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Point-prevalence surveys of hospital-acquired infections in a Chinese cancer hospital: From 2014 to 2018

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ABSTRACT

Background: Both hospital-acquired infection (HAI) and cancer represents major health concerns worldwide, but there is a paucity of data describing HAI in Chinese cancer patients. The objective of this study is to demonstrate the prevalence, causative agents, antimicrobial use and risk factors for HAI in a cancer hospital in Southwestern China.

Methods: We use the criteria of the Ministry of Health of the People's Republic of China to define hospital-acquired infections. One-day cross-sectional surveys were annually conducted from 2014 to 2018. Trained staff collected hospital-acquired infections, antimicrobial use and clinical characteristics data of inpatients. Multivariate logistic regression was used to determine the potential risk factors associated with HAIs.

Results: Of the 6717 patients surveyed, there were 140 patients (2.1%, 95% confidence interval, 1.7–2.4%) with 144 distinct HAIs. Lower respiratory tract infections (47, 32.6%) and surgical-site infections (29, 20.1%) were the most common HAIs. *Escherichia coli* was the most common pathogen (29.6%). Risk factors for HAI included younger age (<18 years) or older age (>65 years), hospitalization in the intensive care unit, presence of central catheter and undergoing surgery in the previous 30 days. The overall prevalence of patients receiving antimicrobial agents was 15.2%.

Conclusion: To control hospital-acquired infections in cancer patients, surveillance and prevention strategies to infections associated with central catheters or related to surgery should be augmented.

Introduction

Hospital-acquired infection (HAI) is a major global public health concern [1]. The burden of hospital infection is enormous, resulting in prolonged hospital stays, increasing antimicrobial resistance, long-term disability, escalating additional costs for healthcare, and unnecessary deaths [2,3]. Infection prevention and control continues to be a challenge in China.

Cancer remains one of the major health concerns worldwide. It is estimated that 18.1 million new cancer cases and 9.6 million cancer deaths occurred in 2018 worldwide [4]. Cancer accounts for two of the five leading causes of death in China, which is home to a fifth of the global population [5]. Cancer patients, especially the immunocompromised, are more susceptible to be affected with HAIs [6–8]. The immune dysfunction mainly because of cancer-associated immune deficiencies, and invasive procedures during supportive care, such as undergoing surgery or indwelling central catheter, or antineoplastic chemotherapy or radiation therapy [6,9–11]. Over the last few decades, therapies in oncology have evolved rapidly. Furthermore, there has been increasingly more recognition of the role of infection prevention and control in the outcomes of cancer patients [12].

Cross-sectional prevalence survey is a cost-effective surveillance strategy for hospital-acquired infection, providing meaningful data to investigate potential trends of such infections, isolated pathogens and antimicrobial uses [13–16]. Public health officials and health care leaders of different countries have used repeated point-prevalence surveys to assess hospital-acquired infection and evaluate the impact of prevention and control interventions [17–25]. Unfortunately, few studies that concern the point-prevalence of hospital-acquired infection among cancer patients have been conducted. Moreover, there is few English-language literature for trends of HAIs and antimicrobial use of Chinese cancer patients.

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To address the current knowledge gap, we conduct five annual point-prevalence surveys of hospital-acquired infections in a cancer hospital in Southwestern China. The objective of this report was to estimate the prevalence of hospital-acquired infections and antimicrobial use in a Chinese cancer hospital, determine the distribution of these infections according to infection site and pathogen, and identify factors associated with these infections.

Materials and methods

Study design and setting

The one-day cross-sectional surveys were conducted in Affiliated Tumor Hospital of Guangxi Medical University on Aug 20th 2014, Aug 12th 2015, Aug 4th 2016, Aug 23rd 2017 and Aug 15th 2018. These annual point-prevalence surveys used the same methodology, a standardized questionnaire designed by Guangxi Nosocomial Infection Control and Quality Improvement Center. The surveys did not require ethical approval because they were part of a mandatory quality improvement program.

