	.30	22	83,785	0.26	-1.9	<.001
<b>CAUTI Organisms</b>													
Gram-positive bacteria	31	57,679	0.53	12	65,519	0.18	-3.5	<.001	13	62,843	0.21	+0.3	<.001
Gram-negative bacteria	96	57,679	1.66	58	65,519	0.88	-7.8	<.001	44	62,843	0.70	-1.8	<.001
Fungi	96	57,679	1.66	0	65,519	NA	-100	NA	0	62,843	NA	NA	NA

NOTE. CLABSI, central line-associated bloodstream infections; CAUTI, catheter-associated urinary tract infections; NA, not available.

<sup>a</sup>Rate is reported per 1,000 catheter days.

definition change has likely led to a more appropriate attribution of catheter-related candidemia by excluding CAUTI as a potential source.

Our study has some limitations. This is a retrospective single-center study, and our findings may not be generalizable to other institutions. The exclusion of candiduria may have had a larger impact on CAUTI rates in our tertiary-care center, with higher rates of candiduria compared to smaller hospitals. We have yet to assess the impact of NHSN definition changes on antimicrobial usage at our institution.

Our experience highlights our CLABSI prevention efforts, which led to a decline in CLABSI rates, including the incidence of catheter-related candidemia. In addition, our study also shows that the 2015 NHSN definition change has led to more appropriate CLABSI attribution of catheter-related candidemia with removal of CAUTI as a potential secondary source. These definition changes have important implications for the perceived effectiveness of CLABSI and CAUTI prevention efforts. These findings underscore the importance of updating surveillance definitions to closely correlate with clinical definitions.

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*PREVIOUS PRESENTATION.* The data from this study were presented in part at the 55th Annual Meeting of the Infectious Diseases Society of America, IDWeek 2017 on October 5, 2017, in San Diego, California, as a poster presentation (abstract 474) in the session "HAI: Surveillance Plus Reporting."

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#### REFERENCES

- Kennedy EH, Greene MT, Saint S. Estimating hospital costs of catheter-associated urinary tract infection. *J Hosp Med* 2013;8:519–522.
- Higuera F, Rangel-Frausto MS, Rosenthal VD, et al. Attributable cost and length of stay for patients with central venous catheter-associated bloodstream infection in Mexico City intensive care units: a prospective, matched analysis. *Infect Control Hosp Epidemiol* 2007;28:31–35.
- Rosenthal VD, Guzman S, Migone O, Crnich CJ. The attributable cost, length of hospital stay, and mortality of central line-associated bloodstream infection in intensive care departments in Argentina: a prospective, matched analysis. *Am J Infect Control* 2003;31:475–480.
- Vandijck DM, Depaemelaere M, Labeau SO, et al. Daily cost of antimicrobial therapy in patients with intensive care unit-acquired, laboratory-confirmed bloodstream infection. *Int J Antimicrob Agents* 2008;31:161–165.
- National Healthcare Safety Network (NHSN) Patient Safety Component Manual. Centers for Disease Control and Prevention website. [https://www.cdc.gov/nhsn/pdfs/pscmanual/pscmanual\\_current.pdf](https://www.cdc.gov/nhsn/pdfs/pscmanual/pscmanual_current.pdf). Published January 2017. Accessed July 1, 2017.
- Advani SD, Lee RA, Schmitz M, Camins BC. Impact of changes to the National Healthcare Safety Network (NHSN) definition on catheter-associated urinary tract infection (CAUTI) rates in intensive care units at an academic medical center. *Infect Control Hosp Epidemiol* 2017;38:621–623.
- Bardossy AC, Jayaprakash R, Alangaden AC, et al. Impact and limitations of the 2015 National Health and Safety Network case definition on catheter-associated urinary tract infection rates. *Infect Control Hosp Epidemiol* 2017;38:239–241.
- Fakih MG, Groves C, Bufalino A, Sturm LK, Hendrich AL. Definitional change in NHSN CAUTI was associated with an increase in CLABSI events: evaluation of a large health system. *Infect Control Hosp Epidemiol* 2017;38:685–689.
- Boyce JM, Nadeau J, Dumigan D, et al. Obtaining blood cultures by venipuncture versus from central lines: impact on blood culture contamination rates and potential effect on central line-associated bloodstream infection reporting. *Infect Control Hosp Epidemiol* 2013;34:1042–1047.
- Garcia RA, Spitzer ED, Beaudry J, et al. Multidisciplinary team review of best practices for collection and handling of blood cultures to determine effective interventions for increasing the yield of true-positive bacteremias, reducing contamination, and eliminating false-positive central line-associated bloodstream infections. *Am J Infect Control* 2015;43:1222–1237.
- Drogari-Apiranthitou M, Anyfantis I, Galani I, Kanioura L, Daikos GL, Petrikos G. Association between candiduria and candidemia: a clinical and molecular analysis of cases. *Mycopathologia* 2017;182:1045–1052.