15-15 Use of Active Surveillance Cultures

19 "Real-Life" Performance of Real-Time PCR for Detection of Methicillin-Resistant *Staphylococcus aureus* (MRSA) and Vancomycin-Resistant *Enterococcus* (VRE)

Diana Von Stein[1], **Daniel J. Diekema, MD, MS**[1], Kelly Richardson[2], Joann Page[2], Stefan Riedel[1], Sarah Miller[2], Patricia Winokur, MD[2].
[1]University of Iowa, Iowa City, IA, USA, [2]Iowa City Veterans Affairs Medical Center, Iowa City, IA, USA.

Background: Active surveillance cultures (ASCs) may aid MRSA and VRE control efforts, but long turnaround times for standard culture results present a major problem.

Objective: To compare real-time PCR detection of MRSA and VRE with standard culture methods during a study of the impact of rapid MRSA and VRE detection in a Veterans Affairs Medical Center (VAMC).

Methods: From 1/11/06-12/19/06, all VA patients admitted during one week of the each month had nares swabs (for MRSA) and perirectal swabs (for VRE) collected for culture and real-time PCR testing. Point-prevalence surveys of all acute care patients were also performed the 3rd Tuesday of each month. Molecular detection of MRSA was performed using the GenOhm IDI MRSA Extraction and Detection Kit on the Cepheid SmartCycler. Detection of *vanA* and *vanB* was performed on the ABI 7500 FAST Real Time PCR System using a locally developed PCR strategy. Pulsed field gel electrophoresis (PFGE) was performed on all isolates, and analyzed using Bionumerics gel analysis software.

Results: We performed a total of 864 MRSA and 803 VRE screening tests. Using culture detection as the gold standard, the sensitivity/specificity of real-time PCR was 97.7%/98.3% for MRSA and 89.9%/99.7% for VRE detection. The positive predictive value/negative predictive value for PCR was 86.9%/99.7% for MRSA and 96.4%/98.8% for VRE detection. Turnaround time for real-time PCR assays was five hours, compared to 48 and 72 hours for MRSA and VRE culture results, respectively. Of 83 VRE isolates examined, 71 carried *vanA*, 8 *vanB*, and 4 both genes. Compared with culture, the "false +" rate of PCR was 1.7% (13/776) for MRSA and 0.4% (3/714) for VRE. The false negative rate was 2.3% (2/88) for MRSA and 10.1% (9/89) for VRE. Most VRE false negatives clustered in a two month period and correlated with improper reagent storage. PFGE revealed that >90% of MRSA isolates were type USA100, with only one USA300 isolate detected. Over half of VRE isolates belonged to 3 major PFGE types. Among patients testing negative on admission screening who were hospitalized during subsequent monthly prevalence screening, 5/68 (7.4%) acquired MRSA, compared with 20/69 (29%) who acquired VRE (p=0.001).

Conclusions: Successful implementation of real-time PCR for MRSA and VRE detection is possible, with comparable assay performance and significant reduction in time to reporting. Our data suggest that nosocomial acquisition of VRE is more common than MRSA in our VAMC. We now plan to examine the impact of rapid detection compared to traditional culture detection for enhanced control of MRSA and VRE.

	Admission screens		Prevalence screens		Total	
	MRSA	VRE	MRSA	VRE	MRSA	VRE
N performed	423	389	441	414	864	803
N (%) positive	43 (10.2)	21 (5.4)	45 (10.2)	68 (16.4)	88 (10.2)	89 (11.2)

20 Reduction in Methicillin-resistant *Staphylococcus aureus* (MRSA) Infections Through Active Surveillance & Empiric Contact Precautions (ECP) Targeting Admissions From Long Term Care Facilities (LTCF)

Marion A. Kainer, MB, BS, MPH[1], Sherri Hillis[2], Russell J. Smith[2].
[1]Tennessee Department of Health, Nashville, TN, USA, [2]Blount Memorial Hospital, Maryville, TN, USA.

