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Major article

Hospital infection control units: Staffing, costs, and priorities

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Background: This article describes infection prevention and control professionals' (ICPs') staffing levels, patient outcomes, and costs associated with the provision of infection prevention and control services in Australian hospitals. A secondary objective was to determine the priorities for infection control units.
Methods: A cross-sectional study design was used. Infection control units in Australian public and private hospitals completed a Web-based anonymous survey. Data collected included details about the respondent; hospital demographics; details and services of the infection control unit; and a description of infection prevention and control-related outputs, patient outcomes, and infection control priorities.
Results: Forty-nine surveys were undertaken, accounting for 152 Australian hospitals. The mean number of ICPs was 0.66 per 100 overnight beds (95% confidence interval, 0.55-0.77). Privately funded hospitals have significantly fewer ICPs per 100 overnight beds compared with publicly funded hospitals ($P < .01$). Staffing costs for nursing staff in infection control units in this study totaled $16,364,392 (mean, $380,566). Infection control units managing smaller hospitals (<270 beds) identified the need for increased access to infectious diseases or microbiology support.
Conclusion: This study provides valuable information to support future decisions by funders, hospital administrators, and ICPs on service delivery models for infection prevention and control. Further, it is the first to provide estimates of the resourcing and cost of staffing infection control in hospitals at a national level.

Over the last decade, the prevention and control of health care–associated infections (HAIs) has been at the forefront of safety and quality initiatives in hospitals internationally. In Australia, reducing the incidence of HAIs in hospitals is one of the priorities for the Australian Commission for Safety and Quality in Health.[1] Like similar agencies internationally, the Australian Commission for Safety and Quality in Health Care acknowledges that the success of multimillion dollar HAI programs is almost entirely dependent on the capacity of the infection prevention and control professionals (ICPs) to implement the recommended strategies, lead hospital quality improvement efforts, and lead infection prevention and control programs.[2,3] Despite the fact that infection control programs have been running for some time, little is known about their structure, effectiveness, or sustainability. Apart from work on ICP competencies,[4-6] there is scarce information regarding infection control structures and service delivery models internationally. Specifically, since a sentinel study published in 1985,[7] there is very little literature that explores infection control staffing levels in hospitals,[8-10] and no data associated with the cost of providing infection control services at a national level have been published in the peer reviewed literature.

To inform decisions, it is critical that funders, hospital administrators, and ICPs have access to information on the organizational support, staffing, and resources required to deliver an infection control program. Further, such information will assist the development of robust business cases related to infection control activities and the subsequent decisions around investment. The aim of this article is to describe existing hospital-based infection control

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programs at a national level in Australian public and private hospitals, building on previously published work.[10-12] The specific research questions used to address this aim are as follows:

1. What are the infection control staffing levels in Australian hospitals and how do these staffing levels differ between hospitals?
2. What are the quantifiable outputs produced by Australian infection control units?
3. What is the relationship between the incidence of health care–associated (HCA) *Staphylococcus aureus* (SAB) and hospital-identified *Clostridium difficile* infection (CDI) and staffing levels and hospital demographics?
4. What are the salary costs of infection control nurse staffing in Australian hospitals?
5. What are the stated infection control priorities in Australian hospitals?

The findings of this study form part of a larger project aimed at providing recommendations to health services regarding the organizational support, staffing, skills, and expertise required by infection control units.

METHODS

Study design

A cross-sectional study design was used. Participants completed an anonymous online via a Web-based survey.

Participants and setting

Australian hospitals are managed by either a public (government) governance system or by private entities. There are 1,338 individual hospitals in Australia, of which 56% are public hospitals. There are 87,315 overnight hospital beds (3.9 per 1,000 population), 67% of these are public hospital beds.[13] Infection control units may provide services to an individual or group of hospitals. The participants in this study were from the infection control units in Australian public and private hospitals. The true number of ICPs and infection control units in Australia is not known.

Recruitment and data collection

Between November 2013 and April 2014, the lead infection control coordinators of infection control units were invited to participate in the study. Direct contact was made with lead infection control coordinators via post or e-mail, inviting participation. Where names of infection control coordinators were publicly available, the letters were addressed accordingly; otherwise, a generic invitation was used. Participation in the study was voluntary and anonymous. In each invitation a unique identification code was included to ensure duplicate samples from the same hospital could be identified. The study was promoted using advertisements on the discussion list of the peak professional body representing ICPs in Australia (Australasian College for Infection Prevention and Control), and a flyer was placed in the conference bag for those attending the national infection control conference in late 2013.

An online confidential Web-based cross-sectional survey was developed using a combination of instruments used in previous studies from the United States, United Kingdom, and Australia,[2,9,10,12,14,15] with additional questions added to further address the aims of the study. Participants were asked demographic information about their hospital, including the number of hospital beds and the number of hospitals the unit provides a service to; current staffing levels, grades, and contract hours; details about information technology systems used to support practice; and hours spent undertaking various infection control activities. Barriers and enablers to evidence-based practice were also explored using a Likert scale, with a focus on resource, professional, and cultural challenges.[14] Participants were also asked to provide details on specific infection control–related outputs and patient outcomes in the previous 12 months. Outputs included the number of infection prevention and control policies developed and reviewed, accepted peer reviewed journal publications with listed authors from the infection control unit, and conference presentations (oral or poster presentations at conferences, associated with work undertaken by the infection control team). Patient outcomes included infection rates for HCA SAB and hospital-identified CDI. The definitions used for infection rates were based on nationally agreed definitions, supported by various tools and existing validation processes.[16-18]

Data analysis

Data were imported into and analyzed using IBM SPSS version 21.0 (IBM, Armonk, NY). Comparison of descriptive demographic variables was undertaken using independent t tests, with nonparametric independent data compared using the Mann-Whitney U test. The full-time equivalent (FTE) of a position was calculated on the assumption of a 38-hour work week. Mean FTE and 95% confidence intervals (CIs) per 100 overnight hospital beds were calculated using Poisson distribution. The incidence of HCA SAB and CDI were calculated as the number of cases per number of patient days $\times$ 10,000; 95% CIs were calculated for Poisson-distributed counts.

Staffing costs of nurses in infection control units were calculated using the FTE pay rates, according to the Queensland Health Enterprise Bargaining Agreement (April 1, 2014) and 30% on-costs. It was assumed that all staff were on contract or had permanent positions and received no casual loading. Annual staffing expenditure per 100 hospital beds was calculated, with 95% CIs determined, using bootstrapping with 10,000 iterations. Costs in this article are presented in US dollars using the average annual exchange rate for 2013 (US \$1 = A\$ 1.036).

For questions that required participants to rank a response, mean scores and SDs were calculated. Analysis of variance was performed to compare any differences between variable mean scores. A homogeneity of variance test was conducted prior to the 1-way analysis of variance, and if the assumption of homogeneity was not concluded, then a Kruskal-Wallis test was conducted.

Ethical considerations

Human research ethics approval was granted by several organizations, including the Avondale College of Higher Education, Hunter New England Health Service, Queensland Health, and Department of Heath South Australia. All participants were required to complete a consent form prior to completing the survey.

RESULTS

Surveys from 49 individual infection control units were completed, accounting for 152 Australian hospitals with 19,436 overnight hospitals beds (Table 1). No duplicate responses from an infection control unit were received. Infection control units were responsible for between 1 and 46 individual hospitals (median, 1). The 19,426 overnight beds constitute data representing 22.2% of all Australian hospital beds (both public and privately funded).[13] The