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Original Article

Alterations in Bacterial Spectrum and Increasing Resistance Rates in Isolated Microorganisms from Device-Associated Infections in an Intensive Care Unit of a Teaching Hospital in Istanbul (2004–2010)

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SUMMARY: The aim of the present study was to determine the rate of device-associated infection (DAI) and the change in profiles and antimicrobial resistance patterns of the causative microorganisms in a medical-surgical intensive care unit (ICU), as well as to evaluate the effect of a new nationwide hospital infection control program (NHICP), which has been implemented in Turkey. In this study, 5,772 patients that were hospitalized for a total of 43,658 days acquired 1,321 DAIs, with an overall rate of 30.2% per 1,000 ICU days. Between 2004 (before the NHICP) and 2010, the incidence densities of catheter-associated urinary tract infection (CAUTI) decreased from 10.2 to 5.7 per 1,000 device-days ($P < 0.0001$), and central venous catheter-associated bloodstream infection (CVC-BSI) decreased from 5.3 to 2.1 per 1,000 device-days ($P < 0.0001$). However, ventilator-associated pneumonia increased from 27.0 to 31.5 per 1,000 device-days. Multidrug-resistant species rates increased from 5.8% to 76.6% ($P < 0.0001$) for *Acinetobacter* spp. and from 6.8% to 53.1% ($P < 0.0001$) for *Pseudomonas aeruginosa*. The extended-spectrum β-lactamase-producing *Enterobacteriaceae* rate increased from 23.1% to 54.2% ($P = 0.01$); the vancomycin-resistance rate among *Enterococcus* spp. increased from 0% in 2004 to 12.5% in 2010 ($P = 0.0003$). In conclusion, while a significant decrease was achieved in the incidences of CAUTI and CVC-BSI, the NHICP was not completely effective in our ICU. The high incidence of DAI and the increasing prevalence of multidrug-resistant microorganisms indicate that further interventions are urgently needed.

INTRODUCTION

Healthcare-acquired infections increase mortality, length of hospital stay, and costs. Patients in the intensive care unit (ICU) are at high risk of device-associated infection (DAI), due to their underlying conditions and surgery, impaired host defenses, and invasive medical procedures (1–3). Surveillance and the ability to make meaningful comparisons of infection rates are key components of infection control (3). The National Nosocomial Infection System (NNIS) and National Healthcare Safety Network (NHSN) of the Centers for Disease Control and Prevention (CDC) provides ICU type-specific DAI rates and device-utilization ratios, which allow for interhospital comparisons, as well as early follow-up, awareness, and effective solutions to problems faced by infection control practitioners (4,5). Similar standards have been implemented in Europe (3). Recently, a new governmental regulation for hospital infection control (NHICP) has been enacted in Turkey (6). In addition, a national hospital infection surveillance network (Turkish Hospital Infection Surveillance; THIS) has been established, with the aim of reducing hospital infection rates, including DAI (7).

The frequency, epidemiology, microbiological spectrum, and antimicrobial resistance patterns of microorganisms that cause DAI vary among institutions and can change from year to year (4,5,8–17). In addition, multidrug-resistant (MDR) pathogen infections are on the rise, which further complicates the management of these infections (4,5). Therefore, hospital-specific and even unit-specific antimicrobial resistance trends for DAI-causing organisms should be determined to initiate early and effective empiric antimicrobial therapy.

The aim of this study was to determine the incidence, changes in profiles, and antimicrobial resistance patterns of DAI-causing organisms in the medical-surgical ICU of a teaching hospital between 2004 and 2010. In addition, we aimed to compare our results with data from the NNIS, International Nosocomial Infection Control Consortium (INICC), and THIS, and to evaluate the impact of the NHICP on DAI rates and an-

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timicrobial resistance in our ICU.

PATIENTS AND METHODS

Setting: This prospective, observational study was conducted in the medical-surgical ICU of a teaching hospital with 725-beds between January 1, 2004 and December 31, 2010. The unit had 12 beds in 2004 and grew to have 21 beds and moved to a new location within the hospital in 2006. The mean total nurse-to-patient ratio was 1:3 per day shift and 1:4 per night shift in the ICU, during the study periods. Our hospital has complete electronic patient records that are available for use by the infection control practitioners and a clinical laboratory that tests the in vitro susceptibility of clinical isolates by means of standardized methods (20,21). A hospital infection control committee (HICC) was established in 1989, and active patient data-based surveillance of hospital infections in targeted clinics, such as the ICU, has been performed since 2003. After the publication of NHICP in 2005, the new infection control regulations for our hospital were published in a hospital-wide computer system in the same year, and 2 infection control nurses began to work at our hospital. HICC has met at least twice per year, and the ICU personnel (doctors, nurses, and others) have been periodically educated in hand washing compliance, the care of invasive devices, and other infection control measures.