The hospital founded in 1985 in Nanning, a city in Southwestern China. This tertiary hospital, also known as Cancer Hospital of Guangxi Zhuang Autonomous Region, has been designated a Cancer Center by the Guangxi Province Government, and cares exclusively for patients with cancer. The hospital owns 25 clinical departments and 1300 beds, with 43,559 patient admissions in 2018.

In this study, clinical wards were divided into the following four groups: medical oncology (including chemotherapy, invasive technology, comprehensive internal medicine and traditional Chinese medicine), radiation oncology, surgical oncology (including hepatobiliary surgery, gastrointestinal surgery, breast surgery, thoracic surgery, gynecologic oncology, head and neck surgery, neurosurgery, urology, bone and soft tissue surgery), and intensive care unit (ICU).

Definitions

The survey included all patients at the hospital on survey day and patients who were discharged on the same day. Patients who were admitted to the hospital on survey day were not included. All inpatients including those who were discharged on survey days were eligible for enrolment; outpatients and newly admitted patients were excluded from the study.

Case definitions for HAI were based on the definition criteria established by the original Ministry of Health of the People's Republic of China (MHPRC) [26], adapted from the US Center for Disease Control and Prevention (CDC) [27]. An infection was defined as HAI when: (1) the signs and symptoms of infection present more than 48 h after admission, and do not present or incubating on admission; or (2) the signs or symptoms of a surgical-site infection were present at admission or started before 48 h after admission, and the surgical-site infection occurred within 30 days of a surgical intervention (or within one year if an implant was in place). HAIs were classified as upper or lower respiratory tract infection (URTI/LRTI), urinary tract infection (UTI), bloodstream infection (BSI), surgical-site infection (SSI), intra-abdominal infection, gastrointestinal infection, skin and soft tissue infection and other infections.

Data collection procedures and management

The surveys were conducted by the Department of Hospital Infection Prevention and Control. Consisting of several clinicians, public health physicians and nurses, the team is responsible for survey operations, personnel training, and data collection. The infection preventionists and chief residents of each ward received training in data collection procedures and definitions for HAI. By visiting patients and reviewing medical records and laboratory reports, trained staff manually completed each standardized survey questionnaire, including basic demographic and clinical information, HAI-specific details and antimicrobial use. Program staff entered data into a network data software developed at the National Nosocomial Infection Surveillance System. To ensure the reliability and validity, we checked the data for errors and inconsistencies, and re-reviewed medical records when HAI cases were found or when necessary.

Statistical analysis

Data were analyzed with the use of SPSS software, version 22.0 (IBM, Armonk, NY, USA). The prevalence of HAI patients was calculated with 95% confidence interval (CI). Chi-square tests were used for categorical variables and median tests for continuous variables. To identify potential risk factors associated with HAIs, we first compared patients with and without HAIs using univariate logistic regression. Covariates with *P* values of 0.1 or less in the univariate analysis or with clinical plausibility were selected and included in a multivariate logistic regression model. All tests were two-tailed and *P* value of 0.05 or less was considered to indicate statistical significance.

Results

Patient baseline characteristics

Overall, 6717 patients were included in the five point-prevalence surveys performed between 2014 and 2018. The survey completion rate was 99.1% (6717/6775). Table 1 shows the demographics and clinical characteristics of the surveyed patients. Ages of all patients ranged from 3 years to 100 years and the median age was 52 years (interquartile range, 43–60). About half (52.0%) of patients were in surgical wards on the survey date; followed by medical wards (30.3%); 0.5% were in ICU (Table 1). Of the patients surveyed, 1474 (21.9%) had at least one central catheters in place. In total, 1309 (19.3%) of the patients underwent surgery and 2484 (37.0%) received chemotherapy during the prior 30 days.

