

Presentation Type:

Oral Presentation

Comparing Automated Cluster Detection Methods for Carbapenem-Resistant Enterobacteriaceae (CRE): Rule-Based Versus Statistical

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Background: The Tennessee (TN) Department of Health (TDH) has been identifying clusters of reportable conditions using the Electronic Surveillance System for Early Notification of Community-Based Epidemics (ESSENCE), a cluster detection method using space-time scan permutation statistics based on patient ZIP code. CRE are reportable in Tennessee; isolate submission is required for carbapenemase (CP) production and resistance mechanism (eg, KPC gene) testing. The Council for Outbreak Response: Healthcare-Associated Infections (HAI) and Antimicrobial-Resistant (AR) Pathogens (CORHA) released proposed thresholds of reporting CRE to public health. Thresholds vary by healthcare facility type and regional epidemiology. The TDH HAI/AR program currently runs a daily automated SAS code using the CORHA reporting threshold to help public health identify suspect KPC clusters. We evaluated our rule-based CORHA method against 2 space-time statistic-based methods for KPC cluster detection in Tennessee. **Methods:** Simulations for each cluster detection method were performed using retrospective CP-CRE surveillance data for 2018. Simulations were conducted using (1) CORHA reporting thresholds by facility case count to flag clusters of 2 or more cases within 28 days, (2) ESSENCE using patient residence ZIP code and the earliest of collection date or symptom onset date as is used for other reportable conditions in Tennessee, and (3) a modified space-time statistical method using SaTScan in which reporting facility, rather than a geographic location, was used as space variable to detect within-facility clusters within 1–28 days. We compared the number and overlap of cases and clusters identified with each method. Univariate logistic regression with CORHA flagging as predictor and flagging by each ESSENCE or CORHA method as outcome variables, were used to compare cases tagged by each method pair, respectively. **Results:** Of 183 KPC CP-CRE cases, 54 (30.6%) were flagged as part of suspect clusters by at least 1 method. Simulations generated 16 alerts (36 cases) using CORHA, 10 clusters (25 cases) using modified SaTScan, and 10 clusters (20 cases) using standard ESSENCE protocol. Among KPC CP-CRE cases flagged by CORHA, 12 (33.3%) were also flagged by modified SaTScan and 2 (5%) by ESSENCE. A case flagged using CORHA method has 5.15

(95% CI, 2.10–12.64) times higher odds of also being flagged by the modified SaTScan method compared to cases not flagged by CORHA. **Conclusions:** An algorithm based on CORHA thresholds for reporting CRE to public health had strong agreement with modified SaTScan, a space-time method. We intend to explore the extension of the time interval for ESSENCE.

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Contamination of Healthcare Worker Personal Protective Equipment with MRSA Outside the Intensive Care Unit Setting

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Background: Estimates of contamination of healthcare personnel (HCP) gloves and gowns with methicillin-resistant *Staphylococcus aureus* (MRSA) following interactions with colonized or infected patients range from 17% to 20%. Most studies were conducted in the intensive care unit (ICU) setting where patients had a recent positive clinical culture. The aim of this study was to determine the rate of MRSA transmission to HCP gloves and gown in non-ICU acute-care hospital units and to identify associated risk factors. **Methods:** Patients on contact precautions with history of MRSA colonization or infection admitted to non-ICU settings were randomly selected from electronic health records. We observed patient care activities and cultured the gloves and gowns of 10 HCP interactions per patient prior to doffing. Cultures from patients' anterior nares, chest, antecubital fossa and perianal area were collected to quantify bacterial bioburden. Bacterial counts were log transformed. **Results:** We observed 55 patients (Fig. 1), and 517 HCP–patient interactions. Of the HCP–patient interactions, 16 (3.1%) led to MRSA contamination of HCP gloves, 18 (3.5%) led to contamination of HCP gown, and 28 (5.4%) led to contamination of either gloves or gown. In addition, 5 (12.8%) patients had a positive clinical or surveillance culture for MRSA in the prior 7 days. Nurses, physicians and technicians for MRSA were grouped in “direct patient care”, and rest of the HCPs were included in “no direct care group.” Of 404 interactions, 26 (6.4%) of providers in the “direct patient care” group showed transmission of MRSA to gloves or gown in comparison to 2 of 113 (1.8%) interactions involving providers in the “no direct patient care” group ($P = .05$) (Fig. 2). The median MRSA bioburden was 0 log₁₀CFU/mL in the nares (range, 0–3.6), perianal region (range, 0–3.5), the arm skin (range, 0–0.3), and the chest skin (range, 0–6.2). Detectable bioburden on patients was negatively correlated with the time since placed on contact precautions ($r_s = -0.06$; $P < .001$). Of 97 observations with detectable bacterial bioburden at any site, 9 (9.3%) resulted in transmission of MRSA to HCP in comparison to 11 (3.6%) of 310 observations with no detectable bioburden at all sites ($P = .03$). **Conclusions:** Transmission of MRSA to gloves or gowns of HCP caring for patients on contact precautions for MRSA in non-ICU settings was lower than in the ICU setting. More evidence

Venn Diagram of Overlap of CP-CRE Cases Flagged by Three Cluster Detection Methods, 2018

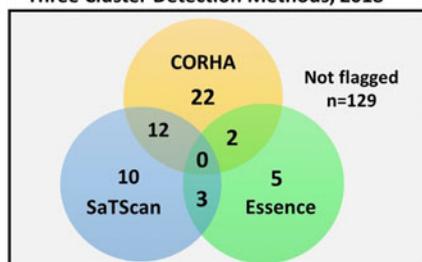


Fig. 1.

