Major article

Working relationships of infection prevention and control programs and environmental services and associations with antibiotic-resistant organisms in Canadian acute care hospitals

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Background: Environmental contamination in hospitals with antibiotic-resistant organisms (AROs) is associated with patient contraction of AROs. This study examined the working relationship of Infection Prevention and Control (IPAC) and Environmental Services and the impact of that relationship on ARO rates.

Methods: Lead infection control professionals completed an online survey that assessed the IPAC and Environmental Services working relationship in their acute care hospital in 2011. The survey assessed cleaning collaborations, staff training, hospital cleanliness, and nosocomial methicillin-resistant *Staphylococcus aureus* (MRSA) infection, vancomycin-resistant *Enterococcus* (VRE) infection, and *Clostridium difficile* infection (CDI).

Results: The survey was completed by 58.3% of hospitals (119 of 204). Two-thirds (65.8%; 77 of 117) of the respondents reported that their cleaners were adequately trained, and 62.4% (73 of 117) reported that their hospital was sufficiently clean. Greater cooperation between IPAC and Environmental Services was associated with lower rates of MRSA infection ($r = -0.22$; $P = .02$), and frequent collaboration regarding cleaning protocols was associated with lower rates of VRE infection ($r = -0.20$; $P = .03$) and CDI ($r = -0.31$; $P < .001$).

Conclusions: Canadian IPAC programs generally had collaborative working relationships with Environmental Services, and this was associated with lower rates of ARO. Deficits in the adequacy of cleaning staff training and hospital cleanliness were identified. The promotion of collaborative working relationships and additional training for Environmental Services workers would be expected to lower ARO rates.

There is substantial evidence indicating that environmental contamination in hospitals with antibiotic-resistant organisms (AROs) is associated with patient contraction of AROs, and growing evidence that effective cleaning and disinfection of hospitals is associated with decreased ARO rates.[1-9] Education and training on infection prevention and control for hospital cleaning staff has been associated with lower ARO rates.[7-10] Close collaboration between Infection Prevention and Control (IPAC) programs and Environmental Services is associated with improved cleaning practices and decreased rates of AROs.[2,8,9]

The purpose of this national study was to examine the nature of the working relationships of IPAC and Environmental Services, and to determine whether educational and cleaning practices collaborations affected ARO levels in Canadian acute care hospitals. The study results can guide the development of strategies to improve the environmental cleaning of hospitals and reduce ARO rates.

METHODS

The infection control and prevention training and cleaning collaborations of IPAC programs and Environmental Services in medium to large-sized acute care hospitals in Canada were

quantitatively assessed as part of the Canadian Hospitals Environmental Services Studies (CHESS). In 2012 and the first half of 2013, lead infection control professionals completed an online survey eliciting information on the educational and consultative services that IPAC programs provided to hospital Environmental Services in 2011. The CHESS project also included a separate online survey assessing Environmental Services cleaning resources and activities in acute care hospitals.[11] The CHESS project was reviewed and approved by the Queen's University Research Ethics Board.

The infection control survey was developed in conjunction with an expert steering committee composed of experts in infection control and environmental services and was prepared in French and English versions. The survey was pilot tested by 7 infection prevention and control professionals working in Canadian acute care hospitals. Questions assessed the infection control and prevention educational services provided by IPAC programs, as well as collaboration and cooperation between the services. Respondents quantitatively rated the adequacy of training of Environmental Services cleaning staff and hospital cleanliness.

Data on the number of new nosocomial cases (colonizations and infections) of methicillin-resistant *Staphylococcus aureus* (MRSA), vancomycin-resistant *Enterococcus* (VRE), and *Clostridium difficile* infection (CDI) were collected. ARO rates were recorded as simple incidence per 1,000 admissions.[12] Respondent addresses were obtained from the Canadian Hospital Association database, and respondents were contacted by mail. Second and third invitations to participate were mailed to nonresponders. Respondents were also contacted by e-mail when e-mail addresses were available.

Simple regression was used to test associations between hospital bed classifications, cleaning collaborations, educational services, degree of cooperation, and respondents' ratings of cleaning staff training and hospital cleanliness with MRSA, VRE, and CDI rates. Variables found to be associated at the ≤.05 level were tested by multiple stepwise regression analysis with forward and backward selection for association with ARO rates. Separate multivariate models were developed for MRSA, VRE, and CDI rates. The forward selection procedure added variables if the probability of F to enter was ≤.05, and the backward elimination procedure subtracted variables if the probability of F to remove was ≥.05. Data analyses were performed with StatView version 5.0 (SAS Institute, Cary, NC).