Prevalence and distribution of hospital-acquired infections

Overall, 140 of 6717 patients were diagnosed as hospital-acquired infection. Among the 140 infected patients with a total of 144 infection sites, one infection occurred in 136 patients (97.1%) and two concurrent infections in 4 patients (2.9%). The overall prevalence of HAI was 2.1% (95% CI, 1.7–2.4%) (Table 2). The overall prevalence of HAIs per day of hospitalization was 1.6‰ (140 patients/85,370 days). The trend for prevalence of hospital-acquired infection is shown in Fig. 1. There was no significant difference in HAIs prevalence between the annual surveys ($\chi^2 = 9.346$, $P = 0.053$). Lower respiratory tract infection was the most common infection, followed by surgical-site infection, bloodstream infection, and urinary tract infection (Table 2). Of 29 surgical-site infections in the surveys, 22 (75.8%) were deep incisional or organ-space infections.

Pathogens causing hospital-acquired infections

For yearly prevalence of HAI and trend for distribution of the pathogens causing HAI, see Fig. 1. A total of 71 pathogens were reported for 64 of 144 hospital-acquired infections (44.4%). *Escherichia coli* was the most common pathogen, causing 21 hospital-acquired infections (29.6%). *Pseudomonas aeruginosa* and *Klebsiella pneumoniae* were the following common pathogens, with

Table 1
Demographic and clinical characteristics of surveyed patients.

Characteristics	All patients (N = 6717)	Patients without HAI (N = 6577)	Patients with HAI (N = 140)	P value
Sex				0.396
Male	3360 (50.0)	3285 (49.9)	75 (53.6)	
Female	3357 (50.0)	3292 (50.1)	65 (46.4)	
Age				0.003
<18 years	142 (2.1)	134 (2.0)	8 (5.7)	
18–39 years	1083 (16.1)	1067 (16.2)	16 (11.4)	
40–54 years	2757 (41.0)	2706 (41.1)	51 (36.4)	
55–64 years	1741 (25.9)	1706 (25.9)	35 (25.0)	
≥65 years	994 (14.8)	964 (14.7)	30 (21.4)	
Location of patient in hospital on survey date – no. (%)				<0.001
Medical oncology	2038 (30.3)	1990 (30.3)	46 (32.9)	
Radiation oncology	1156 (17.2)	1131 (17.2)	25 (17.9)	
Surgical oncology	3492 (52.0)	3430 (52.2)	64 (45.7)	
Critical care unit	31 (0.5)	26 (0.4)	5 (3.6)	
Central catheter in place on survey date – no. (%)				<0.001
Yes	1474 (21.9)	1404 (21.3)	70 (50.0)	
No	5243 (78.1)	5173 (78.7)	70 (50.0)	
Urinary catheter in place on survey date – no. (%)				<0.001
Yes	527 (7.8)	503 (7.6)	24 (17.1)	
No	6190 (92.2)	6074 (92.4)	116 (82.9)	
Ventilator in place on survey date – no. (%)				0.078
Yes	48 (0.7)	45 (0.7)	3 (2.1)	
No	6669 (99.3)	6532 (99.3)	137 (97.9)	
Patient underwent surgery in the previous 30 days – no. (%)				<0.001
Yes	1309 (19.3)	1254 (19.1)	55 (39.3)	
No	5408 (80.7)	5323 (80.9)	85 (60.7)	
Patient received chemotherapy in the previous 30 days – no. (%)				0.031
Yes	2484 (37.0)	2420 (36.8)	64 (45.7)	
No	4233 (63.0)	4157 (63.2)	76 (54.3)	
Patient received radiotherapy in the previous 30 days – no. (%)				0.579
Yes	947 (14.1)	925 (14.1)	22 (15.7)	
No	5770 (85.9)	5652 (85.9)	118 (84.3)	

HAI, hospital-acquired infection.

Table 2
Prevalence of hospital-acquired infections in a cancer hospital in Guangxi, China.

