culture at the time of hospital admission in both patients and was considered to represent asymptomatic bacteriuria.

One month before identification of the first CRAB, the patients overlapped at DHMC for 8 days on different units. Potential epidemiologic links included radiology and wound care. Both patients had radiographs taken on the same day; one patient traveled to the radiology department, whereas the other had a portable radiograph. Observations of portable radiology technicians revealed consistent and adequate low-level disinfection of equipment and reliable hand hygiene. One wound-care nurse provided care to both patients on the same day. Observations of the wound-care team indicated opportunities to improve hand hygiene prior to donning and after doffing gloves; the use of single-use scissors on multiple patients; and inconsistent cleaning of a mobile device used to photograph open wounds. Discussion with the patients' outpatient providers showed that their suprapubic and wound care supplies were obtained from different companies.

Molecular analyses of the 2 patients' isolates were indistinguishable by PFGE using the restriction enzymes *AscI* and *ApaI*. Antimicrobial susceptibility testing revealed that both isolates were susceptible to colistin and resistant to all carbapenems tested. Both harbored OXA-23–like genes according to a Research Use Only assay performed at CDC.

While OXA-23-like enzymes are novel in Colorado, they were first identified in Scotland in 1985 and are the most common carbapenemase enzyme detected worldwide, accounting for 63% of nosocomial CRAB in Argentina, 42%–100% in Brazil, 98% in Colombia, and 55%–80% in Saudi Arabia.[4,6,7] OXA-23–like enzymes are almost exclusively found in *Acinetobacter baumannii* and can be encoded by genes located on either a chromosome or plasmid.[2,5] OXA-23–like enzymes do not require the presence of other resistance mechanisms (eg, porin mutations or efflux pumps) to confer carbapenem resistance. However, when a bacterial strain also carries an efflux pump, the bacteria exhibit higher minimum inhibitory concentration (MIC) to carbapenems as well as resistance to multiple antibiotics, complicating the detection of the gene variant through phenotypic surveillance.[5]

We suspect that the organisms were transmitted during the overlapping hospital admission, although we could not determine where the organism originated or the route of transmission. On the facility level, opportunities to improve hand hygiene and low-level disinfection were identified and addressed. The charts were flagged to indicate that the patients harbored an MDR organism and would require contact precautions upon arrival. Infection preventionists notified clinics when upcoming outpatient appointments were detected. The clinics scheduled these patients to be the last of the clinic session when possible to allow for a thorough environmental cleaning after the clinic visit.

On a regional level, CDPHE epidemiologists contacted other healthcare facilities where these patients frequently sought care and encouraged these facilities to also electronically flag medical records and to ensure effective infection control measures. While no further cases of CRAB have been identified to date at DHMC, 1 additional OXA-23–producing CRAB case, without epidemiologic links to the previous 2 patients, has been identified in Colorado since this cluster.

The emergence of previously undetected carbapenemases in Colorado is of great public health concern. Active collaboration and communication between public health and healthcare facilities is critical to halt transmission of novel regional pathogens.

Acknowledgments.

Financial support. No financial support was provided relevant to this article.

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

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Post-discharge impact of healthcare-associated infections in a developing country: A cohort study

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Cite this article: de Souza ECO, *et al.* (2018). Post-discharge impact of healthcare-associated infections in a developing country: A cohort study. *Infection Control & Hospital Epidemiology* 2018, 39, 1274–1276. doi: 10.1017/ice.2018.201

To the Editor —The impact of healthcare-associated infections (HCAIs) on in-hospital mortality, morbidity, length-of-stay, and costs has been extensively reported.[1,2] However, few studies have focused on the follow-up of HCAI-affected subjects after

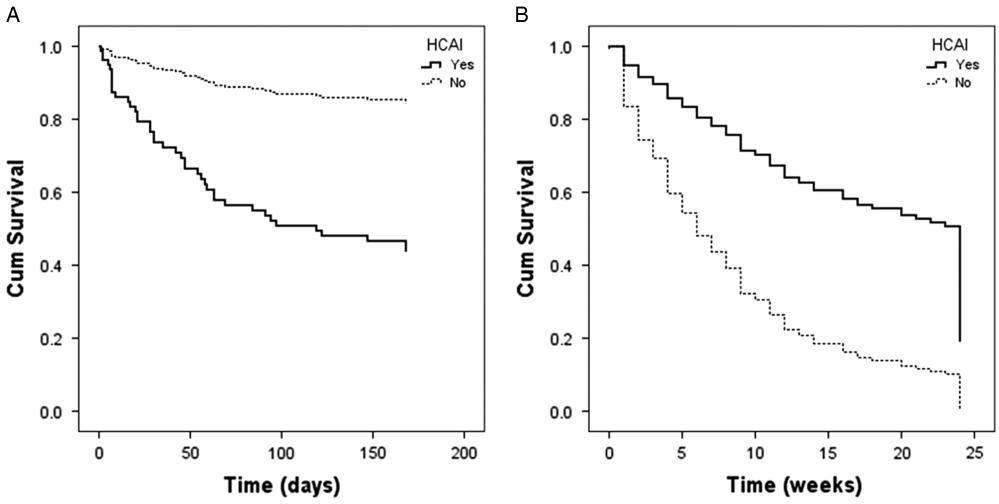

Fig. 1. Survival analysis graphics for hospital readmission and return to work or usual activities after discharge among subjects with and without healthcare-associated infections. (A) Survival graphic for hospital readmission (time counted in days). (B) Survival graphic for return to work or usual activities, with time counted in weeks. Note. HCAI, healthcare-associated infection.

