ISSN: 0976-3031

Available Online at http://www.recentscientific.com

CODEN: IJRSFP (USA)

International Journal of Recent Scientific Research
Vol. 10, Issue, 08(E), pp. 34293-34297, August, 2019

International Journal of Recent Scientific Research

DOI: 10.24327/IJRSR

Research Article

SURVEY OF INFECTION CONTROL PROFESSIONALS IN JIANGSU PROVINCE, CHINA

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DOI: http://dx.doi.org/10.24327/ijrsr.2019.1008.3862

ARTICLE INFO

Article History:

Received 10th May, 2019
Received in revised form 2nd June, 2019
Accepted 26th July, 2019
Published online 28th August, 2019

Key Words:

Infection control; Healthcare-associated infection; Prevention; Resource; China

ABSTRACT

Background: The use of evidence-based strategies to prevent and control infection is the most effective way to mitigate healthcare-associated infections. Infection control professionals (ICPs) are essential for implementing evidence-based strategies. The aim of this study was to evaluate if the installment of ICPs in Jiangsu province prevented and controlled healthcare-associated infections.

Methods: All secondary and tertiary hospitals located in thirteen major metropolitan areas of Jiangsu Province were invited to participate in a survey between July and September 2015. Heads and members of all infection control teams were asked to complete the questionnaires.

Results: Data from 105 hospitals were analyzed. Up to 98.1% of the surveyed hospitals have established an independent Infection Control Department. Most (63.8%) infection control team heads had a nursing education. On average, the participants reported 7.1 (SD = 5.7) years of work experience with infection control. Nearly half of the respondents had less than 5 years of experience as an ICP. The mean number of ICPs was 0.36 per 100 overnight beds, and the mean numbers of infection control nurses (ICNs) and infection control doctors (ICDs) were 0.21 and 0.08 per 100 overnight beds, respectively. The average numbers for major metrics to evaluate the ICPs were higher in tertiary hospitals than in secondary hospitals, except for the ICN and ICD categories (P = 0.018). Hospitals with fewer beds had more ICPs per 100 overnight beds than hospitals with more beds (P = 0.001).

Conclusions: All the surveyed hospitals have an established Infection Control Department. However, there are insufficient numbers of personnel with specialties in infection control, especially physicians, across all hospitals in Jiangsu Province, China. Hospital administrators should recruit more physicians to the infection control team and appoint them as heads of the department. A standardized certification of ICPs with different educational backgrounds is imperative for improving the composition of ICP teams in China.

INTRODUCTION

Background

Healthcare-associated infections are a major cause of hospital-acquired morbidity and mortality as well as a challenge for healthcare institutions worldwide [1], especially in developing countries [2]. The introduction of infection prevention and control teams/departments in Chinese hospitals started in the 1980s. In 1986, the National Corporation Group of Healthcare-associated Infection Management was established, marking the birth of the organization that specializes in the control of nosocomial infections in Chinese hospitals [3]. Although much progress has been made in the past few decades, the effectiveness of controlling nosocomial infections in China remains behind those of developed countries, including those in North America and Europe. A turning point was 2003, when China was hit hard by the severe acute respiratory syndrome outbreaks, which exposed the vulnerability of the infection control system and sounded a loud alarm to governments and hospitals. Since then, the prevention and control of healthcare-associated infections have become a focus for improving hospital management.

Infection control professionals (ICPs) are essential for executing infection prevention and control programs [4]. In the 1980s, the Centers for Disease Control and Prevention in the USA conducted a national study on the Efficacy of Nosocomial Infection Control (SENIC), which generated strong evidence that hospitals with higher rates of infection control professional staffing correlated with lower rates of healthcare-associated infections [5]. As shown by this study, the optimal staffing for infection control programs was one ICP for every 250 occupied beds in acute-care facilities. This ratio has been used in

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healthcare facilities of the USA and other countries since 1985. However, no further studies have been conducted since then. Many experts have acknowledged that the scope and role of ICPs in health care have expanded and changed dramatically [6-8]. Therefore, the SENIC conclusions might no longer be optimal for present needs. In addition, the healthcare system in China is different from that of other countries, and the organization of infection control teams in China is unique. One ICP per 200–250 acute-care beds was implemented as the standard for nosocomial infection surveillance in 2009 [9]. However, it is not clear whether this standard has been met in hospitals in Jiangsu Province. The purpose of this study was to obtain the latest information on ICPs by conducting a baseline survey regarding the installment and composition of ICP teams in Jiangsu province, China.