	2014 (N = 1349)	2015 (N = 1334)	2016 (N = 1442)	2017 (N = 1256)	2018 (N = 1336)	Total (N = 6717)
Number of patients with infections	39	29	18	27	27	140
Number of infections	39	29	19[a]	30[b]	27	144
Percentage of patients with infection (95% CI)	2.9 (2.0–3.8)	2.2 (1.4–3.0)	1.2 (0.7–1.8)	2.1 (1.3–3.0)	2.0 (1.3–2.8)	2.1 (1.7–2.4)
Type of infection – no. (%)						
Lower respiratory tract infection	14 (35.9)	7 (24.1)	5 (26.3)	8 (26.7)	13 (48.1)	47 (32.6)
Surgical-site infection	11 (28.2)	6 (20.7)	3 (15.8)	5 (16.7)	4 (14.8)	29 (20.1)
Bloodstream infection	3 (7.7)	5 (17.2)	3 (15.8)	3 (10.0)	3 (11.1)	17 (11.8)
Urinary tract infection	3 (7.7)	4 (13.8)	2 (10.5)	3 (10.0)	1 (3.7)	13 (9.0)
Intra-abdominal infection	2 (5.1)	2 (6.9)	0	5 (16.7)	0	9 (6.3)
Upper respiratory tract infection	2 (5.1)	1 (3.4)	1 (5.3)	1 (3.3)	2 (7.4)	7 (4.9)
Skin or soft tissue infection	2 (5.1)	2 (6.9)	0	1 (3.3)	2 (7.4)	7 (4.9)
Gastrointestinal infection	1 (2.6)	0	1 (5.3)	3 (10.0)	1 (3.7)	6 (4.2)
Other infection	1 (2.6)	2 (6.9)	4 (21.1)	1 (3.3)	1 (3.7)	9 (6.3)

[a] One patient was diagnosed as both lower respiratory tract infection (LRTI) and gastrointestinal infection (GI).
[b] One patient was diagnosed as both LRTI and GI, one both LRTI and intra-abdominal infection, and one both intra-abdominal infection and skin or soft tissue infection.

being reported for 16.9% and 11.3% of all hospital-acquired infections (Table 3). *E. coli* was the most prevalent pathogens causing surgical-site infections (45.0%, 9/20) and urinary tract infections (55.6%, 5/9). *P. aeruginosa* was most frequently detected from lower respiratory tract infections (35.0%, 7/20).

Overall, 17 (23.9%) of all isolates were multidrug-resistant organisms. Out of six *Staphylococcus aureus* isolates 3 (50.0%) were methicillin resistant (MRSA). Among 34 *E. coli*, *klebsiella*, and *enterobacter* isolates 12 (35.3%) were resistant to third-generation cephalosporins and none to carbapenems.

Risk factors for hospital-acquired infections

Patients who were younger than 18 years or older than 65 years, were in the ICU, had a central catheter or urinary catheter in place, or had been underwent surgery or chemotherapy in the previous 30 days were at an increased risk of HAIs in the unadjusted analysis (Table 4). Multivariate logistic regression analysis showed that patients who were younger than 18 years or older than 65 years, were in the ICU, had a central catheter in place, or had been received surgery in the previous 30 days had an increased risk of hospital acquired infection (Table 4).

Antimicrobial use

Among all patients, 1023 (15.2%; 95% CI, 14.4–16.1%) received at least one antimicrobial agent at the time of the surveys. Among these, 493 (48.2%) received one antimicrobial agent, 488 (47.7%) received two, and 42 (4.1%) received there or more antimicrobial agents (Table 5). Among patients who received antimicrobial agents, 441 (43.1%) were for prophylaxis, 442 (43.2%) for therapeutic purpose, and 140 (13.7%) for both therapeutic and prophylactic

