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Controlling nosocomial transmission of drug-resistant pathogens at different endemic stages in a resource-limited setting

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RESEARCH BRIEFS

Controlling Nosocomial Transmission of Drug-Resistant Pathogens at Different Endemic Stages in a Resource-Limited Setting

Worldwide, 7%–10% of hospitalized patients will experience a healthcare-associated infection, many of them due to multidrug-resistant organisms.[1] Control of multidrug-resistant organisms in healthcare settings is thus an important global challenge in infection control (IC), but there is wide variation in the pathogens of concern and the resources available to inhibit their spread. In resource-limited settings, local patterns of endemicity impact the choice of IC measures.[1,2] In Thailand, while extensively drug-resistant (XDR)-*Acinetobacter baumannii* is the most common nosocomial infection (with >70% of isolates resistant to carbapenems), vancomycin-resistant *Enterococcus* (VRE) and carbapenem-resistant Enterobacteriaceae (CRE) remain relatively uncommon. As of 2014, only 5.5% of clinical isolates of *Enterococcus faecium* and 1.4% of those of *E. faecalis* were vancomycin-resistant.[3] Similarly, the national prevalence of CRE is 0.4%–1.4%.[3] Here we describe trends in the incidence of VRE, CRE, and XDR-*A. baumannii* infection and/or colonization at Thammasat University Hospital, a tertiary care referral hospital in Pathumthani, Thailand, and compare these with IC strategies targeted to these multidrug-resistant organisms of varying endemicities.

We conducted a retrospective evaluation of microbiologic and IC data from 2012 to 2014. All patients with clinical microbiology isolates positive for VRE, CRE, or XDR-*A. baumannii* were evaluated. Outpatient cases were excluded. If a patient had 2 or more isolates of the same organism within a 30-day period, only the first isolate was counted. Given the low-level endemicity of VRE and CRE in this hospital, IC measures were more stringent and included hand hygiene, contact precautions with placement in a single room, environmental cleaning, and active surveillance to detect additional cases via rectal swab cultures. For XDR-*A. baumannii*, with its higher-level endemicity, IC measures focused on creating ward cohorting areas, along with hand hygiene, contact precautions, environmental cleaning, real-time feedback on compliance with IC practices, and in the intensive care units, daily chlorhexidine bathing.[4,5] Incidence was calculated as cases/1,000 patient-days and the χ^2 test for trend was used to evaluate trends over time. $P < .05$ was considered significant.

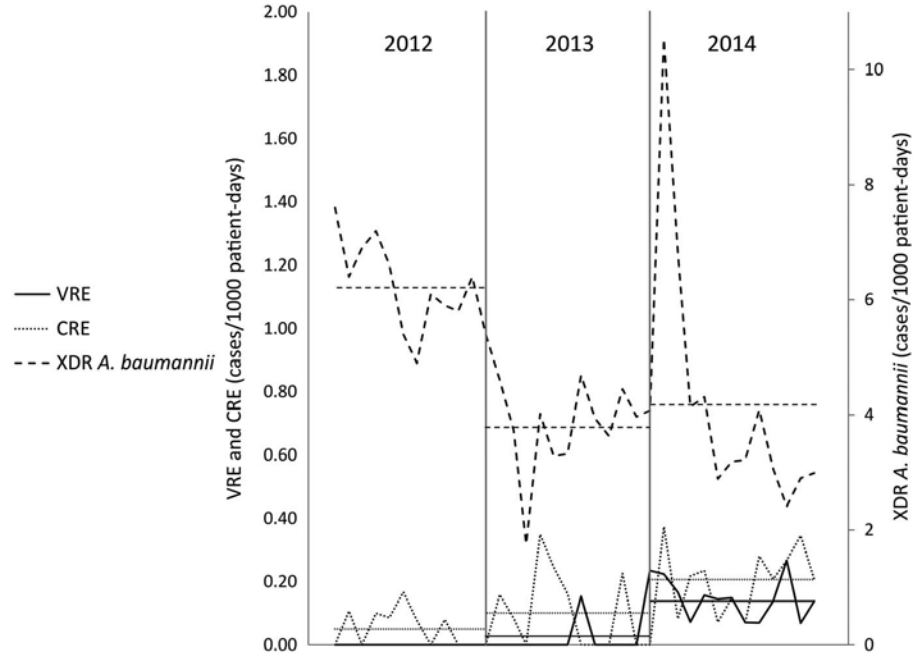
An outbreak of VRE or CRE was defined as more than 2 cases of the organism occurring in the same unit within a 30-day period from detection of the index case. XDR-*A. baumannii* outbreaks were defined using the historical control chart and declared on the basis of control chart threshold principles.[6] We routinely monitored IC practices for hand hygiene, contact precautions, and environmental cleaning. Compliance was monitored in all units by the same IC nurse via direct observation, as previously published.[7] An antibiotic stewardship program was initiated in 2003 and remains in place.[8] Data on inpatient use of third-generation cephalosporins, quinolones, and carbapenems were obtained from the hospital pharmacy and used to calculate defined daily doses dispensed/1,000 patient-days.[8]

