Impact of Expanded Carbapenem Resistant Enterobacteriacae (CRE) Screening on Rates of Hospital Acquired (HA) CRE Infection

Carolinas HealthCare System

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Background

Optimal strategies to prevent CRE transmission remain unclear. Unrecognized patients colonized with CRE serve as potential reservoirs for transmission, particularly when there are lapses in hand hygiene and environmental cleaning. Active surveillance for CRE allows for earlier identification and isolation. The goal of this study was to compare the effectiveness of two different screening approaches on detection of CRE colonization and the impact these approaches have on reducing hospital acquired (HA) infections by allowing for early isolation and cohorting interventions.

Methods

Active surveillance for CRE was performed using a culture based technique on rectal swabs. CRE was defined as any *Enterobacteriacae* isolate intermediate or resistant to ertapenem, meropenem, imipenem or doripenem. Of note, at the time of this study, the 2010 CLSI breakpoints for carbapenems had not yet been implemented. Mechanism of carbapenem resistance was not determined.

Throughout all study periods, once a patient was identified as being colonized or infected with CRE, they were placed on contact precautions, housed on select units with dedicated nursing staff and received daily chlorhexidine bathing for the duration of their hospital stay.

January 2014 through July 2015, we utilized a limited CRE surveillance strategy by performing point prevalence surveillance testing on 2–3 units per week on a rotating basis hospital wide. In August 2015 thru April 2016, expanded CRE surveillance was implemented to include on admission testing for high risk populations (hospital stay >48 hours in the past year, transfer in from another facility, or admission to medical or surgical ICU, hepatobiliary unit or bone marrow transplant unit). Weekly screening sweeps were performed in the units above as well as the three units housing CRE patients in our facility.

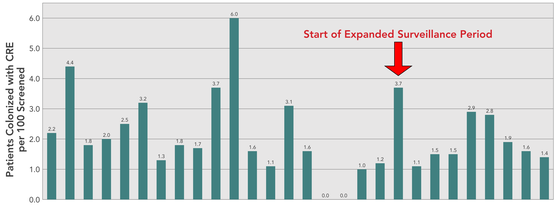
Patients admitted throughout all time periods were monitored for development of CRE colonization or infection. All clinical and surveillance culture results were reviewed by an Infection Preventionist to determine if they met National Health Safety Network (NHSN) criteria for a healthcare associated infection. A patient was considered to have developed hospital acquired CRE if they either had a positive culture on or after hospital day 3 OR they had a positive culture on hospital day 1–2 but had a hospitalization to our facility in the 4 weeks prior to admission.

Statistical Methods

Fisher's exact test was used to calculate statistical significance of incidence rates. Multivariable analysis was performed to determine risk factors associated with hospital acquired infection. A modified Poisson model reporting incident risk ratios was used. The two surveillance periods were included in the model as the expanded surveillance variable with the referent category the limited surveillance time period.

Results

Figure 1: Trends in Number of CRE Colonized Patients per 100 Screened



CRE Colonization rates per 100 patients screened are shown in Figure 1. There was no statistically significant difference in the average rate of CRE colonized patients per 100 patients screened identified with the limited screening approach (1.8 CRE positive per 100 screened) vs the expanded screening period (2.2 per 100 screened, p=0.07) however number of patients with community acquired (CA) CRE colonization increased significantly from 0.2 per 100 screened in the limited surveillance period to 0.9 per 100 screened (p<0.001) in the expanded surveillance period.

Figure 2: Rates of Hospital (HA) and Community Acquired (CA) CRE Infection and Colonization per 10,000 Patient Days

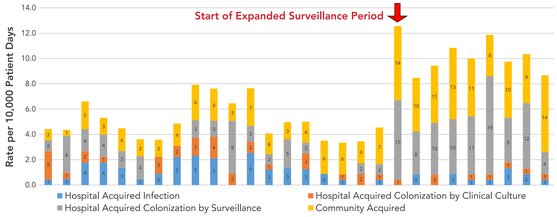
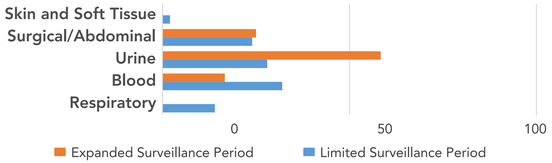


Figure 3: Percent of Hospital Acquired Infections by Body Site in Limited Surveillance vs Expanded Surveillance Periods



Hospital Acquired CRE bacteremia and respiratory tract infections were more common in the limited surveillance time period. Urinary tract infections constituted a larger percentage of the hospital acquired infections in the expanded surveillance period.

