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Comparison of Non–Intensive Care Unit (ICU) versus ICU Rates of Catheter-Associated Urinary Tract Infection in Community Hospitals

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Abstract

We describe and compare the epidemiology of catheter-associated urinary tract infection (CAUTI) occurring in non–intensive care unit (ICU) versus ICU wards in a network of community hospitals over a 2-year period. Overall, 72% of cases of CAUTI occurred in non-ICU patients, which indicates that this population is an important target for dedicated surveillance and prevention efforts.

Catheter-associated urinary tract infection (CAUTI) occurs frequently and leads to excessive use of healthcare resources each year.[1] Many studies of CAUTI epidemiology, surveillance, and prevention have focused on the intensive care unit (ICU) population.[2–4] In contrast, the epidemiology of CAUTI in non-ICU settings has not been carefully examined. The objectives of our study were to identify and compare the incidence, patient characteristics, and microbiology of CAUTI occurring in non-ICU and ICU patients in community hospitals.

METHODS

The Duke Infection Control Outreach Network (DICON) is a network of community hospitals in the southeastern United States that has been described previously.[5] DICON provides infection control consultation services to 43 hospitals in 5 states. Trained infection preventionists at each hospital use standardized surveillance definitions to prospectively identify cases of healthcare-associated infection. De-identified demographic, clinical, microbiologic, patient census, and device utilization data are entered into a centralized DICON surveillance database.

We performed a retrospective analysis of prospectively collected surveillance data from 15 DICON-affiliated hospitals (median size, 186 beds [range, 50–457 beds]) for which complete hospital-wide and ICU-specific data were available from January 1, 2010, through

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December 31, 2011. All identified adult and pediatric cases of hospital-acquired CAUTI were included in our analysis. Cases of hospital-acquired CAUTI were defined as follows: (1) criteria for symptomatic UTI[6] were fulfilled, (2) symptomatic UTI occurred more than 48 hours after hospital admission or was present at admission in a patient discharged from the same hospital less than 48 hours before admission, and (3) indwelling urinary catheter was present at the time of or within 48 hours before the time of diagnosis of symptomatic UTI. Henceforth we will use CAUTI to refer to the specific condition of hospital-acquired CAUTI as defined above.

Overall incidence rates of CAUTI were calculated as events per 1,000 catheter-days by dividing the total number of CAUTI for all 15 hospitals by the total number of catheter-days for all 15 hospitals for 3 patient groups: (1) the entire cohort, (2) non-ICU patients, and (3) ICU patients. Hospital-specific rates of CAUTI were calculated for each hospital for the preceding 3 patient groups in a similar manner. Overall and hospital-specific catheter utilization ratios (CURs) were calculated as number of catheter-days per patient-days for each of the 3 patient groups described above.

Statistical analysis was performed using SAS, version 9.3 (SAS Institute), and Stata, version 12.0 (StataCorp). Categorical variables were compared using χ^2 tests or Fisher exact test; continuous variables were compared using the Student *t* test or Wilcoxon rank-sum test. Overall rates and incidence rate ratios were compared using the *Z*-test. Hospital-specific rates were compared using Poisson regression controlled for clustering within hospitals. Pearson's correlation coefficient was calculated to assess correlation between CAUTI incidence rate and CUR.

RESULTS

A total of 506 CAUTIs were observed during 312,946 catheter-days and 1,331,280 patient-days during the 24-month study period. A total of 363 CAUTIs (72%) occurred in non-ICU patients, and 143 (28%) occurred in ICU patients. Patient-level data were available for 503 of 506 patients (Table 1).

The overall and hospital-specific incidence rates of CAUTI and CUR for the total cohort, non-ICU patients, and ICU patients are shown in Table 2. The overall incidence rate of CAUTI was not significantly different in non-ICU versus ICU patients (incidence rate ratio [IRR], 0.84 [95% confidence interval {CI}, 0.70–1.02]; $P = .09$). The overall CUR was significantly lower in non-ICU patients than ICU patients (0.21 catheter-days per patient-day vs 0.83 catheter-days per patient-day in ICU patients; rate ratio, 0.25 [95% CI, 0.25–0.26]; $P < .001$). There was no correlation between hospital-specific CAUTI rates and CUR ($r = 0.05$; $P = .8$).

