Screening and electronic labelling of ward contacts of vancomycin–resistant *Enterococcus faecium vanB* carriers during a single-strain hospital outbreak and after discharge from hospital

John W Pearman,[1] Peta L Perry,[2] Frank P Kosaras,[3] Charles R Douglas,[4] Rosie C Lee,[5] Allison Peterson,[6] C Terri Orrell,[5] Claire H Khinsoe,[2] Christopher H Heath,[7] Keryn J Christiansen[8]

Abstract

A large single-strain outbreak of vancomycin–resistant *Enterococcus faecium* (VREF) *vanB* occurred in Royal Perth Hospital from July to December 2001. When a VREF–carrying patient was discovered on a ward, all patients on the ward were screened with rectal swabs. A total of 172 patients were colonised, four with infections, but no deaths were attributable to VREF. The number of rectal swabs required to detect each carrier was recorded. On average four rectal swabs, each collected on separate days, were needed to detect more than 90 per cent of the 172 VREF carriers who were epidemiologically linked to the Royal Perth Hospital outbreak. An electronic alert system (Micro-Alert) was used to identify ward contacts of VREF carriers and enabled those who had not been screened before discharge to be followed-up and screened. Ninety-six contacts were actively followed-up in October 2001 and 32 (33.3%) were found to be VREF carriers. From 28 September 2001 to 30 April 2002, a total of 1,977 ward contacts were screened after discharge from hospital and 54 (2.73%) were found to be carrying VREF. We conclude that during single-strain outbreaks of vancomycin-resistant enterococci in hospitals, patient contacts need to be screened on more than three occasions in order to detect most of the carriers and control the outbreak. Secondly, electronic labelling and active follow-up of patients with VREF resulted in a significant number of carriers being detected who otherwise posed a risk of initiating further outbreaks in hospitals if they were readmitted. *Commun Dis Intell* 2003;27 Suppl:S97–S102.

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Introduction

The control of spread of vancomycin-resistant enterococci (VRE) in hospitals depends largely on the prompt detection of asymptomatic carriers which, in turn, depends on two factors; the collection of a sufficient number of specimens from exposed individuals and the laboratory's ability to promptly and accurately detect VRE. The sensitivity of a single rectal swab is low, being only 79 per cent in one recent study[1] and 58 per cent in another.[2] Since the diagnostic accuracy of one rectal swab is poor, the Division of Public Health, Georgia, United States of America, has recommended that three negative rectal swabs are needed before isolation precautions are discontinued.[3]

1. Head, Department of Microbiology and Infectious Diseases, Royal Perth Hospital, Perth, Western Australia
2. Senior Medical Scientist, Department of Microbiology and Infectious Diseases, Royal Perth Hospital, Perth, Western Australia
3. Senior Medical Scientist in charge, Department of Microbiology and Infectious Diseases, Royal Perth Hospital, Perth, Western Australia
4. Director, Eastern Perth Public and Community Health Unit, Perth, Western Australia
5. Clinical Nurse Specialist, Infection Control, Royal Perth Hospital, Perth, Western Australia
6. Clinical Nurse, Infection Control, Royal Perth Hospital, Perth, Western Australia
7. Infectious Diseases Physician and Clinical Microbiologist, Department of Microbiology and Infectious Diseases, Royal Perth Hospital, Perth, Western Australia
8. Clinical Microbiologist, Department of Microbiology and Infectious Diseases, Royal Perth Hospital, Perth, Western Australia

Corresponding author: Professor John W Pearman, Head, Department of Microbiology and Infectious Diseases, Royal Perth Hospital, Perth WA 6000. Telephone: +61 8 9224 2442. Facsimile: +61 8 9224 1989. Email: john.pearman@health.wa.gov.au

On 18 July 2001, a 58-year-old male was admitted to Royal Perth Hospital (RPH) Intensive Care Unit (ICU) with pneumococcal pneumonia. The man had been receiving haemodialysis in the RPH In-centre Dialysis Unit (IDU) three times a week during the previous six weeks. A central venous catheter was inserted on 18 July 2001 and he was given benzylpenicillin intravenously. Five days later he developed bacteraemia and blood cultures collected on 23 July 2001 yielded vancomycin–resistant *Enterococcus faecium* (VREF) *vanB* which was susceptible to teicoplanin. He was treated with teicoplanin 400 mg intravenously after each haemodialysis from 28 July 2001 to 20 August 2001 and survived.