Table 1: Comparison of Hospital (HA) and Community Acquired (CA) Infection and Colonization Rates Between Limited and Expanded Active Surveillance Periods

	Limited Surveillance Rate of infections or colonization per 10,000 patient days (#patients with infection or colonization/ #patient days)	Expanded Surveillance Rate of infections or colonization per 10,000 patient days (#patients with infection or colonization/ #patient days)	Incident Rate Ratio (IRR) expanded vs limited surveillance (95% Confidence Interval)	P-value
HA Infection	1.16 (50/433087)	0.57 (12/212184)	0.49 (0.29, 0.99)	**0.03**
HA Colonization by Clinical culture	0.86 (33/433087)	0.38 (8/212184)	0.49 (0.22, 1.07)	0.09
HA Colonization by Surveillance	1.25 (54/433087)	4.57 (97/212184)	3.67 (2.6, 5.1)	**<0.001**
CA Infection	0.99 (43/433087)	0.42 (9/212184)	0.43 (0.21, 0.88)	**0.02**
CA Colonization	0.88 (38/433087)	4.29 (91/212184)	4.9 (3.3, 7.1)	**<0.001**
Patients who screened positive and progressed to infection (# CRE colonized who progressed to infection per 1000 patients screened)	1.7 (6/3490)	0.16 (1/5958)	0.10 (0.01, 0.81)	**0.02**

In the univariate analysis, the rate of HA Infections per 10,000 patient days decreased significantly in the expanded surveillance time period as compared to the limited surveillance time period (IRR 0.49, p=0.03). The rate of community acquired CRE infection decreased significantly in the expanded surveillance period (IRR 0.43, p =0.02). The rates of HA and CA colonization increased significantly in the expanded surveillance time period (IRR 3.7 and 4.9 respectively). HA colonization by clinical culture and progression from HA colonization to HA infection decreased in the expanded surveillance period though the decrease was not statistically significant.

Table 2: Modified Poisson Model to Assess the Risk of Hospital Acquired CRE Infection

Risk Factor	Incident Risk Ratio (RR)	95% Confidence Interval	P-value
Age (years)	1.01	0.99, 1.03	0.24
Race (ref. White)			
Black	0.71	0.37, 1.35	0.30
Other	0.98	0.56, 1.72	0.95
Male (ref. female)	1.41	0.90, 2.22	0.14
Endoscopy procedure prior to CRE diagnosis	0.67	0.90, 2.22	0.34
Expanded Surveillance Period (ref. Limited Surveillance period)	0.83	0.55, 1.25	0.37

After adjustment for patient age, gender, race, and endoscopy procedure prior to CRE diagnosis, the rate of HAI in the limited surveillance period, while still higher than that in the expanded surveillance period, was no longer statistically significant.

Limitations

Limitations of the study are that is a single center study. Possible confounders include changes in prevalence of CRE over time and impact of multiple ongoing interventions which couldn't be accounted for in the model. Also we only adjusted for some patient specific factors. Compliance with sending CRE surveillance on admission for patients transferred in or with recent hospitalizations during the expanded surveillance period was poor and may have led to missed opportunities.

Conclusion

The percent of patients screened who were found to have CRE was unchanged between the limited and expanded surveillance periods. Expanded active surveillance resulted in increased identification of patients with community acquired CRE colonization and infection, allowing for earlier isolation, cohorting of nursing staff and CHG bathing to be implemented.

While rates of hospital acquired CRE infection decreased in the expanded surveillance period, the impact was lessened when we accounted for other patient specific factors such as age, gender, race and endoscopy procedures prior to development of CRE. Further study is needed to elucidate the predictors of CRE HA infections and the impact of active surveillance for CRE on HA infection rates. We significantly increased our ability to identify patients with CRE on admission allowing for earlier isolation, cohorting of nursing staff, and CHG bathing and less progression to infection.

References:

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