Background: Blount Memorial Hospital (BMH) is a community hospital licensed for 334 beds; bed-occupancy is usually 200. Prevalence of MRSA infection and colonization had increased from 3.2/1,000 patient-days in 2002 to 6.3 in 2003. LTCFs in BMH's catchment area were reluctant to readmit patients hospitalized at BMH from whom MRSA was isolated; most patients had MRSA colonization of sputum. LTCF staff believed that BMH was "giving the resident MRSA at the hospital" and did not distinguish between colonization and infection. BMH staff were concerned about potential MRSA spread to other hospitalized patients, increased length of stay (LOS) and costs resulting from delays in discharge to LTCFs and about the number of calls received from LTCF for MRSA.

Objective: To reduce MRSA transmission and discharge delays.

Methods: On admission, patients from LTCFs were placed in ECP whilst awaiting active surveillance cultures (ASC) for MRSA from the anterior nares. Isolation precautions (gloves and gown, dedicated patient equipment) were discontinued if ASC were negative. Masks were worn if pneumonia was diagnosed. Education and training programs started Nov. 2003; the protocol was implemented in Jan. 2004. No decolonization was performed. LTCF residents were the only target group for ASC. There was a concomitant hand-hygiene campaign. We calculated the incidence of MRSA blood stream infections (MRSA-BSI) and of MRSA infection developing 48 hours after admission (HOMRSAI). In addition, we calculated hospital-wide prevalence rates of MRSA infection and colonization (MRSAIC); ASC MRSA isolates were included. All rates are per 1,000 patient-days. We determined the percentage of nasal isolates of *S. aureus* that were MRSA from ASC among LTCF residents requiring hospitalization (LTCFRRH). This data was provided to LTCF staff.

Results: Nasal MRSA percentages among LTCFRRH ranged from 80% to 91%. HOMRSA decreased 44% from 0.08 to 0.04 in 2006, (p=0.03) (Table 1). Hospital wide prevalence rates of MRSAIC dropped from 6.3 to 5.5 in 2006 (p=NS). MRSA-BSI decreased from 0.08 to 0.02 (p=NS). Mean LOS among hospitalized LTCF residents decreased by 2.2 days. Calls to discuss placement of LTCF residents colonized/infected with MRSA decreased dramatically (from 2-3/week in 2002-4 to 5/year in 2005-6).

Conclusions: ASC for LTCFRRH coupled with ECP resulted in a decrease LOS, and sustained decreases in HOMRSA and MRSA-BSIs. Despite the addition of ASC for LTCFRRH, hospital-wide prevalence of MRSAIC decreased.

Table 1

	2002	**2003**	**2004**	**2005**	**2006**
MRSAIC	183	322	262	260	277
MRSAIC/1,000 patient days	3.2	6.3	5.3	5.2	5.5
HOMRSAI	47	40	21	28	22
HOMRSAI/1,000 patient-days	0.08	0.08	0.04	0.06	0.04
MRSA BSI	5	4	4	1	1
MRSA BSI/1,000 patient-days	0.09	0.08	0.08	0.02	0.02

21 Impact of Routine ICU Surveillance for VRE on Bacteremia

Susan S. Huang, MD, MPH[1], Deborah S. Yokoe, M.D., M.P.H.[1], Virginia L. Hinrichsen, M.P.H., M.S.[2], Laura S. Spurchise, M.P.H.[2], Rupak Datta, B.S.[2], Irina Miroshnik, M.P.H.[2], Richard Platt, M.D., M.S.[2]. [1]Brigham and Women's Hospital, Boston, MA, USA, [2]Harvard Medical School and Harvard Pilgrim Health Care, Boston, MA, USA.