The most common pathogens were *Escherichia coli* (122 cases; 24%), enterococci (104 cases; 20%), and *Candida* species (101 cases; 20%). We found a low incidence of CAUTI caused by multidrug-resistant pathogens in our cohort (methicillin-resistant *Staphylococcus aureus* [MRSA]: 11 cases [2%]; vancomycin-resistant enterococci [VRE]: 15 cases [3%]; extended-spectrum β-lactamase [ESBL]–producing organisms: 15 cases [3%]). Fewer non-ICU CAUTIs than ICU CAUTIs were caused by *Candida* species (IRR, 0.62 [95% CI, 0.42–0.93]; $P = .02$). Otherwise, there were no significant differences in CAUTI pathogens, including MRSA, VRE, or ESBL-producing organisms, between non-ICU and ICU patients.

DISCUSSION

To our knowledge, this cohort study is the first to describe patients who developed hospital-acquired CAUTI in a network of community hospitals. Furthermore, our study is one of the few to directly compare the incidence of CAUTI and CUR in non-ICU and ICU settings. Our analysis of this population led to several important and unique findings.

Nearly three-quarters of all CAUTIs occurred in non-ICU patients. These findings are even more striking than those previously reported by Weber et al,[7] who found that 55% of all CAUTI occurred in non-ICU patients at a single academic institution. In our cohort, non-ICU patients with CAUTI were significantly older and were more likely to have been admitted from a nursing home or a long-term care facility. Clearly, non-ICU patients are an important population for targeted CAUTI surveillance and prevention efforts.

The incidence rates of CAUTI were similar in non-ICU and ICU patients. This finding was unexpected, given the increased severity of illness of patients who require ICU admission and the presumed increased risk of device-related infection. Our observed rates of CAUTI are consistent with those reported to the National Healthcare Safety Network (NHSN),[8] although the NHSN report does not necessarily include non-ICU and ICU rates for all reporting hospitals.

CUR was 4 times lower in non-ICU wards than ICU wards. The hospital-specific CUR was not correlated with CAUTI incidence rate. This paradoxical nonassociation between CUR and CAUTI incidence has been previously demonstrated.[9,10] We emphasize this point here because CAUTI prevention programs frequently and appropriately target reduction in unnecessary catheter use as a primary goal. It is important to note that decreasing CUR should not be expected to necessarily result in decreased incidence of CAUTI when the rate is calculated per catheter-day. Therefore, a meaningful assessment of the overall burden of CAUTI events requires interpretation of CAUTI incidence in conjunction with the CUR.

There are several limitations to this study. We only included community hospitals in one geographic region of the United States, so our results may not be generalizable to tertiary care hospitals or hospitals in other geographic areas. We were unable to evaluate for potential confounding risk factors for CAUTI, including antibiotic exposure and duration of catheter use, because our data were collected primarily for surveillance purposes. We assessed ICU status only at the time of CAUTI; some non-ICU patients may have had ICU exposure before developing CAUTI that was not accounted for by our surveillance methods. Patients who developed manifestations of CAUTI after discharge from the hospital were not included in our investigation. Thus, our estimate that three-quarters of CAUTIs occur outside of the ICU may be an underestimate. Finally, we were unable to provide more detailed comparisons of antibiotic resistance profiles between non-ICU and ICU CAUTI, because these data are not included in our surveillance database.

Historically, most infection surveillance and prevention efforts have targeted the ICU patient. Our data demonstrate that 3-fold more CAUTIs occur outside the ICU than inside the ICU. We believe that surveillance efforts and prevention strategies should be expanded to include patients outside of the ICU. A greater understanding of specific risk factors for CAUTI in this patient population is needed to guide tailored infection prevention strategies.