Surveillance: An active, targeted prospective surveillance was performed by infectious disease specialists and infection control nurses, following the recommendations of the NNIS system and using a standard form. The surveillance data were gathered according to the device-associated healthcare-associated infection (DA-HAI) definitions provided by the CDC-NNIS and CDC-NHSN (4,5,18,19) and evaluated biweekly during the study period.

Definitions: Pneumonia or bloodstream infections were considered to be device-associated if a ventilator or central line was in place at the time of or within 48 h before the onset of infection.

(i) Ventilator-associated pneumonia (VAP): VAP was defined using 2 criteria: (i) new or progressive and persistent infiltrates, consolidation, cavitation, or pleural effusion on chest radiographs; (ii) at least 1 of the following signs and symptoms: fever (temperature, $>38°C$), leukopenia (leukocyte count, $<4,000$ leukocytes/mm^3) or leukocytosis (leukocyte count, $>12,000$ leukocytes/mm^3), new onset of purulent sputum or change in the character of sputum, positive blood culture or isolation of an etiologic agent from a specimen obtained by tracheal aspirate, bronchial brushing, or bronchoalveolar lavage.

(ii) Laboratory-confirmed central venous catheter-associated bloodstream infections (CVC-BSI): CVC-BSI were confirmed by the laboratory when patients with a CVC had a recognized pathogen isolated from 1 or more percutaneous blood cultures after 48 h of vascular catheterization (not related to an infection at another site). The patients also had to have at least 1 of the following signs and symptoms: fever (temperature, $>38°C$), chills, or hypotension. With the common skin commensals (e.g., diphtheroids, bacilli, propionobacteria, coagulase-negative staphylococci [CNS], or micrococci), the organisms had to have been cultured from 2 or more blood cultures drawn on separate occasions.

(iii) Catheter-associated urinary tract infection (CAUTI): CAUTI diagnosis was established based on 2 criteria: fever (temperature, $>38°C$) with no other recognized cause and a positive urine culture result ($\geq 10^5$ microorganism/mL of urine, with no more than 2 species of microorganisms), in a patient with a urinary catheter in the ICU.

Culture techniques: (i) VAP: Deep tracheal aspirate cultures were obtained in all suspected cases of VAP. The aspirates were Gram-stained and quantitatively cultured.

(ii): CVC-BSI: CVCs were removed aseptically and the distal 5-cm portion of the catheter was removed and cultured by using a standardized semiquantitative method. Blood cultures were drawn percutaneously in all cases.

(iii) CAUTI: A urine sample was aseptically aspirated from the sampling port of the urinary catheter (UC) and cultured quantitatively.

Antimicrobial susceptibility: The isolates were identified to species level using conventional methods by infectious disease specialists. Antimicrobial susceptibilities of the isolates were investigated using the Kirby-Bauer disk diffusion method, according to the National Committee for Clinical Laboratory Standards (NCCLS) until 2008 and the Clinical and Laboratory Standards Institute (CLSI) criteria thereafter (20,21). The double-disk synergy test was used for detection of *Enterobacteriaceae* producing extended-spectrum β-lactamases (ESBL). Multidrug-resistance was defined as methicillin (oxacillin) resistance for staphylococci, vancomycin resistance for *Enterococci*, production of ESBL for *Enterobacteriaceae*, and resistance to 3 or more antimicrobial agents normally used to treat these organisms for *Acinetobacter* spp. and *Pseudomonas aeruginosa* (for example, ceftazidime, quinolones, carbapenems, aminoglycosides, ampicillin-sulbactam, or piperacillin-tazobactam).

Calculation of DAI rates and statistical analysis: Device-utilization rates were calculated by dividing the total number of device-days by the total number of patient-days. Rates of VAP, CVC-BSI, and CAUTI per 1,000 device-days were calculated by dividing the total number of infections by the total number of specific device-days and multiplying the result by 1,000. The overall nosocomial infection rates per patient and per patient-day were calculated by dividing the total number of nosocomial infections by the total number of patients ($\times 100$), and patient-days ($\times 1,000$), respectively.

