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Changing dynamics of colonization in nursing facility patients over time: Reduction in methicillin-resistant *Staphylococcus aureus* (MRSA) offset by increase in vancomycin-resistant *Enterococcus* (VRE) prevalence

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Nursing facilities integrally serve the larger healthcare system by providing temporary care to acutely ill patients with skilled nursing needs before safely transitioning back to their homes. However, patients transferred from hospitals to nursing facilities are also more likely to be colonized by multidrug-resistant organisms (MDROs), which commonly cause healthcare-associated infections.[1] Infection prevention and control efforts have focused mostly on acute care, successfully reducing incidence of methicillin-resistant *Staphylococcus aureus* (MRSA) colonization in hospitals by 31% from 2005 to 2011.[2] Meanwhile, enterococcal infections and colonization with vancomycin-resistant *Enterococcus* spp (VRE) have arisen, often with serious clinical implications, including a doubling in VRE-related hospital discharges.[3,4]

Methods

In response, this investigation examined whether nursing facilities mirrored these national trends in MRSA and VRE, using data from 4 sequential multisite nursing facility studies in southeastern Michigan between 2003 and 2016: cross-sectional study A (2003–2004; 14 nursing facilities and 208 residents)[5]; prospective study B (2005–2010; 15 nursing facilities and 178 residents)[6]; prospective study C (2010–2013; 12 nursing facilities and 414 residents)[7]; and prospective study D, the first phase of an ongoing prospective study (2014–2016; 6 nursing facilities and 651 residents).[1] Study C was limited to residents with a feeding tube or urinary catheter, whereas the other studies included individuals with and without devices. For all studies, swabs were collected at the time of enrollment from residents' nares, oropharynx, groin, perianal area, and wounds and were tested for MRSA, VRE, and ceftazidime-resistant gram-negative bacteria (CTZR-GNB). Standard microbiological methods were used by trained research staff and were conducted in the same research lab for all 4 studies.[1,5–7] All studies were approved by the institutional review board at the University of Michigan. Written informed consent was obtained from each resident or his or her durable power of attorney.

Results

The mean study age ranged from 74.7 years (SD, 12.2) in the period 2014–2016 to 80.5 years (SD, 11.0) in the period 2005–2010. Prevalence of MRSA declined in each sequential study, whereas prevalence of VRE increased over time (Table 1). In the earliest study, 37.1% of participants were colonized with MRSA and 9.9% were colonized with VRE. In comparison, in the most recent study, only 13.4% were colonized with MRSA, but more patients, 28.9%, were colonized with VRE. These trends hold true in the subset of high-risk patients with devices (Table 1); MRSA colonization was 48% in cohort A (2003–2004) compared to 16.4% in cohort D (2014–2016). However, VRE increased from 9.0% to 44.8% from cohort A to cohort D. These trends among patients with devices are more pronounced than those in patients with no devices, especially in the case of VRE.

Discussion

Our findings indicate that MRSA colonization in southeastern Michigan nursing facilities has steadily decreased since 2003,

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Table 1. Trends in Multidrug-Resistant Organism (MDRO) Colonization From 2005 to 2016[a]

Characteristic	Cohort A 2003–2004 ($n = 208$)[a]	Cohort B 2005–2010 ($n = 178$)[a]	Cohort C[b] 2010–2013 ($n = 414$)[a]	Cohort D 2014–2016 ($n = 651$)[a]
All participants				
MRSA	37.1 (30.8–43.8)	20.2 (14.9–26.8)	17.8 (14.4–21.8)	13.4 (11.0–16.2)
VRE	9.9 (6.5–14.7)	9.6 (6.0–14.8)	15.1 (12.0–18.9)	28.9 (25.5–32.5)
CTZR-GNB	12.2 (8.4–17.3)	9.6 (6.0–14.8)	18.3 (14.8–22.3)	10.6 (8.5–13.2)
Any MDRO	46.0 (39.4–52.8)	28.7 (22.5–35.7)	37.3 (32.7–42.0)	41.0 (37.3–44.8)
Any Devices				
MRSA	48.0 (38.3–57.8)	24.4 (16.6–34.4)	17.8 (14.4–21.8)	16.4 (9.3–27.4)
VRE	9.0 (4.7–16.5)	15.6 (9.4–24.6)	15.1 (12.0–18.9)	44.8 (33.3–56.9)
CTZR-GNB	20.0 (13.2–29.1)	15.6 (9.4–24.6)	18.3 (14.8–22.3)	19.4 (11.6–30.7)
Any MDRO	57.0 (47.1–66.4)	38.9 (29.3–49.4)	37.3 (32.7–42.0)	56.7 (44.6–68.1)
No Devices				
MRSA	27.4 (20.0–36.4)	15.9 (9.6–25.2)	. . .	13.0 (10.5–16.0)
VRE	10.6 (6.1–17.8)	3.4 (1.1–10.1)	. . .	27.1 (23.6–30.8)
CTZR-GNB	5.3 (2.4–11.4)	3.4 (1.1–10.1)	. . .	9.6 (7.4–12.3)
Any MDRO	36.3 (27.9–45.6)	18.2 (11.4–27.7)	. . .	39.2 (35.3–43.2)

Note. MRSA, methicillin-resistant *Staphylococcus aureus*; VRE, vancomycin-resistant *Enterococcus*; CTZR-GNB, ceftazidime-resistant gram-negative bacteria.
[a]Proportion of residents (%) colonized at baseline and (95% CI) are given.
[b]Cohort C only included patients with either a urinary catheter or a feeding tube. We show similar trends in MRSA and VRE in nursing facility patients with and without indwelling devices.

whereas prevalence of VRE has nearly tripled. A similar trend was reported within a single long-term acute-care hospital in Chicago. In this study, Munoz et al[8] reported an increase in the incidence of VRE recovered from rectal swabs from 29% in 2005 to 44% in 2008. This trend was mirrored in nursing facilities, and interventions used to reduce MDROs in hospitals will also benefit nursing facility populations, which could result in a regional approach to combat antibiotic resistance.[9]

Our findings suggest several future directions. First, more studies are needed to confirm these trends in postacute care and other alternative care settings from other geographic settings. Second, future infection prevention measures should focus on clinical consequences of increasing VRE, particularly in older adults. Third, healthcare facilities must develop cost-effective, efficient MDRO surveillance strategies to characterize and understand long-term trends.

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Conflicts of interest. All authors report no conflicts of interest relevant to this article.

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