The index patient was a resident of a hostel for people from country areas receiving specialised medical treatment in Perth. Twenty-five residents of the hostel who attended Perth hospitals from 28 July 2001 to 31 December 2001 were screened and 10 of them were found to be carrying the outbreak strain of VREF. All 10 carriers were being dialyzed; nine at RPH and one at another hospital.

Screening of 589 patients on the ICU, IDU, Nephrology ward and Satellite Dialysis Unit (SDU) on multiple occasions from 28 July 2001 to 31 December 2001 detected a total of nine VREF carriers on the ICU, four carriers attending the IDU, 13 carriers on the Nephrology ward and four carriers attending the SDU. Swabbing of these areas demonstrated environmental contamination with VREF on the ICU and Nephrology ward.

Patients carrying VREF were strictly isolated and ward contacts were segregated, cohorted and screened. Wards where carriers were detected were closed and thoroughly cleaned and disinfected in two steps with an anionic detergent followed by a phenolic disinfectant. The wards were then swabbed and not reopened until all environmental swabs were negative for VREF. Despite these measures, transmission of VREF between patients within the RPH continued for five months. Twenty-three wards or units in the hospital and one outpatient unit (SDU) were involved.

As previous studies[1,2] had reported the low sensitivity of a single rectal swab for detecting the carriage of VRE, patients who had been on wards where VREF carriers had been detected (ward contacts) were screened on multiple occasions during their in-patient stay. Screening of patients while they were in RPH detected a total of 118 carriers. The last hospital-acquired colonisation by the outbreak strain of VREF of an in-patient in RPH was detected on 28 December 2001.

It was of concern that many ward contacts of VREF carriers had been discharged from hospital before they had been screened on at least four occasions and it was decided to screen as many discharged ward contacts as possible by collecting at least four rectal swabs on separate days from each of them. Screening of ward contacts after they had been discharged from hospital detected a further 54 carriers, making a total of 172 patients who were colonised.

As a result of the outbreak, four patients were clinically infected with VREF; bacteraemia associated with an intravenous catheter, urinary tract infection associated with an indwelling urethral catheter, peritonitis associated with continuous ambulatory peritoneal dialysis and deep wound infection and subphrenic abscesses following abdominal surgery. No deaths were attributable to VREF but 53 patients have died from causes unrelated to VREF, indicating that many of those who became carriers were suffering from terminal illnesses. Pulsed–field gel electrophoresis of all the isolates and plasmid analysis of 13 isolates demonstrated a single-strain outbreak.

Methods

Screening specimen

The screening specimen used was the rectal swab, which was obtained by dipping a cotton wool tipped swab into sterile water and then gently inserting the swab into the rectum. When the first swab was negative for VREF, further swabs were collected on separate days until at least four negative swabs were obtained. Some patients whose first four swabs were negative had further swabs collected and some of the later swabs were positive. (Table 1).

Table 1. Sensitivity of single and multiple rectal swabs for detecting vancomycin–resistant *Enterococcus faecium* carriers

	Number of carriers						
Number of rectal swabs	1	2	3	4	5	6	7 or more
VREF carriers detected for first time	96	31	17	15	4	2	7
Cumulative number of carriers detected	96	127	144	159	163	165	172
Cumulative percentage of carriers detected (sensitivity)	56	74	84	92	95	96	100

VREF vancomycin–resistant *Enterococcus faecium*.