The statistical program GraphPad Prism 5, and Fisher's exact test, the chi-square trend test, and ANOVA were used for the statistical analysis, and $P < 0.05$ was considered statistically significant.

RESULTS

During the study period, surveillance data were collected on 5,772 patients hospitalized in the ICU for an aggregate of 43,658 patient-days. A total of 1,321 DAIs were observed, with an overall rate of 22.8% per 100 patients and 30.2% per 1,000 ICU days. The rates of

Table 1. Incidence of DAI and device-utilization ratio by year

Year	No. hospitalized patients/patient-day	Infection rate per 1,000 device-days			Device-utilization ratio		
		VAP	CAUTI	CVC-BSI	MV	UC	CVC
2004	500/2,980	27.00	10.26	5.38	0.74	0.91	0.74
2005	783/5,036	18.66	2.78	4.79	0.87	0.92	0.78
2006	908/6,407	23.91	3.65	3.67	0.89	0.98	0.68
2007	1,004/7,151	24.35	5.73	2.30	0.83	1.00	0.72
2008	605/7,395	33.57	10.68	2.01	0.80	1.00	0.94
2009	965/7,436	29.16	4.95	2.42	0.77	0.99	0.94
2010	1,007/7,253	31.53	5.79	2.11	0.75	0.99	0.91
Total	5,772/43,658	26.87	5.12	2.86	0.81	0.98	0.83

DAI, dovice-associated infection; VAP, ventilator-associated pneumoniae; CAUTI, catheter-associated urinary infection; CVC-BSI, central venous catheter-associated bloodstream infection; MV, mechanical ventilator; UC, urinary catheter; CVC, central venous catheter.

Table 2. Distrubition of pathogens isolated from patients with DAI

	2004 no. (%)	2005 no. (%)	2006 no. (%)	2007 no. (%)	2008 no. (%)	2009 no. (%)	2010 no. (%)	$P_{linear\ trend}$
Pseudomonas aeruginosa	29 (27.6)	38 (29.0)	26 (13.0)	33 (15.4)	55 (21.0)	63 (24.9)	50 (17.2)	NS
Acinetobacter spp.	17 (16.1)	34 (25.9)	78 (39.0)	75 (35.2)	91 (34.8)	90 (35.5)	118 (40.6)	0.01
Klebsiella spp.	7 (6.6)	2 (1.5)	1 (0.5)	4 (1.9)	6 (2.3)	4 (1.5)	19 (6.5)	NS
Escherichia coli	4 (3.8)	4 (3.0)	11 (5.5)	12 (5.6)	29 (11.1)	17 (6.7)	17 (5.8)	NS
Enterobacter spp.	15 (14.2)	6 (4.6)	8 (4.0)	18 (8.4)	21 (8.0)	15 (5.9)	31 (10.6)	NS
Other Gram-negative organisms		1 (0.7)						
Staphylococcus aureus	17 (16.1)	33 (25.2)	58 (29.0)	27 (12.7)	31 (11.8)	20 (7.9)	18 (6.2)	<0.0001
Coagulase-negative staphylococci	1 (0.9)	1 (0.7)	1 (0.5)		1 (0.4)	2 (0.7)	4 (1.3)	NS
Enterococcus spp.	4 (3.8)	5 (3.8)	7 (3.5)	4 (1.8)	12 (4.6)	8 (3.1)	8 (2.7)	NS
Other Gram-positive organisms	1 (0.9)			4 (1.8)	5 (1.9)	6 (2.3)	2 (0.6)	NS
Candida spp.	10 (9.5)	7 (5.3)	10 (5.0)	36 (16.9)	10 (3.8)	28 (11.0)	23 (7.9)	NS

NS, not significant.

DAI and device use are listed in Table 1.