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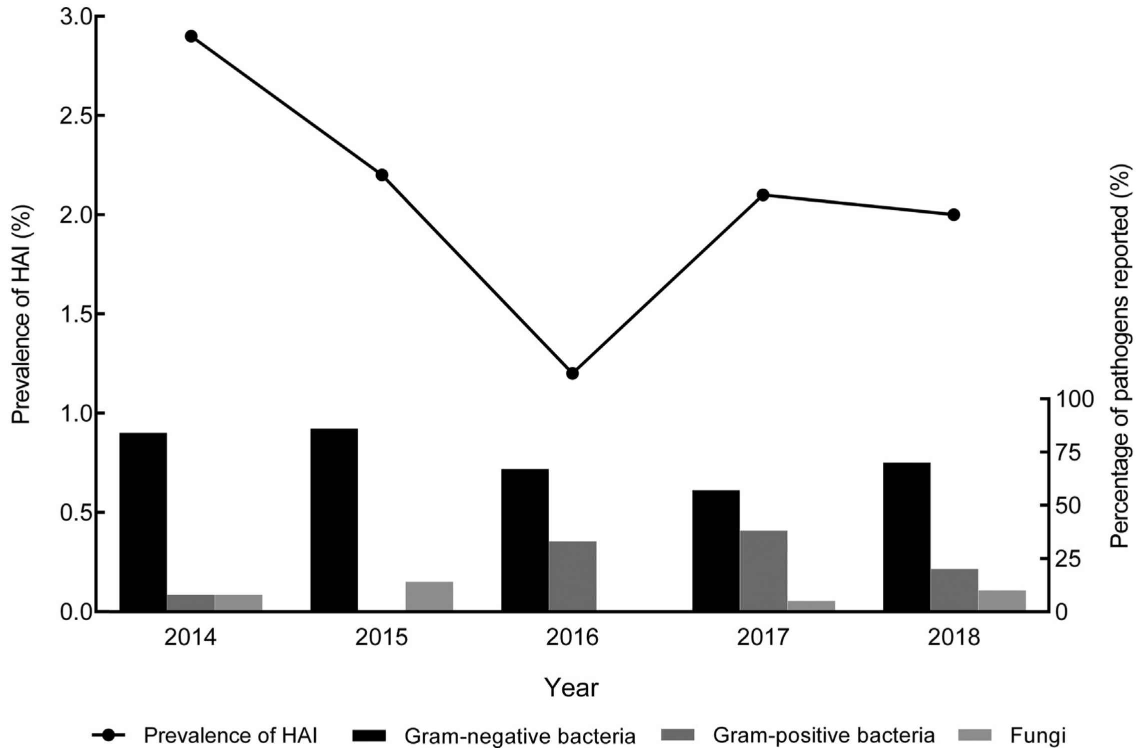

Fig. 1. Trend for prevalence of hospital-acquired infection (HAI) and distribution of the pathogens causing HAI in a cancer hospital in Guangxi, China. HAI, hospital-acquired infection.

Table 3
Distribution of HAI pathogens in a cancer hospital in a cancer hospital in Guangxi, China, 2014–2018.

Pathogens	All infections[a] (*N* = 144)	Lower respiratory tract infection[b] (*N* = 47)	Surgical- site infection [c] (*N* = 29)	Bloodstream infection (*N* = 17)	Urinary tract infection (*N* = 13)	Intra-abdominal infection (*N* = 9)	Skin or soft tissue infection (*N* = 7)	Other infection (*N* = 22)
Pathogens reported	64 (44.4)	19 (40.4)	17 (58.6)	9 (52.9)	8 (61.5)	5 (55.6)	2 (28.6)	4 (18.2)
Gram-negative bacteria								
Escherichia coli	21 (29.6)	0	9 (45.0)	1 (11.1)	5 (55.6)	4 (66.7)	1 (33.3)	1 (25.0)
Pseudomonas aeruginosa	12 (16.9)	7 (35.0)	2 (10.0)	0	2 (22.2)	0	0	1 (25.0)
Klebsiella pneumoniae	8 (11.3)	4 (20.0)	1 (5.0)	1 (11.1)	0	1 (16.7)	1 (33.3)	0
Acinetobacter baumannii	2 (2.8)	1 (5.0)	0	1 (11.1)	0	0	0	0
Proteus mirabilis	2 (2.8)	0	1 (5.0)	0	1 (11.1)	0	0	0
Other Gram-negative bacteria	6 (8.5)	3 (15.0)	0	2 (22.2)	0	0	0	1 (25.0)
Gram-positive bacteria								
Staphylococcus aureus	6 (8.5)	0	4 (20.0)	0	0	0	1 (33.3)	1 (25.0)
Enterococcus species	4 (5.6)	0	2 (10.0)	0	1 (11.1)	1 (16.7)	0	0
Other Gram-positive bacteria	5 (7.0)	0	1 (5.0)	4 (44.4)	0	0	0	0
Fungi								
Candida albicans	5 (7.0)	5 (25.0)	0	0	0	0	0	0
No pathogen reported	51 (35.4)	17 (36.2)	7 (24.1)	8 (47.1)	4 (30.8)	2 (22.2)	3 (42.9)	10 (45.5)
No sample submitted	29 (20.1)	11 (23.4)	5 (17.2)	0 (0)	1 (7.7)	2 (22.2)	2 (28.6)	8 (36.4)