From 2012 to 2014 there were 28 cases of VRE, 57 cases of CRE, and 2,082 cases of XDR-*A. baumannii*. VRE incidence increased from 0 to 0.14 cases/1,000 patient-days ($P = .36$) (Figure 1). Similarly, CRE incidence also increased from 0.05 to 0.21 cases/1,000 patient-days ($P = .29$). We carefully reviewed the inpatient record of all VRE and CRE cases and found no nosocomial acquisition; all cases either had evidence of previous colonization or infection, or were transferred from other hospitals. In contrast, incidence of XDR-*A. baumannii* decreased from 6.22 to 4.21 cases/1,000 patient-days ($P < .001$). Notably, there was a peak of cases in January 2014, representing an outbreak in the medicine ward that resolved with educational interventions to improve adherence to existing IC measures (Figure 1).

Compliance with all 3 IC measures (hand hygiene, contact precautions, and environmental cleaning) improved during the study period. Compliance was lowest for all measures during 2012, then increased substantially in 2013, corresponding to the institution of a hospital-wide educational program on hand hygiene and IC precautions. Compliance subsequently stabilized in 2014. The rate of third-generation cephalosporin, carbapenem, and quinolone use during this time period was unchanged (Figure 1).

The hospital's connections with other healthcare facilities via patient sharing and referral and the regional endemicity of these organisms may have influenced surveillance and IC strategy.[9] Although VRE and CRE rates increased during our study period, their overall incidence remained low. To control VRE and CRE at this early stage of endemicity, routine IC measures were more aggressive. In combination with increased compliance, this aggressive approach may have limited the increase in incidence of these infections. This is evidenced by the lack of documented nosocomial transmission of VRE and CRE, despite patient transfers from other healthcare facilities with higher rates, and increasing prevalence in the regional rates (mean, 4.2 cases/1,000 patient-days, unpublished data).[3,10]

The decreasing rates of XDR-*A. baumannii* provide further support for the impact of compliance with IC measures. Rates of XDR-*A. baumanii* nationwide increased throughout the study period.[3,10] We documented the opposite trend in our institution, with rates going from 6.22 to 4.21 cases/1,000 patient-days over 3 years. Because of the high incidence of this pathogen, resources are not available for isolation in private rooms or active surveillance. Despite this, our basic IC



Compliance (%)	2012				2013				2014			
Hand Hygiene	66	74	74	76	90	90	88	90	88	88	73	82
Contact Precautions	40	36	38	40	66	59	56	56	43	61	58	54
Environmental Cleaning	36	37	37	37	67	63	60	58	45	61	59	58
Antibiotic Use (DDD/1000 patient-days)												
Cephalosporins, 3rd Generation	51				54				55			
Quinolones	8.9				8.2				9.1			
Carbapenems	37				38				42			

FIGURE 1. Trends in drug-resistant organisms, infection control compliance, and antibiotic use. Horizontal lines represent annual rates of each pathogen per 1,000 patient-days. CRE, carbapenem-resistant Enterobacteriaceae; DDD, defined daily dose; VRE, vancomycin-resistant *Enterococcus*; XDR-*A. baumannii*, extensively drug-resistant *Acinetobacter baumannii*.

measures featuring hand hygiene, contact precautions, and environmental cleaning—together with early detection of outbreaks followed by rapid interventions to improve compliance—correlate with the improving incidence rates. Importantly, we noted little change in antibiotic use over the study period, despite changes in incidence of these infections.

