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Session: 212. Healthcare Epidemiology: You Can try this at Home - Innovative Epi Abstracts

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Background. Carbapenem-resistant Enterobacteriacae (CRE) are an urgent US public health threat. CDC reported CRE incidence to be 2.93/100,000 population in 2012–2013 in selected sites but changed the CRE surveillance case definition in 2016 to improve sensitivity for detecting carbapenemase-producing (CP) CRE. We describe CRE epidemiology before and after the change.

Methods. Eight CDC Emerging Infections Program sites (CO, GA, MD, MN, NM, NY, OR, TN) conducted active, population-based CRE surveillance in selected counties. A case was defined as having an isolate of *E. coli*, *Enterobacter*, or *Klebsiella* meeting a susceptibility phenotype (figure) at a clinical laboratory from urine or a normally sterile body site in a surveillance area resident in a 30-day period. We collected data from medical records and defined cases as community-associated (CA) if no healthcare risk factors were documented. A convenience sample of isolates were tested for carbapenemase genes at CDC by real-time PCR. We calculated incidence rates (per 100,000 population) by using US Census data. Case epidemiology and the proportion of CP-CRE isolates in 2015 versus 2016 were compared.

Results. In total, 442 incident CRE cases were reported in 2015, and 1,149 cases were reported in 2016. Most isolates were cultured from urine: 87% in 2015 and 92% in 2016 ($P < .001$). The crude overall pooled mean incidence in 2015 was 2.9 (range by site: 0.45–7.19) and in 2016 was 7.48 (range: 3.13–15.95). The most common CRE genus was *Klebsiella* (51%) in 2015, and in 2016 was *Enterobacter* (41%, $P < 0.001$). Of the subset of CRE isolates tested at CDC, 109/227 (48%) were CP-CRE in 2015 and 109/551 (20%) were CP-CRE in 2016. In 2015, 52/442 (12%) of cases were CA CRE, and in 2016, 267/1,149 (23%) were CA CRE ($P < 0.001$). In 2016, 3/111 (2.7%) of CA CRE isolates tested were CP-CRE.

Conclusion. A large increase in reported CRE incidence was observed after the change in the case definition. The new case definition includes a substantially larger number of *Enterobacter* cases. A decrease in CP-CRE prevalence appears to be driven by an increase in non-CP-CRE cases. Although CP-CRE in the community still appear to be rare, a substantial proportion of phenotypic CRE appear to be CA, and CDC is undertaking efforts to further investigate CA CRE, including CP-CRE.

Figure: Comparison of 2015 and 2016 CRE case phenotypic definition

Surveillance Year	Species	Carbapenem/cephalosporin susceptibility phenotype*
2015	*Escherichia coli* *Klebsiella pneumoniae* *Klebsiella oxytoca* *Enterobacter cloacae* *Enterobacter aerogenes*	Intermediate or resistant to: Imipenem (MIC ≥2), Meropenem (MIC ≥2), or Doripenem (MIC ≥2) AND resistant to (if tested): Ceftazidime (MIC ≥16), Ceftriaxone (MIC ≥4), and Cefotaxime (MIC ≥4)
2016	*Escherichia coli* *Klebsiella pneumoniae* *Klebsiella oxytoca* *Enterobacter cloacae* *Enterobacter aerogenes*	Resistant to: Imipenem (MIC ≥4), Meropenem (MIC ≥4), Doripenem (MIC ≥4), or Ertapenem (MIC ≥2)

*Based on 2012 Clinical Laboratory Standards Institute (CLSI) MIC breakpoints

Disclosures. **G. Dumyati**, Seres: Scientific Advisor, Consulting fee.

1762. The Adjusted Ranking Metric (ARM) and Its Use in Composite Measures for HAI Prevention in the National Healthcare Safety Network (NHSN)

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Background. The National Healthcare Safety Network (NHSN), developed and used by the Centers for Disease Control and Prevention (CDC) for surveillance of healthcare-associated infections (HAIs), provides benchmark measures, such as standardized infection ratio (SIRs), that CDC and its partners in healthcare and public health use for prevention purposes. NHSN provides benchmarks for each HAI measure separately, but a composite HAI measure could provide a more rounded assessment of HAI problems and prevention opportunities.

Methods. Several issues must be addressed to produce a sound HAI composite measure, the most of which is that the SIR can be inaccurate for facilities with low HAI exposure (e.g., low device days, operative procedure volume). We remedy this issue with the Adjusted Ranking Metric (ARM), a new measure that reliability-adjusts the SIR using a Bayesian mixed effects model. The ARM is particularly useful in the production of a composite measure because ARMs are well-suited to comparison between facilities. The composite was therefore produced by applying adjustments to the ARMs to account for (1) differences between exposure to separate HAI types within facilities and (2) differences in frequency and severity between HAIs. The composite is calculated for 6 HAIs based on 2015 data.

Results. Case studies of 3 facilities (table) show that the new composite measure provides a meaningful measure of overall facility performance that is less prone to the biases that afflict simple combinations of SIRs.