Contact

A contact was defined as a patient who had been on the same ward as a known carrier of VREF.

Negative contact

A negative contact was defined as a contact who had subsequently had at least four negative rectal swabs collected on separate days.

Laboratory methods

Rectal swabs were first inoculated directly onto CHROMagar®, Orientation medium[4,5] (CHROMagar, Paris, France) containing added vancomycin 6 mg/L and gentamicin 8 mg/L and then placed in Enterococcosel™ broth (BBL Products, Becton Dickinson Microbiology Systems, Maryland, USA) containing added vancomycin 8 mg/L. CHROMagar®, was incubated in air at 35 ± 1ºC for 36 hours (first examined at 24 hours). Enterococcosel™ broth was incubated in air at 35 ± 1ºC for a minimum of 24 hours. Blue colonies resembling enterococci on CHROMagar®, were assayed for *vanA* and *vanB* genes by polymerase chain reaction (PCR). Brown/black Enterococcosel™ broths were subcultured onto CHROMagar®, not containing added antibiotics and incubated in air at 35 ± 1ºC for 24 hours. Blue colonies resembling enterococci on CHROMagar®, were screened for vancomycin resistance using brain heart infusion agar (BHIA)(CM375, Oxoid Ltd, Basingstoke, England) containing added vancomycin 6 mg/L and BHIA containing added vancomycin 16 mg/L. Both BHIA plates were incubated in air at 35 ± 1ºC for 48 hours (first examined at 24 hours). If there was growth on the BHIA vancomycin screening plates, the colonies were Gram-stained and Gram-positive coccal colonies were tested for pyrrolidonyl-ß-naphthylamide production and were assayed for *vanA* and *vanB* genes by PCR. Isolates which were likely to be VRE were identified using motility and standard biochemical tests. Antimicrobial susceptibility tests for ampicillin, gentamicin and vancomycin were performed by disk diffusion according to the National Committee on Clinical Laboratory Standards guidelines.[6] Minimum inhibitory concentrations of vancomycin and teicoplanin for each VRE isolate were determined by Etest®, (AB Biodisk, Sola, Sweden).

Electronic alert system

All public hospitals in the Perth metropolitan area use the same medical record numbering system. Each patient attending a public hospital in Perth is given a unique medical record number which applies in all other Perth public hospitals. The system has several alerts, including Micro-Alert which identifies known carriers of antibiotic-resistant organisms, including methicillin–resistant *Staphylococcus aureus* (MRSA). Micro-Alert was established in 1981 and VRE was included from 1996.

Screening of VREF contacts after discharge from hospital

On 28 September 2001 a new category of Micro-Alert (Micro-Alert 'F') was introduced to identify patients who had been ward contacts of patients found to be VREF carriers and who therefore required four negative swabs to be cleared. These patients were labelled Micro-Alert 'F' and during the outbreak 4,155 contacts were discharged from hospital before they had been swabbed four times.

A program to actively follow-up discharged ward contacts of VREF carriers was undertaken. The aim was to screen as many discharged ward contacts as possible by collecting at least four rectal swabs on separate days from each of them. The swabs were collected in one or more of the following places; the RPH outpatient clinics, on readmission to RPH or on admission to other hospitals. In addition, swabs were collected at the VRE Screening Clinic as described below.

