Major Article

Current status of personnel and infrastructure resources for infection prevention and control programs in the Republic of Korea: A national survey

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Background: There is significant variability in personnel and infrastructural resources for infection prevention and control (IPC) among health care institutions. The aim of this study is to evaluate the current status of individual hospital-based IPC programs in the Republic of Korea (ROK).
Methods: A multicenter cross-sectional survey of 100 hospitals participating in the national surveillance programs for multidrug-resistant organisms (MDROs) in the ROK was conducted in September 2015. The survey consisted of 140 standardized Web-based questionnaires.
Results: The survey response rate was 41.0%. The responding hospitals are largely organized with multibed rooms, with an insufficient numbers of single rooms. Employment status of infection specialists and hand hygiene resources were better in larger hospitals. The responding hospitals had 1 full-time infection control nurse per 400.3 ± 154.1 beds, with wide variations in training and experience. Facilities have great diversity in their approach to preventing MDROs. There appeared to be no difference in supplies consumption and protocols for IPC among the hospitals, stratified according to size.
Conclusions: A greater availability of specialist personnel, single rooms, and a comprehensive IPC program, with the support of a policy-oriented management, is necessary to achieve effective IPC.
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Following the findings of the Study on the Efficacy of Nosocomial Infection Control (SENIC Project), many countries defined the duties of hospitals for infection prevention and control and implemented legislation regulating the periodic accreditation of the quality of medical care.[1-3] In the Republic of Korea (ROK), a full-time infection control nurse (ICN) and an infection control physician (ICP)

were appointed in 1991, for the first time, at a national university-affiliated hospital.

Since 2010, it is a legal requirement in the ROK to report infections caused by 6 types of multidrug-resistant organisms (MDROs) to a national sentinel surveillance program: vancomycin-resistant *Staphylococcus aureus*, vancomycin-resistant *Enterococcus* (VRE), methicillin-resistant *S aureus* (MRSA), multidrug-resistant *Pseudomonas aeruginosa* (MRPA), multidrug-resistant *Acinetobacter baumannii* (MRAB), and carbapenem-resistant *Enterobacteriaceae* (CRE). Since 2011, many hospitals have obtained Joint Commission International accreditation, considered the gold standard certification in global health care. Since the revision of the Regulation of Medical Service Act in 2012, hospitals with >200 beds have been required to appoint an infection control committee and at least 1 full-time experienced staff member to oversee an infection control program.[4] Over the last 25 years, legislation and accreditation procedures have strongly influenced infection prevention and control

programs.[5] However, there is scarce information on the details of the current status of infection prevention and control programs in acute care hospitals in the ROK.

The purpose of this study is to examine hospitals participating in the national surveillance programs for MDROs to evaluate personnel, structure resources, and strategies associated with infection prevention and control in the ROK.

METHODS

Study design and participants

A multicenter cross-sectional survey was conducted in the ROK in September 2015. Blueprints for this study were drafted on the basis of the SENIC Project design, originally developed by the Centers for Disease Control and Prevention in the United States in the 1970s.[6] Basic information of the 100 hospitals participating in the national surveillance programs for MDROs was obtained from the Korean Association of Infection Control Nurses. To protect the confidentiality of hospitals, researchers compiled a list of the 100 hospitals and directly e-mailed the directors of each infection control unit, inviting them to respond to the Web-based survey. To increase survey response rates, repeat contact by weekly e-mail was made over 4 weeks. Only 1 person in each institution participated in the survey. The study protocol was approved by the institutional review boards prior to starting the study, and the requirement for informed consent was waived (AN15359-001).

Questionnaire

A modified survey form was developed on the basis of the questionnaire used in the SENIC Project.[7] The survey consisted of 140 standardized Web-based questionnaires. There were 3 sections: (1) infrastructure, equipment facilities, and accreditation for infection control programs; (2) human resources, including staff numbers, infection control training, employment status and work experience of ICNs, ICPs, and other support personnel; and (3) detailed practices of infection control activities for MDROs, such as antibiotic stewardship, collection, and analysis of data on the incidence of infections, staff training on infection prevention and control policies and procedures, daily isolation and cohort practices, conference organization and development of policies, employee health, product evaluation, emergency preparedness, and reporting of notifiable diseases.