Conclusion. We introduce a framework for calculating a composite HAI measure that is flexible, customizable, and transparent. The current implementation of the framework is intended to assist in prevention efforts and can be easily modified to include cost weights, if desired. Flexibility in weighting the HAIs provides an opportunity for different stakeholders to customize the composite measure to their own needs.

HAI	Adjusted Ranking Metric (ARM)					
	Facility 1		Facility 2		Facility 3	
	SIR	ARM	SIR	ARM	SIR	ARM
CAUTI	0.86	0.85	0.98	0.97	1.33	1.28
CLABSI	0	0.79	0.35	0.37	1.31	1.19
CDI	0	0.51	0.91	0.9	60.99	8.73
MRSA	0	1.03	0.62	0.68	382.9	3.52
SSI (abdominal hysterectomy)	0	0.65	3.13	1.58	1.68	1.16
SSI (Colon surgery)	0	0.39	2.02	1.62	0.92	0.95
Arithmetic mean of ARMs	**-**	**0.71**	**-**	**1.02**	**-**	**2.80**
Prototype composite	**-**	**0.52**	**-**	**0.84**	**-**	**1.18**

Table: Example of SIRs, ARMs for 6 HAIs with Composite Measures for 3 Sample Facilities

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1763. Estimating Median Survival Time to Central Line-Associated Bloodstream Infection (CLABSI) Among Patients in Intensive Care Units Reported to National Healthcare Safety Network (NHSN)

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Background. Duration free of central line-associated bloodstream infection (CLABSI) in a hospital may vary by type of patient population. We estimated patients' median time to CLABSI by intensive care unit (ICU) type among acute care hospitals.

Methods. The study population was ICU patients whose CLABSI data were reported to National Healthcare Safety Network (NHSN) in 2016 under the reporting requirement of the Centers for Medicare and Medicaid. The unit of analysis was ICU location, not an individual patient. We conducted counting process survival analysis method to compute time (day) to a CLABSI beginning from day 1 of first reporting month in 2016 in a given ICU location. Once a CLABSI occurred in a location, the start time of follow-up was reset to day 1 after the date of event. The Cox regression method was used to explore the hospital and location-level characteristics that are potentially associated with the daily hazard of CLABSI for an ICU. We also assessed the proportionality hazard assumption of these factors. Adjusting for the vector of means of covariates, we then estimated median time to CLABSI by ICU location type, which is defined as follow-up time (days) by which 50% of events have happened in a given ICU type.

Results. In 2016, 6,935 ICUs at 3,384 hospitals reported CLABSI data to NHSN, with a total of 10,985 CLABSIs and 2,449,361 follow-up time in days. Factors associated with an increased daily hazard of CLABSI were the following: admission to a hospital with a large bed size, major teaching status, and admission to a patient care location with a higher device utilization ratio (Table 1). Adjusted survival curves showed that median time to event (median CLABSI-free time) among ICUs ranged from 66 days (level III neonatal ICU), 90 days (burn units) to 275 days (oncology units), and 284 days (cardiothoracic units) (Table 2, Figure 1).

Conclusion. The study demonstrated that ICUs with level III care for neonatal patients and ICUs with burn patients were least likely to achieve the target of "zero" infection in a defined period and may warrant further targeted interventions. Similar research to investigate infection control performance through estimating median infection-free time is needed beyond ICUs and across multiple HAI types and facility settings.

Table-1: Facility and location-level characteristics associated with daily hazard of CLABSI and their parameter estimates from Cox regression model, NHSN, 2016

Facility and location-level characteristics	Parameter Estimate	p-value	Hazard Ratio	95% CI
ICU Location type				
• Burn unit	1.111	<.0001	3.036	(2.655, 3.473)
• Cardiac unit	0.549	<.0001	1.731	(1.558, 1.923)
• Cardiothoracic Pediatric unit	0.821	<.0001	2.274	(1.991, 2.596)
• Medical	0.691	<.0001	1.996	(1.833, 2.174)
• Medical-surgical	0.527	<.0001	1.693	(1.565, 1.832)
• Neuromedical	0.439	<.0001	1.552	(1.259, 1.912)
• Neurosurgical	0.587	<.0001	1.799	(1.579, 2.049)
• Neonatal ICU Level-III	1.488	<.0001	4.427	(4.011, 4.887)
• Oncology unit	0.029	0.9300	1.030	(0.534, 1.986)
• Other pediatric units	0.887	<.0001	2.429	(2.194, 2.688)
• Respiratory	0.946	<.0001	2.574	(1.742, 3.805)
• Surgical	0.597	<.0001	1.817	(1.653, 1.997)
• Neonatal ICU level-II/III	0.939	<.0001	2.558	(2.275, 2.875)
• Trauma	0.800	<.0001	2.226	(1.976, 2.508)
• Cardiothoracic	reference			
Device utilization ratio (at location level)	2.807	<.0001	16.561	(15.075, 18.194)
Being a major teaching hospital	0.519	<.0001	1.680	(1.612, 1.751)
Hospital beds	0.0000446	<.0001	1.000	(1.000, 1.000)