discharge. Most studies have focused on the increased risk of readmissions to hospitals.[3–6] However, HCAIs may impact patient autonomy and the utilization of healthcare resources.[7]

We conducted a cohort study aimed at identifying the impact of HCAIs among persons discharged after diagnosis of HCAI in a teaching in inner Brazil. Adult patients discharged from Botucatu Medical School Hospital (450 beds) during 2016–2017 after diagnosis of 1 or more HCAIs were enrolled. For each subject, we included 2 controls matched by specialty (for medical patients) or by the National Healthcare Safety Network (NHSN) surgical group.[8] The cohort was followed with weekly telephone calls for 24 weeks. Data recorded included (1) hospital readmissions; (2) return to work or usual daily activities (for those who did not work); (3) number of medicines taken after discharge; (4) number of medical consultations during follow up; (5) necessity of a caregiver (including family members).

Predictors of readmission and return to work or usual activities were assessed in univariate and multivariable Cox regression models. In addition to HCAIs, demographics, comorbidities (including the Charlson comorbidity index[9]), and admission data (length-of-stay, procedures, devices) were tested as predictors in those models. We used a stepwise backward strategy for selection of variables in multivariable models. *P* values of .05 and .10 were set as limits for inclusion and exclusion of variables. Other outcomes were assessed using Mann-Whitney U and χ^2 tests, when appropriate.

We included 55 patients with HCAIs and 110 patients without HCAIs in the cohort. Among HCAI subjects, 20 had ≥2 infection sites. The overall distribution of sites was as follows: surgical site infection (SSI, n = 29); bloodstream infection (BSI, n = 20); pneumonia, (n = 11); urinary tract infection (UTI, n = 9); skin and soft-tissue infection (SST, n = 6).

Readmission during follow-up was reported for 39.3% of HCAI subjects and 18.2% of others ($P = .003$). In our multivariable analysis, HCAI (hazard ratio [HR], 4.84; 95% confidence interval [CI], 2.20–10.63; $P < .001$) and the Charlson comorbidity index (HR, 1.60; 95% CI, 1.13–2.25; $P = .007$) were significant predictors of readmission. On the other hand, HCAI was associated with later return to work or usual activities (HR, 0.30; 95% CI, 0.19–0.57; $P < .001$). Other significant associations for that outcome were surgery (HR, 1.83; 95% CI, 1.16–2.90; $P = .01$) and mechanical ventilation (HR, 0.53; 95% CI, 0.33–0.85; $P = .009$). Figure 1 presents survival graphics for the impact of HCAI on readmission and return to work or usual activities. Tables with detailed results of univariate and multivariable analyzes are available as supplementary files.

The groups also differed in the following categories:

- Number of medicines taken after discharge: For HCAI, the median was 5 (quartiles [Q] 4 and 8), and for non-HCAI, the median was 4 (Q 2 and 6) ($P = .02$).
- Number of medical consultations during follow-up: For HCAI, the median was 6 (Q 2 and 10), and for non-HCAI, the median was 3 (Q 2 and 5) ($P < .001$).
- Number of consultations with nonmedical healthcare professionals during follow-up: For HCAI, the median was 1 (Q 0 and 2), and for non-HCAI, the median was 0 (Q 0 and 1) ($P = 003$).

Finally, 20.0% of subjects in the HCAI group required that a family member quit work (either definitively of temporarily) to be a caregiver, a situation reported by only 1 subject (0.9%) in the non-HCAI group ($P < .001$).

Our results agree with those of previous studies. Sreeramoju et al[3] identified HCAIs as a direct cause of hospital readmissions, while Emerson et al[4] (studying a very large retrospective cohort) found that subjects with infections caused by methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant enterococci (VRE), and *Clostridium difficile* were more likely to be readmitted. Schor et al[5] reported that patients discharged after treating healthcare-associated pneumonia were 7.5 times more likely to be readmitted within 30 days of discharge than those treated for community-acquired pneumonia. Finally, Gohil et al[6] identified higher rates of infection-related readmissions among hospitals caring for populations with higher comorbidity and poverty rates.

However, our focus went beyond readmissions. We used return to work or usual activities as a proxy for patient autonomy and found that HCAIs had a significantly negative impact on that outcome. Other findings (eg, greater use of medicines and the number of medical and nonmedical consultations) were

https://doi.org/10.1017/ice.2018.201 Published online by Cambridge University Press

consistent with results from a study of the postdischarge impact of MRSA.[7]

Our study was limited by the small number of subjects and the relatively short follow-up period. Also, we did not perform analysis of postdischarge healthcare costs of HCAI. However, our study also has strengths: the prospective design, the analysis of several relevant outcomes and the focus on all sites of infection. To our knowledge, this is the first study of postdischarge impact of HCAI conducted in a developing country. These countries face the paradox of having a greater burden of HCAI, and they have fewer resources to provide care to affected patients.[10]

In conclusion, HCAI impacted hospital readmissions, later return to work or usual activities, greater use of medicines, and number of medical consultations. These are challenging areas for developing countries and reinforce the importance of including HCAI in the public health agenda.

Supplementary materials. To view supplementary material for this article, please visit https://doi.org/10.1017/ice.2018.201

Acknowledgments. All authors state that they have no conflict of interest regarding this study.

Financial support. C.M.C.B.F. received a researcher grant from the National Council for Scientific and Technological Development (CNPq, grant no. 312149/2015-8), Brazil. K.M.G. participated part of this study as a medical student, with a grant from the São Paulo Research Foundation (FAPESP, grant no. 2014/04498-6), with C.M.C.B.F as advisor.

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

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