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Control of endemic multidrug-resistant Gram-negative bacteria after removal of sinks and implementing a new water-safe policy in an intensive care unit

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SUMMARY

Background: Contaminated handwashing sinks have been identified as reservoirs that can facilitate colonization/infection of patients with multidrug-resistant (MDR) Gram-negative bacteria (GNB) in intensive care units (ICUs).

Aim: To assess the impact of removing patients' sinks and implementing other water-safe strategies on the annual rates of ICU-acquired MDR-GNB.

Methods: This six-year quasi-experimental study was conducted from January 2011 to December 2016. The intervention was carried out in August 2014 in two adult ICU wards with 12 rooms each. To assess the changes in annual MDR-GNB rates before and after the intervention, we used segmented regression analysis of an interrupted time-series. Crude relative risk (RR) rates were also calculated.

Findings: The incidence rates of MDR-GNB were 9.15 and 2.20 per 1000 patient-days in the pre- and post-intervention periods, respectively. This yielded a crude RR of acquiring MDR-GNB of 0.24 (95% confidence interval: 0.17–0.34). A significant change in level was observed between the MDR-GNB rate at the first point of the post-intervention period and the rate predicted by the pre-intervention time trend.

Conclusion: The implementation of a new water-safe policy, which included the removal of sinks from all patient rooms, successfully improved the control of MDR-GNB spread in an ICU with endemic infection. Our results support the contribution of sink use with the incidence of MDR-GNB in endemic environments.

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Introduction

Multidrug-resistant (MDR) Gram-negative bacteria (GNB) are a major problem in healthcare settings worldwide [1–3]. These bacteria are often involved in hospital outbreaks, and occur in intensive care units (ICUs) [4–7]. The hands of healthcare workers are the most important facilitator of cross-transmission from colonized/infected patients or from contaminated environments where micro-organisms may persist [8]. Sinks have also been associated with ICU outbreaks caused by MDR-GNB, especially *Pseudomonas* spp. and *Klebsiella* spp. [9,10].

Accepted measures for controlling outbreaks caused by these bacteria are hand hygiene, contact precautions, active patient screening and environmental cleaning [11–13]. However, some researchers have reported that removing sinks was also necessary for successful resolution of outbreaks [14,15]. Indeed, it has been shown that sinks continue to be contaminated by MDR-GNB in non-outbreak settings, especially when used for handwashing by healthcare workers and the disposal of body fluids. Therefore, sinks might contribute to the persistent spread of these bacteria in endemic settings [16–18].

In our ICU, we have shown that enhancing infection control measures, according to guidelines, facilitated the successful control of endemic *Acinetobacter baumannii* [11,19]. Despite maintaining these control measures, we continued to observe progressive increases in the numbers of patients who acquired clonal MDR *Klebsiella pneumoniae* and *Pseudomonas aeruginosa* during their ICU stays. Molecular typing of MDR *K. pneumoniae* clinical isolates showed sequence types (ST) ST326 and ST101 as the dominant clones causing infections in the ICU [4]. Among the infections caused by MDR *P. aeruginosa*, ST175 was the major clone, followed by the carbapenemase producers ST235 and ST253 strains [7]. Since these bacteria are associated with damp environments, our infection control team hypothesized that sinks could be reservoirs of infection and they proposed to hospital managers the removal of sinks from ICU rooms.

Herein, we evaluate the impact of removing sinks from patients' rooms as a part of a new water-safe policy on the number of new patients acquiring MDR-GNB in our ICU department.

Methods

Setting and study design

This was a six-year quasi-experimental study that comprised a pre-intervention period of 43 months from January 2011 to July 2014 and a post-intervention period of 29 months from August 2014 to December 2016. Sinks were removed in August 2014. All interventions were performed at Bellvitge University Hospital, a 700-bed teaching hospital located in the southern metropolitan area of Barcelona that accepts referrals for more than two million people requiring high-complexity procedures. The intervention was implemented in two mixed (medical and surgical) adult intensive care wards, each with 12 single rooms.

Outcomes

The primary outcome was the annual rate for all new cases of ICU-acquired MDR-GNB bacteria, including both *K. pneumoniae* and *P. aeruginosa*. The secondary outcomes were the separate annual rates of new cases for ICU-acquired MDR *K. pneumoniae* and *P. aeruginosa*.

Figure 1. A sink before the intervention.

Definitions

For analysis, only *K. pneumoniae* producing extended-spectrum β-lactamases (ESBLs) and/or carbapenemase and extensively drug-resistant (XDR) *P. aeruginosa* (producing Verona integron-encoded metallo-β-lactamase (VIM) carbapenemase or not) were considered MDR-GNB. A new case was defined as an MDR-GNB recovered from a clinical sample in a patient hospitalized in the ICU for >48 h. For surveillance, we considered the first isolation in a clinical sample of each of the MDR-GNB per patient (infection or colonization). Isolates obtained from screening rectal swabs were not included.

Strategies for controlling MDR-GNB spread during the study period

Sinks and water policy

Pre-intervention. Each room had a wall-mounted sink with a shallow, stainless steel bowl and a plastic P-trap (Figure 1). The water spout flowed directly into the sink drain, causing splashes of water trapped in the P-trap. The distance from the sinks to the patients' beds or to the medication preparation area was ~1 m. There were no routine sink cleaning and disinfection programmes nor any barriers to prevent splashing. Healthcare workers used the sink water for handwashing and for maintaining patients' daily hygiene (for this, water was

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