[a] A total of 71 pathogens were reported for 64 of 144 hospital-acquired infections. Up to 2 pathogens could be reported for each infection.
[b] A total of 20 pathogens were reported for 19 of 47 lower respiratory tract infections (40.4%).
[c] A total of 20 pathogens were reported for 17 of 29 surgical-site infections (58.6%).

purposes (Table 5). Of the 582 patients who received antimicrobial for therapeutic purposes, 314 (54.0%) had microbiology testing before receiving treatment.

Discussion

In these annual point-prevalence surveys conducted for five consecutive years in a cancer hospital in China, we found that the overall prevalence of patients with HAI was 2.1%. The prevalence is similar to one survey from 124 hospitals in Beijing, China in 2014 (2.1%) [28], but it is a lower percentage than previous surveys that conducted in different parts of China in 2010–2017 (2.9–4.3%) [22,29–32], in Europe in 2010 (7.1%) [19], in the United States in 2015 (3.2%) [18], in Singapore in 2016 (11.9%) [21], in Switzerland in 2017 (5.9%) [33], and in Japan in 2018 (7.4%) [24].

The HAI prevalence in our hospital was close to the lower end of the range, as compared with those in other Chinese provinces and cities. There are several reasons can account for the observed difference between countries and regions. First, differences in HAI prevalence between different studies may be contributed by differences in hospital characteristics and the patient population, including severity of illness and comorbidities. Second, it may be

Table 4
Univariate and multivariate analyses comparing patients with and without hospital-acquired infections in relation to potential risk factors.

Variables	Total no. of patients	No. of patients with infection	Unadjusted risk ratio (95% CI), *P* value	Adjusted risk ratio (95% CI), *P* value[a]
Age				
<18 years	142	8	3.981 (1.672–9.479), *P* = 0.002	3.628 (1.490–8.836), *P* = 0.005
18–39 years	1083	16	Reference	Reference
40–54 years	2757	51	1.257 (0.714–2.214), *P* = 0.429	1.357 (0.766–2.403), *P* = 0.296
55–64 years	1741	35	1.368 (0.754–2.484), *P* = 0.303	1.475 (0.805–2.703), *P* = 0.209
≥65 years	994	30	2.075 (1.124–3.831), *P* = 0.020	2.377 (1.270–4.448), *P* = 0.007
Location of patient in hospital on survey date				
Medical oncology	2038	46	Reference	Reference
Radiation oncology	1156	25	0.957 (0.585–1.566), *P* = 0.862	1.075 (0.650–1.780), *P* = 0.778
Surgical oncology	3492	64	0.783 (0.532–1.151), *P* = 0.213	0.469 (0.290–0.758), *P* = 0.002
Intensive care unit	31	5	12.63 (5.18–30.794), *P* < 0.001	3.257 (1.109–9.567), *P* = 0.032
Central catheter on the survey date	1474	70	3.684 (2.632–5.158), *P* < 0.001	2.866 (1.967–4.176), *P* < 0.001
Urinary catheter on the survey date	527	24	2.498 (1.595–3.914), *P* < 0.001	0.774 (0.422–1.419), *P* = 0.407
Ventilator on the survey date	48	3	3.179 (0.976–10.353), *P* = 0.055	1.146 (0.317–4.137), *P* = 0.836
Patient underwent surgery in the previous 30 days	1309	55	2.747 (1.946–3.877), *P* < 0.001	3.888 (2.405–6.286), *P* < 0.001
Patient received chemotherapy in the previous 30 days	2484	64	1.447 (1.033–2.025), *P* = 0.031	1.298 (0.888–1.898), *P* = 0.178