Statistical analysis

Data were analyzed using descriptive statistics. Nominal variables were presented as the number of subjects (percentage) and analyzed using a χ^2 test. Continuous variables were expressed as mean ± SD or median (interquartile range [IQR]) and analyzed using the Mann-Whitney U test or Student t test, as appropriate. Analysis of variance and χ^2 tests were used to identify differences between the infection prevention and control programs according to hospital size, determined by the total number of beds. All tests were 2-tailed, and a P value <.05 was considered statistically significant. Analyses were performed with SPSS Statistics version 20.0 (IBM, Armonk, NY) and SAS 9.2 (SAS Institute, Cary, NC).

RESULTS

The survey response rate was 41.0%, with 41 hospitals divided into categories according to bed size: 200-499 beds (n = 7), 500-699 beds (n = 9), 700-899 beds (n = 17), and ≥900 beds (n = 8). Most of the hospitals were located in the metropolitan area (n = 29, 70.7%).

All hospitals were teaching institutions. Univariate analysis found no significant difference in the number of beds ($P > .999$) and the ratio of the number of beds to infection control personnel ($P = .943$) between respondents and nonrespondents.

Infrastructure

The median year in which participating hospitals were founded was 1983 (IQR, 1971-1997). The number of hospital beds ranged from 319-2,471, with a median number of beds of 768 (IQR, 581-871). The median number of intensive care unit (ICU) beds was 44 (IQR, 30-57), and the median proportion of ICU beds to total beds was 5.8% (IQR, 5.1-6.5). The median number of single rooms and cohort rooms for patient isolation was 5 (IQR, 2-8) and 5 (IQR, 3-8), respectively. The median ratio of beds to sink was 2.2 (IQR, 1.5-2.7). The median distance between beds in the ICUs was 1.5 m (IQR, 1.3-1.8).

Personnel

The average number of personnel members specializing in infection prevention and control in each hospital was 3.1 ± 1.7 (median, 3; IQR, 2-4; range, 1-10). Of these, 2.2 ± 1.5 (median, 2; IQR, 1-3; range, 1-9) were employed in a full-time position. The rest were employed on a temporary basis. The average number of full-time ICNs was 2.1 ± 1.4 (median, 2; IQR, 1-3; range, 0-8), with 1 full-time ICN per 400.3 ± 154.1 beds. On average, the ICNs had 63.5 months of experience in infection prevention and control (IQR, 28-87; range, 15-141). Of the responding hospitals, 85.4% and 80.5% employed a specialist in infectious disease and clinical microbiology, respectively. The median year in which infection control units were established was 2002 (IQR, 1996-2005; range, 1991-2008).

Infection control activities

All hospitals established written guidelines on the control of MDROs and setup a committee for infection prevention and control. All facilities have held periodic conferences on infection prevention and control. Frequency was evaluated as follows: <3 times per year (n = 12, 29.3%), 3 times per year (n = 23, 56.1%), and >3 times per year (n = 6, 14.6%). Of the responding hospitals, 97.6% monitored resistance trends of major MDROs and adapted clinical practice accordingly. Routine surveillance culture for MDROs was performed in 51.2% of facilities for the following microorganisms: MRSA (n = 10, 24.4%), VRE (n = 10, 24.4%), MRAB (n = 7, 17.1%), MRPA (n = 5, 12.2%), and CRE (n = 8, 19.5%), on the ICUs. Hospital-wide surveillance cultures were performed for MRSA (n = 4, 9.8%), VRE (n = 5, 12.2%), MRAB (n = 4, 9.8%), MRPA (n = 3, 7.3%), and CRE (n = 3, 7.3%). Contact precautions for carriers of MDROs were implemented in 95.1% of ICUs and 65.9% of hospitals. Single-room isolation was implemented in 14 hospitals (34.1%) for patients on ICUs and in only 8 facilities (19.5%) for those on general wards, respectively. On ICUs, single-room isolation was required for MRSA (n = 4, 9.8%), VRE (n = 25, 61.0%), MRAB (n = 8, 19.5%), MRPA (n = 4, 9.8%), and CRE (n = 22, 53.7%). Single-room isolation within the hospital generally was required for MRSA (n = 2, 4.9%), VRE (n = 25, 61.0%), MRAB (n = 2, 4.9%), MRPA (n = 1, 2.4%), and CRE (n = 19, 46.3%).

All hospitals had a hand hygiene monitoring program and feedback system, and 37 facilities (90.2%) implemented these on a regular basis throughout the hospital. All hospitals have organized educational sessions for staff to improve hand hygiene measures. The frequency of these sessions was either once per year (n = 34, 82.9%) or at least twice per year (n = 7, 17.1%). Staff education seminars on infection prevention and control were held annually in 22 hospitals (53.7%). Thirty-eight hospitals (92.7%) implemented an antibiotic