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TABLE 1

Characteristics of Patients with Catheter-Associated Urinary Tract Infection by Intensive Care Unit (ICU) Status in 15 Hospitals in the Duke Infection Control Outreach Network, 2010–2011

Variable	Total (*n* = 503)	Non-ICU (*n* = 360)	ICU (*n* = 143)	Risk ratio (95% CI)	*P*
Female sex[a]	325 (68)	248 (71)	77 (59)	1.20 (1.03–1.41)	.01
Age, years					
Median (IQR)	72 (61–82)	75 (63–84)	64 (56–74)		<.001
<18	12 (2)	10 (3)	2 (1)	…	
>80	138 (27)	118 (33)	20 (14)	2.31 (1.52–3.61)	<.001
Race[a]					
White	295 (67)	221 (70)	74 (60)	Reference	Reference
Black	134 (30)	93 (29)	41 (33)	0.83 (0.62–1.12)	.2
Other	11 (3)	3 (1)	8 (7)	…	…
Location before hospitalization					
Home	386 (77)	264 (73)	122 (85)	Reference	Reference
Nursing home/extended care facility	95 (19)	82 (23)	13 (9)	2.46 (1.42–4.27)	<.001
Hospital	12 (2)	7 (2)	5 (4)	0.66 (0.21–2.03)	.5
Other	10 (2)	7 (2)	3 (2)	…	…
Admitting service[a]					
Medicine	335 (74)	238 (72)	97 (81)	Reference	Reference
Surgery	71 (16)	58 (18)	13 (11)	1.66 (0.95–2.90)	.07
Other	45 (10)	35 (11)	10 (9)	…	…
Discharge disposition[a]					
Home	76 (20)	55 (20)	21 (20)	Reference	Reference
Healthcare service[b]	208 (55)	169 (62)	39 (38)	1.16 (0.95–1.42)	.1
Other hospital	30 (8)	18 (7)	12 (12)	0.68 (0.37–1.24)	.2
Death/hospice	43 (11)	18 (7)	26 (24)	0.44 (0.28–0.72)	<.001
Other	18 (5)	12 (4)	6 (6)	…	…
Hospitalization within previous 1 year[a]	260 (52)	196 (55)	64 (45)	1.21 (0.99–1.48)	.06
Polymicrobial infection	11 (2)	7 (2)	4 (3)	0.70 (0.21–2.34)	.6
Time from admission to diagnosis, median days (IQR)	7 (4–12)	7 (3–11)	9 (4–19)	…	<.001

Variable	Total (*n* = 503)	Non-ICU (*n* = 360)	ICU (*n* = 143)	Risk ratio (95% CI)	*P*
Time from diagnosis to discharge, median days (IQR)[a]	5 (2–12)	4 (2–9)	8 (4–20)	…	<.001
Total length of stay, median days (IQR)[a]	13 (7–25)	11 (7–19)	23 (9–38)	…	<.001

NOTE. Data are no. (%) of patients, unless otherwise indicated. CI, confidence interval; IQR, interquartile range.

[a]Missing information for the following variables: sex, 22 (4%); race, 63 (13%); admitting service, 52 (10%); discharge disposition, 128 (25%); hospitalization within 1 year, 11 (2%); and discharge date, 103 (20%).

[b]Includes skilled nursing facility, other extended care facility, and home health services.

TABLE 2

Overall and Hospital-Specific Incidence Rates (IRs) for Catheter-Associated Urinary Tract Infection (CAUTI) and Catheter Utilization Ratios (CURs) by Intensive Care Unit (ICU) Status in 15 Hospitals in the Duke Infection Control Outreach Network, 2010–2011

Variable	Total (*n* = 506)	Non-ICU (*n* = 363)	ICU (*n* = 143)	IRR[a] (95% CI)	*P*
CAUTIs per 1,000 CDs					
Overall IR	1.62	1.55	1.83	0.84 (0.70–1.02)	.09
Hospital-specific IR	1.21 (1.03–2.01)[b]	1.31 (1.04–1.97)[b]	1.33 (0.50–2.11)[b]	0.84 (0.53–1.37)	.50
CUR					
Overall CUR	0.24	0.21	0.83	0.25 (0.25–0.26)	<.01
Hospital-specific CUR	0.23 (0.21–0.25)[b]	0.19 (0.16–0.21)[b]	0.73 (0.67–0.84)[b]	0.25 (0.23–0.28)	<.01

NOTE. CUR was calculated as CDs divided by patient-days, and IRs were calculated as CAUTI events per catheter-days. CD, catheter-day; CI, confidence interval; IRR, incidence rate ratio.

[a]Hospital-specific IRRs were calculated using Poisson regression adjusting for intrahospital clustering.

[b]Median (interquartile range).