The most frequently isolated microorganisms of DAI were *Acinetobacter* spp. (35.3%), *P. aeruginosa* (20.6%), and *Enterobacteriaceae* (17.6%). We found a linear increase in the proportion of *Acinetobacter* spp. isolated from DAI ($p_{linear\ trend} = 0.01$), and this rate significantly increased from 16.1% in 2004 (before NHICP and our hospital's new infection control regulations) to 40.6% in 2010 ($P = 0.0008$). However, a declining trend was observed in *Stapylococcus aureus* isolates ($p_{linear\ trend} < 0.0001$) during the study period, and the proportion of these isolates decreased from 16.1% in 2004 to 6.2% in 2010 ($P = 0.009$). There was also a decrease in the proportion of *P. aeruginosa* (from 27.6% to 17.2%). These data are presented in Table 2.

There was an increasing trend in the resistance rate of *P. aeruginosa* against ceftazidime ($p_{linear\ trend} = 0.02$) (from 65.5% in 2004 to 96.0% in 2010; $P < 0.0001$), and amikacin ($p_{linear\ trend} = 0.002$) (from 10.3% in 2004 to 20.6% in 2010; $P = 0.005$). A decrease in the resistance rate of ciprofloxacine (from 65.5% in 2004 to 48%; $P = 0.02$) was observed, but it was not a linear trend. A meaningful increasing trend was observed in the resistance rates of *Acinetobacter* spp. to cefoperazon-sulbactam ($p_{linear\ trend} < 0.0001$; from 5.8% in 2004 to 78.8% in 2010; $P < 0.0001$)) and imipenem ($p_{linear\ trend} = 0.02$; from 47.0% in 2004 to 85.5% in 2010; $P < 0.0001$) during the study period. MDR species rates increased from 6.8% in 2004 to 53.1% in 2010 ($P < 0.0001$) for *P. aeruginosa* and from 5.8% to 76.6% ($P < 0.0001$) for *Acinetobacter* spp. The susceptibilities of *P. aeruginosa* and *Acinetobacter* spp. to colistin were 100%.

The distribution rate of ESBL-producing strains among *Enterobacteriaceae* was 23.1% in 2004 and 54.2% in 2010 ($P = 0.01$), but all isolates were susceptible to carbapenems.

The overall methicillin-resistance rate for *S. aureus* strains was 93.1%, and the resistance rate for CNS was 100%. There was also a statistically significant increasing trend in the rate of vancomycin resistance in *Enterococcus* spp. ($p_{linear\ trend} = 0.004$; from 0% in 2004 to 12.5% in 2010; $P = 0.0003$).

The antibiotic resistance rates are shown in Table 3.

Device-utilization ratios: The device-utilization ratios were as follows: 0.81 for mechanical ventilators (MV), 0.98 for UC, and 0.83 for CVC (Table 1).

VAP: The mean overall rate of VAP was 26.8 per 1,000 MV days. There was no significant difference in the incidence of VAP between 2004 (27.0%) and 2010 (31.5%) ($P = 0.64$). The most frequently isolated microorganisms of VAP were *Acinetobacter* spp. (42.0%), *P. aeruginosa* (23.6%), and *S. aureus* (16.1%).

CAUTI: The mean overall rate of CAUTI was 5.1 per 1,000 UC days. The incidence density of CAUTI sig-

Table 3. Antibiotic resistance rates of the major pathogens isolated from DAI

Microorganism	Antibiotic	2004	2005	2006	2007	2008	2009	2010	$P_{linear\ trend}$
Pseudomonas aeruginosa	Ceftazidime	65.5	50.0	61.5	78.7	78.1	96.8	96.0	0.02
	Imipenem	44.8	23.6	23.0	42.4	40.0	53.9	50.0	NS
	Piperacillin-tazobactam	51.7	39.4	26.9	45.4	21.8	53.9	56.0	NS
	Ciprofloxacin	65.5	68.4	53.8	63.6	49.0	69.8	48.0	NS
	Amikacin	10.3	7.8	34.6	30.3	29.0	60.3	26.0	0.002
Acinetobacter spp.	Ceftazidime	82.3	79.4	94.8	100.0	95.6	97.7	97.4	NS
	Imipenem	47.0	38.2	76.9	56.0	67.0	84.4	85.5	0.02
	Cefoperazone-sulbactam	5.8	5.8	12.8	10.6	64.8	80.0	78.8	<0.0001
	Ciprofloxacin	82.3	76.4	80.7	86.6	89.0	91.1	92.3	NS
	Amikacin	70.5	29.4	55.1	56.0	74.7	76.6	43.2	0.002
Enterobacteriaceae	Ceftriaxone	80.7	84.6	70.0	91.1	91.0	80.5	88.0	NS
	Ceftazidime	80.7	76.9	70.0	79.4	82.1	77.7	85.0	NS
	Imipenem	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
	Ciprofloxacin	34.6	23.0	40.0	61.7	71.4	55.5	40.2	NS
	Amikacin	26.9	7.6	25.0	14.7	14.2	33.3	38.8	NS
Staphylococcus aureus	Methicillin	94.1	93.9	98.2	88.8	87.0	90.0	94.4	NS

Data are % of total.
NS, not significant.