RESULTS

Respondent hospital characteristics

The survey response rate was 58.3%; 117 surveys were completed, representing 119 of 204 facilities. One survey was received from a health organization representing 3 hospitals. The mean ± SD number of acute care beds per hospital was 232.5 ± 176.4, with a median of 172 and a range of 48-1,100. Many acute care hospitals had other types of beds, including mental health (75.2%), rehabilitation (52.1%), complex continuing care (47.9%), and long-term care beds (29.9%). The mean number of total beds per hospital was 315.6 ± 234.0, with a median of 247.0 a range of 54-1,510. The mean number of admissions was 12,376.9 ± 9,538.6, and the mean number of patient-days was 90,775.7 ± 67,330.7.

Education and training provided to Environmental Services

The vast majority of IPAC programs (91.3%; 105 of 115) provided education and training in infection prevention and control to Environmental Services staff. Among the IPAC programs that provided education and training, the majority (86.8%; 92 of 106) reported that it was well received and taken seriously by Environmental Services staff (Table 1). Three-quarters (76.9%; 90 of 117)

of IPAC programs informed Environmental Services managers of the latest scientific findings and advancements in environmental cleaning, and two-thirds (65.8%; 77 of 117) reported adequate training of Environmental Services cleaning staff in cleaning and disinfection standards.

Cooperation and collaboration between the services

The majority of respondents (61.5%; 72 of 117) reported that the extent of cooperation between the IPAC program with Environmental Services was excellent, and 28.2% (33 of 117) characterized cooperation as good (Table 1). Two-thirds of IPAC programs (69.2%; 81 of 117) had a designated infection control professional serving as a liaison with Environmental Services. IPAC programs were consulted regarding surface and finishing choices in patient care areas with respect to cleanability often or always in 73.5% of the hospitals (86 of 117) and in the choice of cleaning and disinfection products often or always in 80.3% (94 of 117). Most respondents (90.6%; 106 of 117) reported that Environmental Services used the appropriate cleaning products and equipment. More than three-quarters of IPAC programs (78.6%; 92 of 117) were consulted often or always before any changes to cleaning and disinfection procedures and technologies. Almost two-thirds of the respondents (62.4%; 73 of 117) reported that their hospital was sufficiently clean for the purpose of infection prevention and control.

AROs

The mean rate of new nosocomial cases of MRSA (colonization and infection) was 4.5 ± 4.7 per 1,000 admissions (median, 3.3). Five of 115 hospitals reported having no MRSA cases in 2011. The mean VRE rate was 3.2 ± 4.8 per 1,000 admissions (median, 1.2). Almost one-quarter of the hospitals (23.7%; 27 of 114) reported no cases of VRE in 2011. The mean rate of CDI was 3.2 ± 2.7 per 1,000 admissions (median, 2.4). All hospitals (114 of 114) reported CDI cases.

Univariate regression analysis

Simple regression analysis identified 2 variables as associated with MRSA rates in the respondent hospitals. The number of mental health beds was related to higher rates of MRSA ($r = 0.20$; $P = .04$), and greater cooperation between IPAC programs and Environmental Services was associated with lower rates ($r = -0.22$; $P = .02$). Simple regression analysis identified 2 variables associated with VRE rates. Lower VRE rates were associated with IPAC programs having greater input into choices of surfaces and finishes with regard to cleanability ($r = -0.20$; $P = .03$) and with frequent consultation with IPAC programs before any changes to cleaning protocols ($r = -0.20$; $P = .03$). Four variables were identified by simple regression analysis as associated with CDI rates. The numbers of acute care beds ($r = 0.34$; $P = .0003$) and total beds ($r = 0.29$; $P = .002$) were positively associated with CDI rates. Frequent consultation with IPAC programs before changes to cleaning protocols was related to lower CDI rates ($r = -0.24$; $P = .01$), as was greater cooperation between IPAC programs and Environmental Services ($r = -0.22$; $P = .02$).

Multivariate regression analysis

Multiple stepwise regression analysis identified 2 factors to be independently associated with MRSA rates. A greater degree of cooperation between IPAC programs and Environmental Services was related to lower rates of MRSA ($r = -0.22$; $P = .02$), whereas the number of mental health beds was related to higher rates ($r = 0.20$; $P = .03$). Multiple stepwise regression analysis identified 1 factor as

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