

CONTROL OF VANCOMYCIN-RESISTANT ENTEROCOCCI AT A COMMUNITY HOSPITAL: EFFICACY OF PATIENT AND STAFF COHORTING

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ABSTRACT

OBJECTIVE: To evaluate the efficacy of patient and staff cohorting to control vancomycin-resistant enterococci (VRE) at an Indianapolis community hospital.

DESIGN: To interrupt transmission of VRE, a VRE point-prevalence survey of hospital inpatients was conducted, and VRE-infected or -colonized patients were cohorted on a single ward with dedicated nursing staff and patient-care equipment. To assess the impact of the intervention, staff compliance with contact isolation procedures was observed, and the VRE point-prevalence survey was repeated 2 months after the cohort ward was established.

RESULTS: Following the establishment of the cohort ward, VRE prevalence among all hospitalized inpatients decreased from 8.1% to 4.7% (25 positive cultures among 310 patients compared to 13 positive cultures among 276 patients, $P=.14$); VRE

prevalence among patients whose VRE status was unknown before cultures were obtained decreased from 5.9% to 0.8% (18 positive cultures among 303 patients compared to 2 positive cultures among 262 patients, $P=.002$); and observed staff-patient interactions compliant with published isolation recommendations increased (5 [22%] of 23 interactions compared to 36 [88%] of 41 interactions, $P<.0001$).

CONCLUSIONS: Our data suggest that, in hospitals with endemic VRE or continued VRE transmission despite implementation of contact isolation measures, establishing a VRE cohort ward may be a practical and effective method to improve compliance with infection control measures and thereby to control epidemic or endemic VRE transmission (*Infect Control Hosp Epidemiol* 1999;20:106-109).

Vancomycin-resistant enterococci (VRE) have emerged as a major cause of hospital-acquired infections. Between 1989 and 1996, the percentage of nosocomial enterococcal infections caused by strains resistant to vancomycin reported to the National Nosocomial Infections Surveillance System increased from 0.3% to 15% (unpublished data, Centers for Disease Control and Prevention [CDC], 1997).¹ Over the past several years, there have been numerous reports of VRE outbreaks in acute-care facilities.²⁻⁶ At the same time, data from state health departments have shown that the prevalence of VRE is increasing rapidly in hospitals.⁷ This increase poses important problems because of the lack of available effective antimicrobial therapy for these infections and the possibility of transfer of vancomycin-resistance genes to other gram-positive microorganisms, such as *Staphylococcus aureus*.⁸

From March through December 1995, the infection control department of Community Hospital East (CHE), a

375-bed, 21-ward community hospital in Indianapolis, Indiana, reported more than 75 patients infected or colonized with VRE. When patients continued to acquire VRE despite attempted implementation of Hospital Infection Control Practices Advisory Committee (HICPAC) recommendations,⁹ the CDC was invited to assist in an epidemiological investigation and an implementation of further control efforts.

METHODS

Case Definition and Ascertainment

A case-patient was defined as any CHE patient with an enterococcal isolate from any body site with a minimum inhibitory concentration to vancomycin ≥ 32 $\mu\text{g}/\text{mL}$ (VRE) from March 7, 1995, to February 7, 1996 (the study period). Case-patients were identified by review of CHE laboratory, medical, billing, and pharmacy records. Demographic and clinical information including age, gender, site of culture,

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and clinical outcome was collected for each case-patient. Standard CDC definitions were used to differentiate infection from colonization.¹⁰

Microbiology

At CHE, specimens were inoculated onto a colistin-nalidixic acid plate (Becton Dickinson Microbiology Systems, Cockeysville, MD). Isolates from this plate were identified as enterococci by pyrrolidonyl aryl amidase and catalase tests. Species identification was done by Vitek gram-positive identification (GPI) card (version R09.1; BioMérieux-Vitek, St Louis, MO). Antimicrobial susceptibility was determined using an automated susceptibility panel (Vitek), and vancomycin resistance was confirmed with a vancomycin screening plate (6 µg/mL in brain-heart infusion agar; Remel, Lanexa, KS).