METHODS

This study utilized standardized questionnaires that collected data on the ICPs in hospitals as of 2015. Three types of questionnaires were designed, including those at the hospital level, director level, and personal level. The questionnaires were sent to the infection control teams of the surveyed hospitals by E-mail and returned by E-mail. The director of each infection control team was responsible for completion of both the hospital- and director-level questionnaires. In addition, every ICP was asked to complete a personal-level questionnaire. All secondary hospitals and tertiary hospitals from thirteen major metropolitan areas of Jiangsu province were invited to participate in the survey. The survey was conducted from July to September 2015.

Statistical analyses

Data were analyzed using IBM SPSS, version 22.0 (IBM, Armonk, NY). The mean and standard deviation values were calculated for continuous variables. The descriptive statistic was used for a proportion of responses. Comparison of nonparametric independent data was made using the Mann-Whitney U test for two groups and the Kruskal–Wallis H test for more than two groups. Significance of differences between continuous variables and reference values of nominal variables were considered when $P \leq 0.05$.

RESULTS

Characteristics of the surveyed hospitals

A total of 109 hospitals participated in the survey, and 604 questionnaires were accepted. Demographic characteristics were available for 105 of the 109 hospitals. The total response rate for the surveyed hospitals and infection control heads was 96.3%. The characteristics of these hospitals are described in Table 1. The tertiary hospitals accounted for 73.3% of the surveyed hospitals. Overall, 67% of the surveyed medical facilities ranged from 500 to 1499 beds. The Infection Control Departments in 98.1% of the hospitals were independent organizations, and 63.8% of the surveyed heads had a nursing educational background.

Table 1 The basic characteristics of the surveyed hospitals

Characteristic	Number of hospitals
Hospital level	
Tertiary hospitals	77 (73.3)
Secondary hospitals	28 (26.7)
Hospital size	
0–499	11 (10.1)
500–999	44 (40.4)
1000–1499	29 (26.6)
1500–1999	15 (13.8)
≥2000	9 (8.3)
Type of hospital	
General hospitals	74 (70.5)
Specialized hospitals	25 (23.8)
Traditional Chinese medical hospitals	6 (5.7)
Status of hospital	
Publicly funded hospitals	98 (93.3)
Privately funded hospitals	6 (5.7)
Others	1 (1.0)
Teaching status	
Teaching hospitals	102 (97.1)
Not teaching hospitals	3 (2.9)
Status of the Infection Control Department	
Independent department	103 (98.1)
Not independent department	2 (1.9)
Educational background of the head of the Infection Control Department	
Nursing	67 (63.8)
Medicine	28 (26.7)
Microbiology	4 (3.8)
Epidemiology	4 (3.8)
Pharmacy	1 (1.0)
Others	1 (1.0)

Demographic characteristics of the surveyed respondents

Table 2 shows the basic characteristics of the surveyed respondents. Each of the 105 hospitals recruited ICPs. There were 413 ICPs, and 394 responded to the survey in detail (response rate, 95.40%). More than 90% of the ICPs were female. Their average age was 43.6 (SD = 9.3) years old (>60% of them were >40 years old). The top three educational backgrounds were nursing, medicine, and epidemiology, covering more than 90% of the ICPs. Approximately 15% of the ICPs held master's or doctoral degrees, and a majority (84.0%) of the ICPs had clinical experience. More than 90% of the ICPs had been certified in infection control at the provincial level. Nearly all of the ICPs had attended at least one training session for infection control. The years of experience in infection control of the ICPs are shown in Figure 1. The participants reported an average of 7.1 (SD = 5.7) years of work experience with infection control (range, 1–27 years). Nearly half of the respondents had <5 years of experience as an ICP, while only 21% of them had >10 years of experience.