A database was set up which provided demographic details of all VREF carriers and contacts, their admission history by ward and speciality and the number and results of rectal screening swabs collected. From this database all patients from specialities considered high-risk or who had been in high risk wards were identified. The high-risk units were the Nephrology ward and Dialysis Units, Haematology ward and Bone Marrow Transplant Unit and the Intensive Care Unit. In addition, from the database which records the information about all admissions to public hospitals in the Perth metropolitan area, all VREF contacts were stratified according to the number of times they had been admitted to hospital in the previous 12 months. Combining these two lists, patients from high-risk specialities who were frequent attenders were given the highest priority, whilst those who had been admitted to low-risk specialities only once or twice were considered to be very low-risk. A VRE Screening Clinic (VSC) was set up to screen patients on an outpatient basis, to complement the other screening programs which included the screening of inpatients and those attending the pre-admission clinics for routine procedures. Patients were grouped according to priority, and between the months October 2001 to March 2002 letters were sent to patients, starting with the highest priority group. The letters provided them with information about VREF, informed them that they had been in contact with a carrier and offered them four appointments to be screened and, if all swabs were negative, cleared of their 'contact' status. The hospital's voluntary transport scheme was made available for patients who were unable to get to the hospital by themselves. The clinic operated on Monday to Friday from 22 October 2001 to 19 April 2002. In February 2002, those patients on Category 1 and 2 surgical wait lists were included in the program. (The urgency categories for elective admission were: Category 1, within 30 days; Category 2, within 90 days; Category 3, beyond 90 days.) Over the period 22 October 2001 to 19 April 2002, a total of 4,561 appointments were made and 3,241 appointments were kept (response rate 71.06%).

Results

Screening for VRE carriage with rectal swabs

The number of negative rectal swabs collected from each of the 172 VREF carriers before the first positive rectal swab was used to estimate the sensitivity of single and multiple rectal swabs for detecting the gastrointestinal carriage of VREF (Table 1).

Screening of ward contacts after discharge from hospital

From 28 September 2001 to 30 April 2002, 1,977 discharged ward contacts of VREF carriers were screened. The number of negative contacts and the number of contacts found to be carrying VREF each month are listed in Table 2.

Table 2. Vancomycin-resistant *Enterococcus faecium* vanB carriers detected by screening after discharge from hospital

Period	Total number of ward contacts VREF carriers screened afterdischarge or on subsequent presentations to RPH or other hospitals	Number of negative contacts	Number of VREF carriers detected	VREF acquisition rate (%)
2001				
28 Sep –31 Oct	96	64	32	33.3
November	349	340	9	2.6
December	351	345	6	1.7
2002				
January	403	402	1	0.25
February	331	330	1	0.3
March	290	288	2	0.7
April	157	154	3	1.9
Total	**1,977**	**1,923**	**54**	**2.73**

RPH Royal Perth Hospital.
VREF vancomycin–resistant *Enterococcus faecium*.

Discussion

Screening for VRE carriage with rectal swabs

In small outbreaks of VRE, three consecutive negative rectal swabs may be sufficient to discontinue isolation, as recommended by the Division of Public Health, Georgia, USA.[3] However, in larger or prolonged outbreaks, ward contacts of VRE carriers need to have rectal screening swabs collected on more than three separate days before they can be considered not to have acquired VRE.

Screening of ward contacts after discharge from hospital

During previous single-strain MRSA outbreaks in the RPH, a special category of Micro-Alert was used to identify unscreened discharged ward contacts. The alert facilitated their recognition on subsequent presentations to RPH or other hospitals and assisted in successful termination of MRSA outbreaks in the RPH.[7] This technique has now been used for identifying unscreened, discharged, ward contacts during a single-strain hospital outbreak of VREF.

Of the 96 contacts screened at the height of the outbreak (28 September to 31 October 2001), 32 (33.3%) were found to be carrying VREF. In the following months the yields were progressively lower. In the first four months of 2002, 1,181 contacts were screened, resulting in the detection of seven carriers (0.6%) (Table 2). Since the yield declined over time, the VRE Screening Clinic was closed on 19 April 2002 and the Micro-Alert 'F' label will be removed from contacts who have not been screened within 12 months of being labelled.

The post-hospitalisation screening program detected a significant number of carriers who would otherwise have posed a risk to other patients on subsequent admission to hospital, however, the declining yield over time as lower risk patients were being screened allowed the program to be wound down. Active screening of ward contacts after discharge was shown to be a valuable strategy that contributed to the control of this outbreak.

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