Point-Prevalence Surveys

To identify patients with VRE colonization, we conducted point-prevalence surveys on February 19 and April 8, 1996. For each survey, efforts were made to collect stool for culture from each CHE inpatient. If a stool specimen was not obtained within 3 days of the survey date, a rectal swab culture was performed.

Cohort Ward Intervention

Beginning on February 20, 1996, all VRE-infected or -colonized patients were placed in contact isolation and cohorted on a single hospital ward with dedicated nursing staff and patient-care equipment. Patients requiring many different levels of care, from intensive care to rehabilitation, were placed on the same unit. It therefore was necessary to plan for access to specialized monitoring equipment and specialized nursing care. Administratively, establishing this cohort ward required special Health Care Financing Administration approval to arrange reimbursement for long-term-care patients who were placed in acute-care beds on the cohort ward. After the cohort ward was established, all patients previously hospitalized at CHE or any other healthcare facility, including any long-term-care facility, were screened for VRE by perirectal swab or stool culture within 24 hours of admission to CHE. Patients found to be VRE-infected or -colonized were admitted to the cohort ward. Cultures for VRE were obtained from all roommates of patients found to be VRE-colonized by screening.

Observational Studies

Compliance with contact isolation procedures for patients infected and colonized with VRE was observed unobtrusively before and after establishment of the cohort ward. For 30-minute periods, each contact isolation room was observed, and the occupation, duties, and patient or environmental contacts of each person entering the room were recorded. We noted whether each patient's room had a contact isolation sign, whether gowns and gloves were readily accessible outside the room, whether each person washed his or her hands before and after the visit, and whether gowns and gloves were worn appropriately in sit-

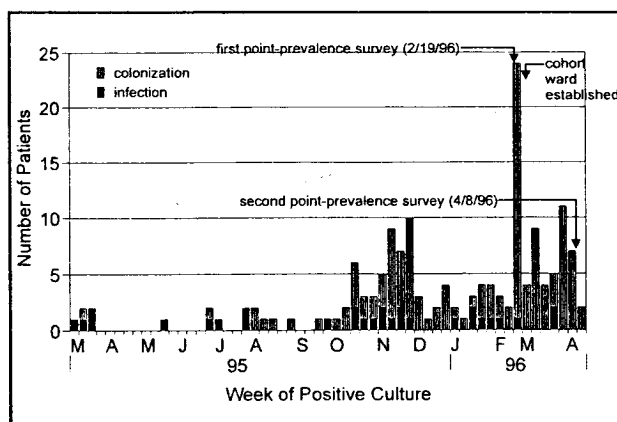


FIGURE. Distribution of case-patients, Community Hospital East, Indianapolis, Indiana, March 7, 1995, to April 15, 1996.

uations requiring their use.

Statistical Analysis

Data were entered and analyzed using Epi Info software (CDC, Atlanta, GA). Categorical variables were compared by using a chi-square or Fisher's Exact two-tailed test. Continuous variables were compared by the Kruskal-Wallis rank sum test, and probability values were determined.

RESULTS

During the study period (March 7, 1995-February 7, 1996), 93 patients met the case definition; 26 (28%) had VRE infections, and 67 (72%) were VRE-colonized (Figure). The age range of case-patients was 21 to 99 (median, 74) years. Fifty-four case-patients (58%) were female. Of those patients who were clinically infected, the sites of infection included the following: bloodstream, 8 (31%); urinary tract, 12 (46%); wound, 4 (15%); and other, 2 (8%). In contrast, the sites of positive culture for colonized case-patients included the following: urinary tract, 21 (31%); wound, 6 (9%); stool or rectal swab, 39 (58%); and other, 1 (1%). Eleven (12%) of 93 case-patients died; however, no death was attributed to VRE infection. There were no significant differences between infected or colonized case-patients with regard to age or gender. However, 7 (27%) of 26 infected case-patients died during the hospitalization, compared to 4 (6%) of 67 colonized case-patients (relative risk [RR], 4.51; 95% confidence interval [CI₉₅], 1.44-14.13; $P=.01$).

