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Short report

First outbreak of linezolid-resistant vancomycin-resistant *Enterococcus faecium* in an Irish hospital, February to September 2014

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SUMMARY

An outbreak of linezolid-resistant vancomycin-resistant *Enterococcus faecium* (LRVRE*fm*) occurred in the hepatology ward of a tertiary referral hospital in Ireland between February and September 2014. LRVRE*fm* was isolated from 15 patients; pulsed-field gel electrophoresis confirmed spread of a single clone. This is the first report of an outbreak of linezolid-resistant vancomycin-resistant enterococcus in Ireland.

Introduction

Linezolid is a first-line treatment for vancomycin-resistant enterococci (VRE) infections. Linezolid resistance in enterococci was first reported in patients who had received the drug during its compassionate use programme.[1] Further cases were reported following its introduction into routine clinical use — initially in patients who had been treated with linezolid, and subsequently following nosocomial transmission to linezolid-naive patients.[2,3] The development of resistance to linezolid in VRE limits treatment options. Fortunately, linezolid resistance in enterococci remains low, with rates of less than 1% reported.[4] Two single cases of linezolid-resistant VRE (one each of *Enterococcus faecalis* and *Enterococcus faecium*) have been reported in Ireland.[5,6] We describe the first outbreak of linezolid-resistant vancomycin-resistant *Enterococcus faecium* (LRVRE*fm*) in Ireland.

Methods

Clinical setting

The outbreak occurred on the hepatology unit of a 480-bedded major academic teaching hospital, home to the Irish

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national liver transplant unit. The hepatology unit is divided into high dependency unit (HDU) and ward sections. The HDU section has one four-bedded room, two two-bedded rooms, and two single rooms, none of which is *en suite*; the ward section has two five-bedded rooms each with an attached toilet and one en-suite single room.

At the time of the outbreak, routine active VRE surveillance was performed in those hospital units with endemic VRE: intensive care unit (ICU), hepatology, general surgery, and haematology/oncology. All patients admitted to these units had rectal screening on admission and weekly thereafter. Colonized patients were isolated with contact precautions in single or cohort rooms.

Twice daily environmental cleaning of the unit with hypochlorite was performed by trained staff. Isolation and cohort rooms were decontaminated using hydrogen peroxide vapour following discharge of patients, whenever possible.

Definitions

Patients were considered to be cases if LRVRE*fm* was isolated from clinical or screening specimens (Table I).

Patients were defined as LRVRE*fm*-exposed if they had been inpatients on the hepatology unit at any time from identification of the first case of LRVRE*fm* (day 1) until full implementation of enhanced control measures (day 70), and were not known to be colonized with LRVRE*fm*.

Non-exposed patients were those patients admitted to the unit after full implementation of the enhanced control measures, who had not previously been inpatients on the unit since the beginning of the outbreak.

Microbiology

Rectal swabs were tested using ChromID VRE (bioMérieux, Marcy l'Étoile, France). Full identification and susceptibility testing, according to European Committee on Antimicrobial Susceptibility Testing (EUCAST) guidelines, were carried out all on all isolates of VRE from clinical specimens using matrix-assisted laser desorption ionization time-of-flight (bioMérieux) and Vitek 2 (bioMérieux). Prior to the outbreak, full identification and susceptibility testing had been performed only on first isolates of VRE from screening specimens, with subsequent positive screens reported as VRE without further work-up. After the outbreak had been identified, linezolid disc susceptibility testing was performed on all isolates of VRE from screening specimens.

Environmental samples were taken from rooms of LRVRE*fm* cases prior to deep cleaning. Flocked swabs were used to sample 10 high touch areas. These were directly inoculated into nutrient broth and incubated at 37°C overnight. Samples were then plated on to ChromID VRE and suspected colonies were processed as above.

Identification of the molecular basis of linezolid resistance and pulsed-field gel electrophoresis to confirm the relatedness of isolates were performed by the German National Reference Centre for Staphylococci and Enterococci.[7]

Table I
LRVRE*fm* cases showing prior VRE status, linezolid exposure, and site of first isolate

Case	Previous VRE	Previous linezolid exposure (days)	Site of first isolate of LRVRE*fm*
1	No	0	Rectal
2	Yes	6	Rectal
3	Yes	0	Rectal
4	Yes	23	Bile
5	No	0	Rectal
6	No	0	Rectal
7	No	0	Rectal
8	Yes	0	Rectal
9	No	0	Rectal
10	Yes	5	Rectal
11	Yes	16	Rectal
12	Yes	6	Rectal
13	No	0	Rectal
14	Yes	7	Rectal
15	Yes	0	Rectal

LRVRE*fm*, linezolid-resistant vancomycin-resistant *Enterococcus faecium*; VRE, vancomycin-resistant enterococcus.

Results

Description of outbreak

Case 1 was a patient on the hepatology ward with negative VRE rectal screening on admission. *E. faecium* was isolated from the second rectal screen taken five days after admission; the isolate had high level resistance to vancomycin and teicoplanin phenotypically consistent with vanA positivity and was also resistant to linezolid. This was designated as day 1 of the outbreak. The patient was initially placed into a VRE cohort room with other VRE-colonized patients, but was transferred to a single room when linezolid resistance was confirmed. This patient had no history of linezolid exposure.

Cases 2 and 3 were identified on day 14, with LRVRE*fm* isolated from rectal swabs. Both patients were previously known to be colonized with VRE and had been in the same cohort room as case 1. Prior to being identified, case 2 had six days of linezolid therapy and case 3 had not received linezolid.

Case 4 had LRVRE*fm* isolated from a bile sample collected during endoscopic retrograde cholangiopancreatography on day 17. The patient was known to be colonized with VRE and had recently received a prolonged course of broad-spectrum antimicrobial therapy, including 23 days of oral linezolid, to treat a large, partially drained intra-abdominal collection. Antimicrobial therapy had been completed prior to the admission of case 1. This patient was considered to be the most likely index patient.

Case 5 was identified on day 21, also on rectal screening. The patient was not previously known to be colonized with VRE and had not received linezolid therapy.

Cases 6—13 were identified between day 35 and day 62. LRVRE*fm* was identified from rectal swabs in all eight patients. Cases 8, 10, 11, and 12 were previously known to be colonized with VRE. Cases 10, 11, and 12 had received linezolid therapy prior to being identified as being colonized with LRVRE*fm* (five, 16, and six days respectively).

Case 14 was identified on day 64 on rectal screening. The patient was known to be colonized with VRE and had previously received seven days of linezolid therapy. This patient was in