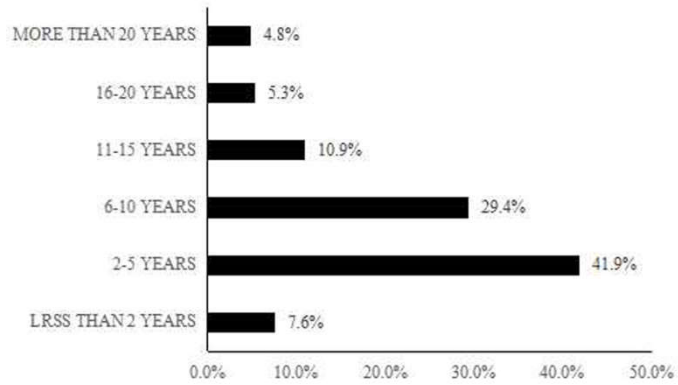

Figure 1 Years of work experience in infection control.

Table 2 Characteristics of the infection control professionals

Characteristic	Number of Responses (%)
Sex	
male	43 (8.7)
female	351 (91.3)
Age, Mean (SD)	43.6 (SD = 9.3)
20–29	39 (9.9)
30–39	85 (21.6)
40–49	126 (32.0)
50–59	140 (35.5)
≥60	4 (1.0)
Educational background	
Nursing	236 (59.9)
Medicine	77 (19.5)
Epidemiology	44 (11.2)
Microbiology	23 (5.8)
Management	6 (1.5)
Others	8 (2.0)
Educational degree	
Doctoral degree	1 (0.3)
Master's degree	62 (15.7)
Bachelor's degree	243 (61.7)
Associate's degree	75 (19.0)
Others	13 (3.3)
Positional title	
Junior	41 (10.4)
Vice junior	123 (31.2)
Middle	148 (37.6)
Primary	70 (17.8)
Others	12 (3.1)
Clinical experience	
Yes	331 (84.0)
No	63 (8.6)
Certification	
Yes	360 (91.4)
No	34 (8.6)
Taken a refresher urse	
Yes	46 (11.7)
No	348 (88.3)
Number of training sessions for infection control each year	
0	27 (6.9)
1–2	238 (60.4)
3–4	104 (26.4)
≥5	25 (6.4)

Ratio of ICPs and hospital beds

The total number of patient beds of the surveyed hospitals was 113,218 (average, 1078 beds), and the total number of ICPs was 413. The mean number of ICPs was 0.36 per 100 overnight beds (equivalent to one person every 278 beds; IQR, 0.30–0.44).

The mean numbers of infection control nurses (ICNs), infection control doctors (ICDs), and others were 0.21, 0.08, and 0.08 per 100 overnight beds (equivalent to one person every 476 beds and one person every 1250 beds), respectively. The average numbers for major metrics to evaluate the ICPs were higher in tertiary hospitals than in secondary hospitals, except for the ICN and ICD categories ($P = 0.018$). Forty-six facilities (43.8%) of the surveyed 105 hospitals, including 18 of the secondary hospitals, had not recruited ICDs yet. In addition, hospitals with fewer beds per 100 overnight beds had more ICPs than hospitals with more beds, especially ICNs. The details are shown in Tables 3 (analyzed at the hospital level) and 4 (based on hospital size).

DISCUSSION

In our survey, nearly half (48.7%) of the surveyed hospitals had more than 1000 beds. More than 90% of the 105 hospitals included were funded by local governments, which is higher than 67% from an Australian study [10]. The Infection Control Department was an independent organization in 98.1% of the surveyed hospitals, which was significantly higher than 39% [10] and 70.9% [11] from two recent large European surveys. In terms of the managerial structure, the Infection Control Department was placed under an executive office of the hospital and ran in parallel with the clinical departments in China. The ICPs had the authority to supervise healthcare workers on healthcare-associated infection-related issues in the hospital. Many European countries do not officially certify qualifications of ICPs, including ICNs and ICDs, which may explain the relatively lower ratio of independent departments [12]. In China, although there is no national standard certification program, the establishment of Infection Control Departments in hospitals is mandated by regulations, leading to this high percentage of independent departments. An independent department that has a mission, focus, authority, and budget would work more efficiently than a group/unit affiliated with other departments.