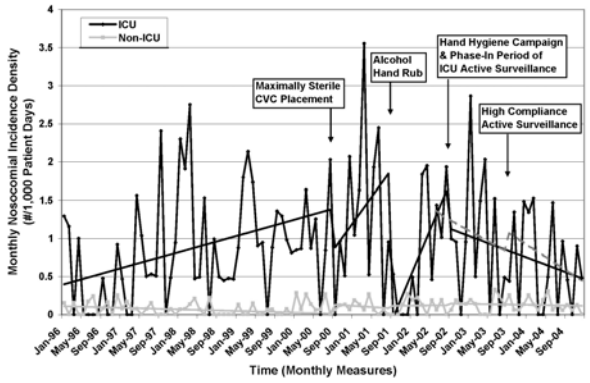
Background: Early identification of VRE carriage via surveillance cultures may reduce transmission of VRE and subsequent bacteremia. This phenomenon has been demonstrated for MRSA.

Objective: To assess the impact of routine screening for VRE on VRE bacteremias in the context of previously implemented infection control measures.

Methods: We evaluated the impact of several infection control interventions on VRE bacteremia using census and microbiologic data from Jan 96-Dec04. The interventions had been added one at a time as part of an ongoing quality improvement program in a 750 bed hospital with 80 beds in 8 ICUs. They included 1) a campaign to enhance sterile technique for central venous catheters (9/00); 2) introduction of alcohol hand rub (9/01); 3) a hand hygiene campaign (7/02) overlapping with a phase-in period (9/02) of screening rectal cultures for VRE on ICU admission and then weekly (compliance 40%); 4) high compliance with screening rectal cultures (compliance 90%) (9/03). All positive screening cultures resulted in contact isolation.
We used interrupted time series to assess intervention effects on monthly incidence density of 1st VRE bacteremias. Since sequelae following colonization can occur after discharge from the ICU, we evaluated both total and nosocomial bacteremias.

Results: Introduction of alcohol hand rub (period 2) was associated with an initial decline in ICU VRE (-2 events/month, p=0.003); this was not sustained. Considered together, the 3rd and 4th intervention periods were associated with a sustained reduction of -0.2 events/month through the end of the study period (black line, Figure 1). Neither of these periods was separately associated with a significant reduction (dashed line, Figure 1). There was no decline in MSSA, a control organism. There was no indirect effect on non-ICU areas. Incidence density was similar when comparing total and nosocomial bacteremias.

Conclusions: VRE bacteremias in the ICU setting declined when the period of a hand hygiene campaign with phase-in of surveillance cultures, and a period of high compliance with surveillance cultures were considered together, but not when either period was considered separately. These results differ somewhat from the simultaneous effects of these same interventions on MRSA; in that case a larger reduction was observed, and was restricted to the period of high compliance with surveillance cultures.



22 Active Surveillance Cultures are NOT Required to Control MRSA Infections in the Critical Care Setting

Michael B. Edmond, MD, MPH, MPA, Janis F. Ober, RN, BSN, CIC, Gonzalo Bearman, MD, MPH.
VCU Medical Center, Richmond, VA, USA.

Background: Active surveillance cultures have been widely touted as necessary to control MRSA in the hospital setting.

Objective: To assess the trends of MRSA infection rates in the ICU setting of an urban, 820-bed academic medical center that does not perform active surveillance cultures.

Methods: Over the 3-year study period, surveillance cultures were not performed but numerous initiatives aimed at broadly decreasing infections were implemented. This included feedback of compliance with infection control process measures to ICU staff, education campaigns on and monitoring of optimal catheter insertion techniques and line maintenance practices. Rates of catheter-associated bloodstream infections (BSI), catheter-associated urinary tract infections (UTI) and ventilator-associated pneumonias (VAP) due to MRSA were determined from concurrent surveillance by trained infection control practitioners utilizing CDC definitions in a 16-bed medical ICU (MICU) and 18-bed surgical ICU (SICU). Cost of MRSA surveillance testing via PCR on nasal swabs was estimated at $25 per test and applied to 2006 census data for both ICUs assuming a strategy of testing all patients on admission and weekly thereafter.