Table 4. Comparison of DAI rates and device-utilization ratio with THIS, INICC, and NHSN reports

Report	Country	Surveillance period	DAI			Device utilizatin ratio		
			VAP	CAUTI	CVC-BSI	MV	UC	CVC
Present study	Turkey	2004–2010	26.8	5.1	2.8	0.81	0.98	0.83
THIS	Turkey	2010	16.4	5.2	5.7	0.65	0.94	0.64
INICC	Developing countries	2002–2007	14.7	6.1	7.4	0.38	0.73	0.54
NHSN	United States	2006–2008	1.9	3.1	1.5	0.45	0.76	0.59

THIS, Turkey Hospital Infection Surveillance; INICC, International Nosocomial Infection Control Consortium; NHSN, National Healthcare Safety Network. Other abbreviatione are in Table 1.

nificantly decreased from 10.2 per 1,000 patient UC days in 2004 to 5.7 episodes in 2010 ($P < 0.0001$) (Table 1). The most frequently isolated microorganisms associated with CAUTI were *Candida* spp. (48.6%), *Enterococcus* spp. (18.8%), and *Enterobacteriaceae* (17.7%).

CVC-BSI: The mean overall rate of CVC-BSI was 2.8 per 1,000 cardiovascular catheter days. The incidence density of CVC-BSI decreased significantly from 5.3 per 1,000 patient central line days in 2004 to 2.1 episodes in 2010 ($P < 0.0001$) (Table 1). The most frequently isolated microorganisms of CVC-BSI were *S. aureus* (21.5%), *Acinetobacter* spp. (18.6%), and *Candida* spp. (17.6%).

The comparison of the overall device-utilization ratio and the DAI rates with THIS, INICC, and NHSN data are shown in Table 4 in detail.

DISCUSSION

This study revealed a high use of devices in our ICU, particularly for MV and CVC, compared with data reported from developing countries (INICC), the United States (NHSN), and other Turkish (THIS) ICUs; the UC-utilization ratio was also high, which is similar to that in other studies (5,7,8). The overall rate of DAI (22.8/100 patients and 30.2/1,000 patient-days) was higher than that reported by NHSN and INICC (5,12), but lower than that of the other Turkish studies (15–17). In a multicenter study by Leblebicioglu et al. (15), the overall DAI rates were 38.3/100 patients and 33.9/1,000 patient-days. Similarly, Inan et al. (16) reported overall DAI rates of 34.2/1,000 patient-days in the ICUs of a large university hospital.

VAP rates vary widely throughout the world; for example, studies in Argentina, Peru, and Cuba reported VAP rates as high as 46.2, 31.3, and 52.5 per 1,000 ventilator-days, respectively (8,13,14), whereas the rate in ICUs in the United States was 1.9 per 1,000 ventilator-days (5). After 5 years of the NHICP and our hospital-wide infection control regulations, elevated rates of VAP persisted in our ICU; however, CAUTI and CVC-BSI rates have been significantly reduced.

The spectrum of pathogens in ICUs may change with time and by hospital, type of ICU, and specific patient population (2–5,8–17). Gram-negative bacilli are responsible for 60% of VAP episodes, but *S. aureus*, most of which are methicillin-resistant *S. aureus* (MRSA), account for 20% to 40% of episodes (22–25). Similar to these results, the most frequently isolated microorganisms in VAP cases in the Haydarpasa Numune Hospital's ICU were *Acinetobacter* spp. (42.0%), *P. aeruginosa* (23.6%), and *S. aureus* (16.1%). The most frequent pathogens causing hospital-acquired UTIs in

ICUs are *Escherichia coli*, *P. aeruginosa*, *Enterococci*, and *Candida* spp. (5,27). We determined that the most causative microorganisms for CAUTI were *Candida* spp. (48.6%), similar to the rates (44.9%) in the study by Leblebicioglu et al. (15). Although an increase in catheter-associated infection has been reported to be caused by Gram-negative bacilli in some institutions, staphylococci are still the most frequently encountered pathogens in device-related BSIs (5,26). In our ICU, *S. aureus* (21.5%) was found to be the predominant pathogen in CVC-BSIs, followed by *Acinetobacter* spp. (18.6%) and *Candida* spp. (17.6%).