Figure 1. Table of description of patients on contact precautions for MRSA in non-intensive care units from August 2018 to March 2019 (N= 55)

Type of ward	N (%)
HIV	8 (14.6)
General Internal Medicine	5 (9.1)
Medicine subspecialty	5 (9.1)
Hospitalist	7 (12.6)
Neurology	1 (1.8)
Cardiac step-down	9 (16.4)
Organ Transplant	6 (10.9)
Orthopedic	8 (14.6)
General Surgery	1 (1.8)
Emergency Surgery	5 (9.1)
Demographics	
Age, mean y (SD)	58.4 (17.8)
Male sex	28 (51)
Patient Characteristics	
Central venous or midline catheter	22 (40)
Surgical drain	12 (21.8)
Indwelling foley urinary catheter	11 (20)
Chest tube	5 (9.1)
Artificial airway (tracheostomy)	5 (9.1)
Nasogastric tube	3 (5.5)
Gastrotomy tube	3 (5.5)
Wound	35 (63.6)
Diarrhea	6 (10.9)

Note:
SD, standard deviation; MRSA, methicillin resistant *Staphylococcus aureus*

Fig. 1.**Figure 2.** Table of association between HCP type, patient bacterial bioburden and transmission of MRSA to glove or gown in patients in non-ICU units colonized with MRSA.

Characteristics	Transmission of MRSA to HCP Glove or Gown		p-value ^e
	Yes n (%)	No n (%)	
HCP type			
Direct patient care ^a	26 (6.4)	378 (93.6)	0.05
No direct patient care ^b	2 (1.8)	111 (98.2)	
MRSA bacterial bioburden			
Detected ^c	9 (9.3)	88 (90.72)	0.03
Not detected ^d	11 (3.6)	299 (96.5)	

MRSA, methicillin resistant *Staphylococcus aureus*, HCP, Healthcare personnel

^aDirect patient care: An aggregated group of HCP with direct patient contact which includes nurses (n=264, 51%), physicians (n=63, 12%), patient care technicians (n=54, 10%), respiratory technicians (n=4, 0.7%), radiology technicians (n=2, 0.3%), occupational or physiotherapists (n=17, 3%).

^bNo direct patient care: An aggregated group of HCP with no direct patient contact which includes environmental services (n=40, 8%), food service workers (n=45, 8%), case managers (n=3, 0.5%), social worker (n=4, 0.7%), patient transporters (n=3, 0.5%), clinical nutritionists (n=2, 0.3%), phlebotomists (n=3, 0.5%).

^cMRSA bioburden (CFU/mL or CFU/mL²) detected at any one or more of the sampled sites. Samples were obtained from the arm, chest, and nares of 54 (98.1%) patients and from perianal sites of 41 (74.5%) patients.

^dMRSA bioburden (CFU/mL or CFU/mL²) not detected at any sampled sites.

^ep-values determined by Fisher's exact test.

Fig. 2.

is needed to help guide the optimal use of contact precautions for the right patient, in the right setting, for the right type of encounter.

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Cost Savings Associated With Decolonization of Postdischarge MRSA Carriers: Results From the CLEAR Randomized Trial

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Background: Greater than 10% of hospitalized MRSA carriers experience serious MRSA infection in the year following discharge. Prevention opportunities have primarily focused on hospital stays; however postdischarge interventions have the potential to reduce morbidity, mortality and healthcare costs. The CLEAR trial found a 30% hazard reduction in postdischarge MRSA infections among patients who had inpatient MRSA cultures and were given postdischarge decolonization (5 days twice-a-month for 6 months) relative to hygiene education alone. We conducted a cost analysis of the CLEAR intervention to quantify the economic implications and understand the value of adopting this MRSA decolonization strategy. **Methods:** We constructed a decision model to estimate the one-year healthcare utilization and costs associated with postdischarge decolonization relative to hygiene education. Trial results for MRSA infection risk and downstream outcomes (including outpatient and emergency room visits, hospitalizations, related nursing home stays, and postdischarge antibiotics) were used to parameterize the model. Other medical care and prescription drug costs were based on Medicare Fee Schedules, Red Book and the literature. Patient out-of-pocket costs and time costs associated with subsequent infections were from a survey of trial participants experiencing infection (n=405). All costs were reported in 2019 US dollars. The analysis was conducted using healthcare system and societal perspectives. Sensitivity analyses were conducted on key parameters. **Results:** Among a hypothetical cohort of 1,000 hospitalized MRSA carriers, we estimated that a postdischarge decolonization intervention versus hygiene education would result in at least 36 fewer subsequent MRSA infections (130 vs 93 of 1,000, respectively) and >40 fewer MRSA-attributable healthcare events including 32 hospitalizations and 6 postdischarge nursing home visits over the course of a year. Assuming an intervention cost of \$185 per individual, the program would result in an overall cost savings of \$469,000 per 1,000 MRSA carriers undergoing decolonization. This translates to an overall savings of \$13,200 per infection averted and \$9,000 per infection averted from the healthcare system perspective. Even assuming a lower infection rate or a less effective intervention (15% reduction in infections vs 30% in the CLEAR trial), or a more expensive (up to \$653 per patient)