Results:

Number of MRSA infections (infections/10,000 patient days)				
		2004	2005	2006
Medical ICU	BSI	0 (0.0)	4 (7.7)	0 (0.0)
	UTI	0 (0.0)	0 (0.0)	1 (1.9)
	VAP	3 (7.0)	2 (3.8)	0 (0.0)
	TOTAL	3 (7.0)	6 (11.5)	1 (1.9)
Surgical ICU	BSI	9 (17.7)	7 (11.8)	3 (5.0)
	UTI	1 (2.0)	0 (0.0)	2 (3.3)
	VAP	4 (7.9)	4 (6.7)	3 (5.0)
	TOTAL	14 (27.6)	11 (18.5)	8 (13.3)

Over the 3-year period, the rate nosocomial infections from all pathogens decreased 46% in the MICU, 56% in the SICU, and 49% across all ICUs. Cost of performing *S. aureus* testing on admission and weekly in the two ICUs would be $66,075 excluding labor for 2006. If the program is 25%, 50%, or 75% effective, the cost per infection avoided would have been $29,367, $14,683, or $9,789, respectively.

Conclusions: (1) Active surveillance for MRSA in the critical care setting is not required to reduce the incidence of MRSA infections; (2) cost of surveillance cultures per infection avoided would be high in our hospital; (3) hospitals should not pursue active surveillance cultures until basic infection control efforts have been maximized and rates of infection thoroughly examined; and (4) we favor a strategy to focus broadly on reducing all nosocomial infections via compliance with optimal infection control practices rather than a resource intensive strategy of questionable effectiveness.

23 A Voice Crying Out in the Wilderness? Sustained Control of Healthcare-Associated MRSA Infection Without Screening or Organism-Based Isolation

Kathryn B. Kirkland, MD, Judy A. Ptak, MSN, Eileen A. Dugan, BSN, Randall H. Smith, MS. Dartmouth-Hitchcock Medical Center, Lebanon, NH, USA.

Background: Continued calls for aggressive screening for MRSA and contact isolation of all patients found to be colonized or infected have taken on an almost evangelical tone, despite the substantial allocation of resources required, and the rising prevalence of community-acquired (CA) infection with this organism. Our medical center continues to use a universal approach to the prevention of clinical infection due to *Staphylococcus aureus* (SA): hand hygiene and standard precautions for all patients, and syndrome-based expanded precautions (formalized in 2005), which are used for all patients with cough, uncontrolled secretions, or diarrhea, regardless of organism.

Objective: We compared 2006 surveillance data to available data from 2002-2005 to determine the ongoing efficacy of this strategy.

Methods: Infection control practitioners review each positive culture for SA and classify it as colonization, infection, or contaminant. Cases are considered healthcare-associated (HA) if they occur > 48 hours after admission, within 30 d after surgery, in patients who receive chronic dialysis, or in patients who have IV catheters at the time of the positive culture. Primary outcome measures of the efficacy of our strategy are rates per 1000 patient-days of HA clinical infection due to SA infection and HA-SA bloodstream infection (BSI).

Results: Of 1275 cases of SA infection and colonization identified in 2006, 332 (26%) were associated with care at our medical center, 873 were CA, and 70 were associated with care at other facilities. The overall percentage of MRSA cases was 31% (increased from 27% in 2002). The table illustrates changes over time in rates of HA and CA MRSA and MSSA infection, and SA and non-SA HA-BSI infection (all per 1000 inpatient days).