Over the past 10 years, there has been a dramatic increase in healthcare-associated infections, due to antibiotic-resistant and MDR pathogens throughout the world (25–27), including Turkey (28–30). MDR bacteria of concern include Gram-negative bacilli (MDR *P. aeruginosa*, ESBL-producing and carbapenamase-producing *Enterobacteriaceae*, and carbapenem-resistant *Acinetobacter baumannii*), MRSA, and vancomycin-resistant *Enterococci* (VRE) (28). In a multicenter study in Turkey, Gür et al. (28) found that hospital-acquired *Acinetobacter* spp. were highly resistant to all antimicrobial agents, with the lowest resistance rate against cefoperazone-sulbactam (52.0%), followed by imipenem (55.5%). Overall, 42.0% of *E. coli* and 41.4% of *Klebsiella pneumoniae* were ESBL producers. In another study, the authors demonstrated that the dramatic decrease in carbapenem susceptibility rates among *A. baumannii* from 2000 to 2006 was attributed to the clonal dissemination of OXA-producing strains (29). Yüce et al. (30) reported high resistance rates for both *P. aeruginosa* (ceftazidime 84%, carbapenems 73%, ciprofloxacin 87%, and piperacillin-tazobactam 88%) and *Acinetobacter* spp. (ceftazidime 98%, carbapenems 87%, and ciprofloxacin 100%) in the ICUs of a Turkish university hospital. We observed that MDR species rates increased significantly among *P. aeruginosa* and *Acinetobacter* spp. during the course of our study. The distribution rate of ESBL-producing strains of *Enterobacteriaceae* was 23.1% in 2004 and 54.2% in 2010, and all isolates were susceptible to carbapenem. These results suggest that carbapenems are still effective against *Enterobacteriaceae*; nevertheless, consideration should be given to carbapenamase-producing *Enterobacteriaceae*, owing to the emergence potential. For empirical therapy of patients with suspected *Pseudomonas* or *Acinetobacter* infections, colistin is now the first-line antibiotic in our ICU. MRSA comprised 93.1% of *S. aureus*, which is higher than the 52.9% resistance rate reported by the NNIS (5) and the 84% resistance rate found in the INICC global study (12). High MRSA rates also were reported in the other studies from our country—81.2% by Doğru et al. (17) and 89.2% by Leblebicioglu et al. (15). We demonstrated that the overall rate of vancomycin resistance among *Enterococcus* spp. was 16.6%, and there was a statistically significant increase in this rate ($P = 0.004$).

The application of hospital infection control regulations is still a challenge and is the most important contributing factor to these results obtained from our ICU. In a recent meta analysis, Allegranzi et al. (31) described determinants of the burden posed by healthcare-associated infections in developing countries. Similar issues, such as issues regarding equipment, personnel insufficiencies, rapid staff turnover, education of new personnel, effective isolation of patients, and physical infrastructure standardization, could not be completely resolved in the unit. In addition, our hospital is a large tertiary state hospital, and critically ill patients with multiple traumas, neurosurgical surgery, and malignancies have been followed in our ICU. These complex factors have resulted in a lack of compliance with the infection prevention rules, high rates of DAI, the widespread use of antibiotics for treatment of these infections, and ultimately the increasing antimicrobial resistance rates in our ICU, despite the well-designed NHCIP and our hospital-wide infection control regulations.

In conclusion, management of healthcare-associated infections is a difficult and dynamic undertaking, particularly in ICUs. After the implementation of NHICP and our own hospital-wide regulations, while a significant decrease was achieved in incidences of CAUTI and CVC-BSI, elevated rates of VAP persisted in our ICU. Important changes were observed in the causative agents—the proportion of MRSA strains decreased, and *Acinetobacter* spp. became the major pathogen. The striking findings of this study were the increasing antimicrobial resistance rates, particularly in *Enterococcus* spp., *Acinetobacter* spp., and *P. aeruginosa* strains, indicating that further interventions are urgently needed.

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