This was a single-center retrospective cohort study, which limits its generalizability and our ability to evaluate other factors impacting trends. However, our data suggest that control of drug-resistant pathogens is achievable and sustainable for all microorganisms, even in resource-limited settings. IC measures must be modified to fit the local infrastructure, available resources, and endemic stage. Systematic surveillance to detect early outbreaks followed by immediate implementation of strategies to improve compliance with basic IC measures is crucial to the sustainability of these practices.

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Trends in Chlorhexidine Use in US Neonatal Intensive Care Units: Results From a Follow-Up National Survey

Chlorhexidine gluconate (CHG) is a broad-spectrum topical antiseptic frequently used to prevent healthcare-associated infections. Common uses include antisepsis for central venous catheter (CVC) insertion and maintenance, preoperative bathing, and daily bathing of patients with CVCs.[1,2] In neonates, CHG bathing has been associated with a reduction in central line–associated bloodstream infections.[3]

A 2009 survey of US neonatal intensive care units (NICUs) with fellowship training programs found that 57% of responding institutions used CHG in the NICU, many restricting use by age or weight.[4] Respondents cited concerns regarding off-label use, as well as limited availability of safety data in preterm infants. Two other surveys have investigated CHG use in the broader context of infection control practices but did not elicit the full scope of CHG use within NICUs.[5,6]

In May 2012, the US Food and Drug Administration modified the labeled indications for CHG from "do not use in premature or low birthweight infants […] or children less than 2 months of age" to "use with care in premature infants or infants under 2 months of age." To ascertain trends in CHG use in the setting of this new indication, we resurveyed US NICUs with fellowship training programs to assess several key facets of CHG use.

In 2014, a survey was sent via email to neonatology training program directors in the United States. Follow-up surveys were sent to nonresponding institutions. Study participants completed an online survey about the use of CHG within the NICU, specific infection control practices, associated adverse effects, and concerns regarding the antiseptic's use in the neonatal population. Data were analyzed using Stata, version 13.0 (StataCorp). This study was approved by the Johns Hopkins Medicine Institutional Review Board.

Of 98 training programs surveyed, 58 (59%) responded (Table 1). Among 46 respondents to the question, there was a mean (SD) of 23 (10.3) years of experience practicing neonatology, and all practiced at level III-IV NICUs. Fifty respondents (86%) reported CHG use within their NICUs, 5 (9%) reported no CHG use, and 3 (5%) did not know whether CHG was used within their NICU. Among NICUs utilizing CHG, the most common uses included skin preparation for CVC insertion, CVC dressing changes, CVC maintenance, and skin preparation for peripheral IV insertion. CHG baths were less frequently utilized, including preoperative baths, decolonization for methicillin-resistant *Staphylococcus aureus*, and routine bathing. Among 50 NICUs in 2014, 32 restricted CHG use: 21 did so by age, whereas 5 used weight-based criteria and 6 used both age- and weight-based restrictions. Among respondents who provided comments on open-ended questioning, the most common age requirement and weight requirement for CHG use were greater than 28 weeks gestation at birth and weighing more than 1 kg. A variety of CHG concentrations were utilized, ranging from 0.25% to 4.0%; the most common concentration used was 2.0%. Adverse effects of CHG were reported by 24 (53.3%) respondents, all of which were dermatologic. Those who provided specific information on dermatologic adverse events most often described skin irritation or burns. Concerns about CHG use were reported by 27, with common themes from open-ended questions regarding potential skin effects, systemic absorption, and potential neurotoxicity.

Among NICUs with fellowship training programs, CHG use has increased over the past 6 years from 57% to 86%. The benefit of using CHG in hospitalized neonates was investigated in a 2014 study conducted in a tertiary care NICU.[3] Among