[a] Variables with a *P* value of <0.1 in univariate analysis or with clinical plausibility were included in the multivariable model.

Table 5
Antimicrobial use in a cancer hospital in Guangxi, China, 2014–2018.

Variables	2014 (*N* = 1349)	2015 (*N* = 1334)	2016 (*N* = 1442)	2017 (*N* = 1256)	2018 (*N* = 1336)	Total (*N* = 6717)
Antimicrobial use on survey date – no. (%)						
Yes	171 (12.7)	198 (14.8)	198 (13.7)	217 (17.3)	239 (17.9)	1023 (15.2)
1 antimicrobial agent	92 (53.8)	83 (41.9)	88 (44.4)	111 (51.2)	119 (49.8)	493 (48.2)
2 antimicrobial agents	73 (42.7)	104 (52.5)	101 (51.0)	96 (44.2)	114 (47.7)	488 (47.7)
3 or more antimicrobial agents	6 (3.5)	11 (5.6)	9 (4.5)	10 (4.6)	6 (2.5)	42 (4.1)
Purpose of antimicrobial use – no. (%)						
Prophylactic	81 (47.4)	77 (38.9)	73 (36.9)	90 (41.5)	120 (50.2)	441 (43.1)
Therapeutic	75 (43.9)	93 (47.0)	95 (48.0)	86 (39.6)	93 (38.9)	442 (43.2)
Therapeutic + prophylactic	15 (8.8)	28 (14.1)	30 (15.2)	41 (18.9)	26 (10.9)	140 (13.7)

caused by the differences in surveillance definitions of HAI, and methods of data collection and analysis. Those studies from China were conducted in accordance with the 2001 MHPRC Diagnostic Criteria, a modified version of the US CDC definitions in 1989 [27]. Thus, the prevalence of HAIs in China (2.9–4.3%) is close to that of the United States (3.2–4.0%) [17,18], which is lower than the surveys using the European CDC definition (5.9–11.9%) [19,21,24,33]. Third, the prevalence of HAIs in our hospital may have been underestimated due to the following two reasons. It is possible that the temporary infections were underestimated, since antimicrobial prophylaxis is commonly used in cancer patients who receive myeloablative therapy and develop severe neutropenia [12]. Next, it is usually difficult to distinguish infectious fever, cancerous fever and fever of tumor necrosis absorption, which might lead parts of patients with unspecified sepsis be omitted. Last, our hospital had implemented a comprehensive infection control and prevention strategy for cancer patients in recent years. Increased focus on improving hand hygiene, prevention of device-related infections, isolation precautions of multidrug-resistant organisms for patients with cancer, and environmental cleaning may also have contributed.

We found LRTI was the most common HAI in our study, consistent with previous studies in China [22,28,30,31]. However, those Chinese study, including ours, were conducted with the definition of MHPRC, in which LRTI refers to “pneumonia” and “lower respiratory tract infection other than pneumonia”. The majority of LRTI in our surveys were pneumonia. The first and second places in our study were LRTI and SSI, which accounted for more than half of the infections. This is consistent with the top two in the studies of Europe and the United States [17,19], but we have a higher proportion (32.6%) of pneumonia than in Europe (25.7%) and the United States (21.8%). We observed the higher proportion of SSI in our study than other studies in China [25,29]. It is likely that cancer patients who undergo surgical intervention treatment are at greater risk of infection, resulting in increased incidence of SSI [6,34,35]. Therefore, it is critical to focus on prevention strategies for surgical-site infections in our hospital in the future.