Table 3 Ratio of ICPs per 100 hospital beds in the surveyed hospitals according to hospital level

Item	All hospitals (n = 105)			Secondary hospitals (n = 28)			Tertiary hospitals (n = 77)			*P* value
	mean	median	IQR	mean	median	IQR	mean	median	IQR	(secondary vs. tertiary
ICN	0.21	0.21	0.15–0.30	0.50	0.24	0.18–0.35	0.20	0.20	0.14–0.27	0.06
ICD	0.08	0.06	0–0.13	0.09	0	0–0.1	0.08	0.07	0–0.13	0.051
Other majors	0.08	0.05	0–0.13	0.09	0	0–0.1	0.09	0.07	0–0.14	0.018
Total	0.36	0.35	0.30–0.44	0.69	0.34	0.30–0.41	0.37	0.36	0.31–0.45	0.178

ICPs,infection control professionals; ICN, Infection control nurse; ICD, Infection control doctor; IQR, Interquartile range.

Table 4 Ratio of infection control professionals per 100 hospital beds in the surveyed hospitals according to the hospital size

Item	0–499 (n = 11)			500–999 (n = 44)			1000–1499 (n = 29)			1500–1999 (n = 15)			≥2000 (n = 9)			*P* value
	mean	median	IQR	mean	median	IQR	mean	median	IQR	mean	median	IQR	mean	median	IQR	
ICN	0.42	0.44	0.27–0.59	0.24	0.22	0.16–0.31	0.23	0.22	0.16–0.31	0.17	0.17	0.12–0.21	0.16	0.12	0.19–0.22	0.00019
ICD	0.11	0	0	0.08	0.10	0–0.15	0.05	0.08	0–0.09	0.07	0.06	0.05–0.12	0.10	0.05	0.04–0.16	0.184
Other majors	0.06	0	0	0.08	0	0–0.13	0.07	0.07	0–0.09	0.09	0.06	0–0.16	0.08	0.07	0–0.14	0.408
Total	0.59	0.57	0.36–0.83	0.40	0.38	0.33–0.47	0.35	0.34	0.30–0.39	0.33	0.33	0.31–0.35	0.34	0.30	0.20–0.39	0.001

ICN, Infection control nurse; ICD, Infection control doctor; IQR, Interquartile range.

The educational background and professional experience of the head of the Infection Control Department are important for implementing an infection control program. Our study found that most of the heads of infection control teams had a nursing education, and less than one-third of them were medical doctors. However, a survey of 309 hospitals from 24 countries found that 58% of infection control heads were medical doctors [13].

In addition, eight infection control heads out of nine hospitals were medical doctors in a Polish study [14]. Appointment of a physician as an infection control head is ideal, as physicians can communicate effectively with other clinicians about infection control and promote antimicrobial stewardship programs. As many as 35.5% of the ICPs were in the age group of 50–59 year olds, followed by 32.0% in the age group of 40–49 year olds; these data are similar to the findings in a recent study from the USA [15]. In China, the retirement age is set at 60 years old, leading to fewer old people working in the hospital.

Most ICPs had a nursing (59.9%) education; however, the percentage was lower than 81.87% reported by a previous study from the USA [15], reflecting a diversified educational background in this study. The majority (61.7%) of the ICPs had bachelor's degrees, which is higher than that in the American report. Yet, the percentage of ICPs with a master's degree or above (16%) was much lower in our study than in the USA report (31.53%), highlighting the need to recruit ICP candidates with graduate degrees.