Microbiology

Case-patient isolate identification at CHE was as follows: *Enterococcus faecium*, 35 (38%); *Enterococcus durans*, 32 (34%); *Enterococcus faecalis*, 5 (5%); *Enterococcus casseliflavus*, 2 (2%); *Enterococcus gallinarum*, 1 (1%); or *Enterococcus avium*, 1 (1%); 17 isolates (18%) were not identified to the species level. However, 29 (91%) of 32 isolates identified as *E. durans* were identified to the species level at CHE after the introduction of an automated identification system software update (Vitek GPI, version R09.1) for the

identification of gram-positive organisms. Upon reevaluation at the University of Iowa, 7 isolates reported as *E. durans* were found to be *E. faecium*. It is likely that all isolates identified as *E. durans* by the automated identification system actually were *E. faecium*.¹¹

Observational Study

During February 2-3, 1996, 11 30-minute observation sessions of VRE contact isolation procedures were conducted. Eight different patient rooms and 23 separate staff-patient interactions were observed. Seven of the eight rooms had a sign indicating that the patient was in contact isolation, seven had gloves readily available outside the room, and seven had gowns readily available. Only 5 (22%) of 23 interactions were compliant with contact isolation technique. The most common breaks in contact isolation technique included failure to use gloves properly during patient contact, failure to dispose of gown and gloves properly before leaving the patient room, and failure to wash hands after patient contact. During March 1 to April 1, 1996, 21 observation sessions of VRE contact isolation procedures were conducted on the cohort ward. Forty-one separate staff-patient interactions were observed. All rooms had contact isolation signs and readily accessible gowns and gloves. In this second observational study, 36 (88%) of the 41 interactions were compliant with contact isolation technique, compared to 5 (22%) of the 23 interactions in the first observational study ($P < .0001$).

Point-Prevalence Surveys

Screening cultures for VRE were obtained from all CHE inpatients on February 19, 1996, and again on April 8, 1996, approximately 7 weeks after the cohort ward was established. At the time of the first prevalence survey, 7 patients were in contact isolation for VRE on different wards. At the time of the second prevalence survey, 11 patients were in contact isolation for VRE on the cohort ward. In the first prevalence survey, 25 (8.1%) of 310 hospitalized patients had a positive culture for VRE, compared to 13 (4.7%) of 276 hospitalized patients in the second prevalence survey ($P = .14$). Moreover, on the first prevalence survey, 18 (5.9%) of 303 patients with unknown VRE status had a positive culture for VRE, compared to 2 (0.8%) of 262 patients with unknown VRE status on the second prevalence survey ($P = .002$).

VRE Infections

During the 2-month period after the establishment of the cohort ward (February 20-April 15, 1996; 2,337 hospital admissions), only two VRE infections occurred, whereas in the 2 months before the establishment of the cohort ward (December 26, 1995-February 19, 1996; 2,482 hospital admissions), seven VRE infections occurred. The infection rate before the cohort ward intervention was 0.28 per 100 admissions, compared to 0.09 per 100 admissions during the cohort ward intervention (RR, 3.30; CI₉₅, 0.69-15.85; $P = .2$).

DISCUSSION

At CHE, an outbreak involving 93 patients infected or colonized with VRE occurred from March 1995 to February 1996. Between November 1995 and January 1996, before our investigation and study, in addition to the HICPAC recommendations, the following interventions were implemented: bland soap was replaced with antimicrobial soap, gloves were recommended for all patient contact on wards where cases had been identified, all shared equipment was disinfected, routine hand washing before any patient-care activity was stressed, and surveillance fecal cultures for VRE were obtained from a total of 83 patients on nine different hospital wards. Before the cohort ward was established on February 20, 1996, implementation of HICPAC recommendations for contact isolation was insufficiently rigorous. Following establishment of the cohort ward, compliance with isolation recommendations significantly improved, VRE prevalence among hospitalized patients decreased, and fewer VRE infections occurred. The overall improvement in control of the VRE outbreak likely was related to a number of factors associated with the cohort ward intervention, including improved surveillance for VRE colonization, isolation of a larger proportion of VRE patients, and better compliance with isolation procedures.