E. coli, with being reported for 45.0% of surgical-site infections, was the most common pathogens of hospital-acquired infection in our study, similar to the former analyses from China [28] and the USA [17]. Nevertheless, it is differed from some other reports [17,19,21,22], in which *S. aureus* were the most frequent bacteria in surgical-site infections. Discrepancies may represent differences in patient characteristics and types of surgery. Some investigators found that *E. coli* was the most familiar pathogens in gastrointestinal, urologic, gynecologic, pancreatic and hepatobiliary surgeries, and extended-spectrum β-lactamase producing strains have become endemic in Asia [34,36].

The overall prevalence of patients receiving antimicrobial agents in our study (15.2%) is markedly lower than the China national survey (35.0%) [37] and previous studies from other countries (32.9–51.8%) [18,20,21,23,24]. The prevalence of antimicrobial use varies considerably among countries and hospitals. Three important points can be surmised. First, part of this variability may be explained by differences in patient case-mix and the prevalence of HAIs. Second, the most common indication for antimicrobial use was the treatment of a community-acquired infection [19,20,23]. However, unlike general hospitals, especially those with emergency departments, our hospital has fewer patients with community-acquired infection. Third, the lower antimicrobial use prevalence observed in our study may be attributable to the antimicrobial stewardship program of our hospital. Furthermore, further research is necessary to better assess the situation of antimicrobial use in cancer hospitals.

Similar with previous investigations [17,19,21,22], we found that advanced age (>65 years), ICU stay, indwelling central catheter and undergoing surgery previous were main risk factors. We also found that under 18 years of age was a risk factor, which was not reported in other point-prevalence surveys. It may be explained by an increased susceptibility to acquiring infections owing to hematologic neoplasms — the most common cancer types in childhood and adolescent [10,11,38]. Owing to oncological treatments, such as chemotherapy and blood transfusions, increasing the use of central catheters may result in an increased risk for catheter-related bloodstream infections [10,12,39]. However, in contrast to the previous studies, we did not find that patients had a urinary catheter in place, or were receiving mechanical ventilatory support had an increased risk of hospital-acquired infections. It may be related to the small sample size of patients using urinary catheter or ventilator. Interestingly, in our study, undergoing surgery in the previous 30 days was a risk factor, while hospitalization in the surgical wards was a protective factor, which may be partially caused by some patients in the surgical wards being in the diagnostic and preoperative preparation stages. Although ICU stay is an infection risk factor mainly because of widespread use of invasive procedures and disease severity, it is worth mentioning that some patients might already had hospital-acquired infection before transferred to ICU.

This study has some limitations. First, the survey patients may not be representative of the cancer patients in China. Second, we did not assess the appropriateness of antimicrobial use because of the lack of data on antimicrobial usage in further detail. Third, because the point-prevalence surveys are restricted to only those infections that were active at the time of the survey, the surveys may have underestimated the latent infections, as infections in discharged patients have not been followed; the surveys also may have overestimated the persistent infections, as patients with such infections are likely to have longer-duration signs or symptoms. Thus, it is impossible to derive the HAI incidence rate from a cross-sectional design.

Conclusions

In summary, our survey results indicate that the prevalence of patients with hospital-acquired infection in our hospital was slightly lower than previous studies from China and most other countries. Lower respiratory tract infection and surgical-site infection were the most common infection types, and *E. coli* was the most common pathogen. Infections those associated with central catheters or related to surgery in cancer patients may warrant increased attention. We provided new insight into the implications of hospital-acquired infection on oncology cancer patients in China. Moving ahead, we should repeat the point-prevalence survey periodically to elucidate hospital-acquired infection trends and to evaluate the impact of interventions on cancer patients.

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Conflict of interest

None declared.

Ethical approval

Not required.

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