Infection Rates per 1000 Patient Days, 2002-2006

	2002	2003	2005*	2006	% change 2002 to 2006
MRSA CAI	0.4	0.7	0.9	1.4	+250
MRSA HAI	0.9	1.0	1.1	0.9	0
MSSA CAI	2.5	3.5	3.6	3.5	+39
MSSA HAI	1.7	2.1	1.3	1.5	-12
SA BSI	0.8	0.8	0.6	0.5	-40
Non-SA BSI	2.2	2.5	1.5	1.6	-27

*SA surveillance suspended during 2004 due to staffing shortage.

Conclusions: A program of universal hand hygiene and standard precautions with syndrome-(not organism) triggered contact precautions, has been effective at controlling HA-MRSA infections, including BSI, in the setting of a 250% increase in the rate of CA-MRSA infection. Our data demonstrate that sustained control of HA-MRSA can be achieved without knowing the colonization status of every patient, or using contact precautions directed at MRSA. This strategy appears effectively to reduce the incidence of other HAI as well.

24 Identifying Methicillin-Resistant *Staphylococcus aureus* (MRSA) or Vancomycin-Resistant *Enterococcus* (VRE) Carriers in a Veterans Affairs Medical Center (VAMC) Population

Stefan Riedel[1], Diana Von Stein[1], Sarah Miller[2], Joann Page[2], Kelly Richardson[2], Patricia Winokur[2], **Daniel J. Diekema**[1].
[1]University of Iowa, Iowa City, IA, USA, [2]Iowa City Veterans Affairs Medical Center, Iowa City, IA, USA.

Background: More hospitals are using admission screening to control the spread of MRSA and VRE. To reduce screening costs, simple rules are needed to identify patients at high risk for MRSA or VRE carriage. One group has identified hospital admission within 1 year as a simple and sensitive indicator of MRSA or VRE carriage (Furuno, et al. Arch Int Med 2006;166:580-85). This rule requires validation in a VAMC population.

Objective: To evaluate the prevalence of, and risk factors for, VRE and MRSA colonization, and to validate a prediction rule for MRSA or VRE colonization in a VAMC population.

Methods: From 2/1/06-12/31/06, all patients admitted during one week each month had nares swabs (for MRSA) and perirectal swabs (for VRE) obtained for culture and real-time PCR testing. Molecular detection of MRSA was performed using the GenOhm IDI MRSA (Becton Dickinson). Detection of *vanA* and *vanB* was performed using a locally developed PCR strategy, and MRSA and VRE cultures were performed using standard methods. We collected data on potential risk factors for MRSA or VRE, including age, underlying illness, admitting diagnosis, admission source, and history of antimicrobial use, device use, hospital admission, or surgical procedure in the prior year. Multivariate logistic regression was used to examine independent associations with MRSA, VRE, and either MRSA or VRE carriage. Sensitivity, specificity and 95% confidence intervals (CIs) were calculated to assess the ability of single variables to identify patients colonized with MRSA or VRE on hospital admission. All analyses were performed using Stata 9.2 (College Station, TX).

Results: We performed admission screens on 422 subjects, 54 (13%) of whom tested positive for MRSA or VRE (43 (10.2%) were MRSA +, 17 (4%) were VRE +, and 6 (1.4%) carried both MRSA and VRE). Although history of antimicrobial use, device use, or hospital admission in the prior year were associated with MRSA or VRE colonization on univariate analyses, the multivariate model revealed device use in the prior year as the only variable significantly associated with MRSA or VRE carriage. As a predictor of MRSA or VRE carriage, history of hospital admission in the prior year was the most sensitive single variable: sensitivity of 67% (95% CI, 52-79%), specificity of 51% (46-56%); negative and positive predictive values of 91% and 17%, respectively. Use of this predictor would have required screening 217 (51%) of 422 admissions, and would have missed 18 of the 54 patients who carried MRSA or VRE.

Conclusions: Hospital admission within one year was the most sensitive single predictor of VRE or MRSA carriage, but still missed one-third of carriers and required screening over half of admitted patients. More complex prediction rules, or universal screening, may be required to detect a greater proportion of MRSA or VRE carriers in our VAMC population.