A number of administrative obstacles regarding reimbursement and staffing issues were encountered when the cohort ward for VRE was established at CHE. A limitation of our study was the termination of the cohort unit, for administrative reasons, after 10 weeks. It is unclear whether a cohort unit could be maintained effectively for a longer period of time or in larger hospitals. Unfortunately, it was not possible to conduct a prevalence survey to determine explicitly the contribution made by cohorting itself.

In 1988, *E. faecium* resistant to penicillins and vancomycin was first reported in the United States.¹² Subsequently, enterococci with high-level resistance to aminoglycosides, penicillins, and glycopeptides were reported.¹³ Preventing the spread of multidrug-resistant pathogens for which no proven antimicrobial therapy is available should be a high priority in all hospitals. Recently, numerous reports of VRE outbreaks in acute- and long-term-care facilities, increasing VRE prevalence in health-care facilities, and establishment of VRE endemicity in some healthcare facilities all emphasize the need for effective VRE control measures.

The CDC recommends that hospitals develop a comprehensive plan to prevent and control infection and colonization of patients with VRE.⁹ This plan should include prudent use of antimicrobials, including vancomycin, and initiation of isolation precautions to prevent patient-to-patient transmission of VRE. At the time of our investigation and cohort ward intervention, CHE did not have any policy in place to restrict the use of any antimicrobial agents. Although one report suggests that antimicrobial controls alone can affect VRE prevalence,¹⁴ most reports suggest that, even with strict antimicrobial (eg, vancomycin) restriction, infection control practices are more

important and harder to implement to reduce the risk of VRE transmission.^{2,3} Our data suggest that, in hospitals with endemic VRE or continued VRE transmission despite implementation of contact isolation measures, establishing a VRE cohort ward enhances uniform compliance with recommendations and may be an effective method to control epidemic or endemic VRE transmission.

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Intradermal Hepatitis B Vaccination in Hemodialysis Patients

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Since 1960, hepatitis B virus-associated chronic liver disease has been considered an important problem in dialysis patients in both Europe and North America. Separate dialysis facilities for hepatitis B-infected patients, the implementation of Universal Precautions for the prevention of transmission, and active immunization against hepatitis B have reduced the yearly incidence to less than 0.05% in Western countries. However, only 50% to 60% of patients with renal insufficiency develop an adequate immune response after

intramuscular hepatitis B vaccination. Propst and coinvestigators from Innsbruck University, Austria, conducted a study to determine whether the route of vaccination plays a role in vaccination response and whether increasing the vaccine dose of primary intradermal hepatitis B vaccination can reduce the number of vaccine injections in hemodialysis patients. They designed a prospective randomized study of antibody responses to hepatitis B vaccine given intradermally, subcutaneously, or intramuscularly in 81 hemodialysis patients. Outcome measures were rates of seroconversion, mean levels of hepatitis B surface antigen (anti-HBs), and antibody levels 8 years after vaccination.

The results showed that the response to intradermal hepatitis B vaccination with a higher vaccination dose than previously used in hemodialysis patients is superior to conventional intramuscular and subcutaneous vaccination and also is tolerated well. Five intradermal injections of 20 µg each induced the development of an adequate anti-HBs antibody titer, which persisted in 70% of the patients over 3 years.

FROM: Propst T, Propst A, Lhotta K, Vogel W, Konig P. Reinforced intradermal hepatitis B vaccination in hemodialysis patients is superior in antibody response to intramuscular or subcutaneous vaccination. *Am J Kidney Dis* 1998;32:1041-1045.