In the category of work experience, 41.9% of the ICPs had infection control experience of 2–5 years, and about one-half of the ICPs had less than 5 years of experience, which is similar an American survey [15] and a Korean survey [4]. Less than 20% of the ICPs had more than 10 years of experience in our study. ICP turnover was 53% in the last 5 years in 33% of the surveyed hospitals (data not shown). These results demonstrate that a frequent ICP turnover is a problem that is shared by other countries. Unlike some countries [16,17] where ICPs have additional responsibilities beyond infection control, the ICPs in China are full-time ICPs. An insufficient number of personnel for infection control has been the main issue in many regions of the world. The lack of ICDs was identified as the biggest issue [18]. In recent years, non-nurse professionals in our locality have been encouraged to join infection control teams. However, they are often not medical doctors or do not have specialization in infection control, which was similarly identified in some European countries [19]. At present, in China, clinicians without a background in infection control are often transferred to the Infection Control Department to fill open positions. Once there, they do not envision an opportunity for career development. No certification for infection control at the national or organizational level is another hurdle, which impedes bringing a uniform quality in the Infection Control Department. The European Committee on Infection Control that is affiliated with the European Society of Clinical Microbiology and Infectious Diseases was founded in 2014 in order to establish an infection control curriculum and issue certifications to ICPs with different backgrounds. A similar approach should be taken in China [20].

The recommendations from the Study on the Efficacy of Nosocomial Infection Control (SENIC Project) in the 1980s have been broadly accepted in many countries. One ICP per 250 acute-care beds was the standard model. In China, one ICP to 200–250 acute-care beds is stated in the regulations book. However, many experts argued that the scope and role of ICPs in health care have been expanded and changed significantly since the SENIC project was initiated. Many studies have investigated new requirements. A report from Canada has suggested the implementation of 0.6 ICPs/100 beds in acute-care hospitals and 0.4 ICPs/100 beds in long-term care facilities [6]. In most Polish hospitals, the number of epidemiological nurses per 100 beds ranges from 0.4 to 0.8 [14]. In addition, the data from 309 hospitals in 24 countries demonstrate a median of 0.4 ICNs and 0.1 ICDs per 100 beds in Europe [13]. Moreover, the mean number of ICPs was 0.66 per 100 overnight beds in an Australian survey including 152 hospitals [10]. Recently, a large survey found that the median ratio of ICDs was 0.18 per 100 beds [11]. The results of our survey showed 0.36 ICPs per 100 beds, including 0.21 ICNs and 0.08 ICDs per 100 beds, respectively; these numbers are similar to or lower than those cited above. Although the ratio of ICNs was higher, the ratios of all ICPs and ICDs in our survey were lower than those recently reported in similar surveys from twelve provinces in China [21].

The ratios identified in this survey were related to the hospital size. Hospitals with more than 1000 beds in our survey accounted for nearly 50% of the surveyed hospitals, and about 10% of them had >2000 beds. The cost of infection control personnel had to be weighed by the hospital administrators. According to our results, hospitals with fewer beds had a much higher ICP to bed ratio than hospitals with more beds. In addition, 43.8% out of the surveyed hospitals had no recruited ICDs. A systematic review has indicated that an effective infection control program in an acute-care hospital must include nursing staff, a dedicated physician trained in infection control, microbiological support, and data management support [8]. The author further suggested that an effective infection prevention program does not rely on a functional infection-control team, but also depends on the hospital organization, bed occupancy, staffing, and workload.

Some limitations of this study should be considered: first, the surveyed hospitals from some cities did not include all hospitals, and the results may not apply everywhere in Jiangsu Healthcare Services; second, our study was descriptive, and we could not provide a definite model that can project ICPs in other hospitals in different regions.

CONCLUSION

Using the ratio of ICPs to beds as metrics, the current infection control personnel in our locality are comparable to other regions in the world. A major issue is the lack of ICDs among ICPs in Jiangsu province, China. Hospital administrators should recruit more clinicians and appoint them as heads of infection control teams.

Acknowledgments

The authors would like to thank all the participating hospitals for their invaluable data.

Funding

This study was supported by the Priority Academic Program Development of Jiangsu Higher Education Institutions (PAPD) (JX10231803).

Availability of data and materials

The data analysed during the current study are available from the corresponding author on reasonable request.

Authors'contributions

Wei Hongzhang was responsible for the design, the supervision of the study. Bo Liu and Caiyun Chen collected and analysed the data, and drafted the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

The study is based on anonymised retrospective datasets, no ethics approval was necessary.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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