Taiwan Healthcare-associated infection and Antimicrobial resistance Surveillance System

I. Preface

"Nosocomial infection" is used to describe infections acquired in hospitals, while "healthcare-associated infection" (HAI) generally refers to infections that patients acquire while receiving medical or surgical treatments. HAIs can occur in various healthcare settings, including hospitals, long-term care facilities, homecare facilities, or outpatient departments. To respond to continuously evolving landscapes of medical services and expand the scope of surveillance, "healthcare-associated infection" instead of "nosocomial infection" was used internationally and in the definition of infection surveillance in acute care settings published by US CDC in 2008. To monitor the occurrence of HAIs effectively, evaluate the epidemiologic trend of HAIs in Taiwan, and analyze surveillance data using standard indicators for policy making, Taiwan CDC launched the Taiwan Nosocomial Infections Surveillance System (TNIS System) in 2007 and revised it to Taiwan Healthcare-associated infection and Antimicrobial resistance Surveillance System (THAS System) in 2020. Moreover, strengthening functions and the utility of the surveillance system is on going. THAS system gathers demographic data, laboratory results of pathogens identified, antimicrobial susceptibility test for each HAI, and provides simple analytical function; reporting hospitals can analyze their own data on line as a reference in developing quality improvement initiatives.

II. Objectives

1. To establish epidemiological database of HAI in Taiwan
2. To monitor HAI trends in Taiwan
3. To facilitate inter- and intra-hospital comparisons for implementation of quality improvement activities
4. To assist hospitals in developing appropriate surveillance mechanisms for timely identification of infection control lapses

III. Reporting methods, data analysis, and feedback

The THAS system adopts voluntary reporting, and each hospital may provide their data either through web-based entry or by conveying it electronically through an interchange platform or Web API. The web-based report mechanism mainly serves for hospitals that do not have their own HAI surveillance system. Hospital staff enter the HAI data on the THAS system website directly. The other mechanism, using an interchange platform or Web

API, serves for the hospitals which have established their own HAI surveillance system. However, to ensure interoperability between hospital information systems (HIS) and THAS system, infection control practitioners work on mapping vocabularies from local to standard codes and hospital information technology staff bridge the connection between the two systems and make the electronic data pack in a standard format according to the working instruction issued by Taiwan CDC. Through this mechanism, surveillance data could be automatically transferred from the HIS to the THAS system, eliminating the need for repetitive data entry. At present, 482 hospitals were enrolled in THAS system. Hospitals may use THAS system to manage HAI cases and generate individual hospital reports. Additionally, Taiwan CDC periodically provides hospitals with national reports for inter- and intra-hospital comparisons, aiming to facilitate hospitals to improve their quality in HAIs control and to safeguard the wellbeing of healthcare workers and the general public.

IV. Healthcare-associated infection surveillance data analysis content

1. Number of medical centers and regional hospitals contributing ICU HAI data in 2022.
2. Distribution of HAI rates by type of location in the ICUs of medical centers and regional hospitals in 2022.
3. Distribution of device-associated infection rates in the ICUs of medical centers and regional hospitals in 2022.
4. Distribution of major sites of HAI in ICU patients from medical centers and regional hospitals in 2022.
5. Common pathogens of HAI for patients in the ICUs of medical centers in 2022.
6. Common pathogens of HAI for patients in the ICUs of regional hospitals in 2022.
7. Antimicrobial resistance proportions of selected pathogens of HAI in the ICUs of medical centers and regional hospitals in 2022.

V. Surveillance method and main results

All the analytical results in this report were extracted from THAS system database with data updated as of July 13, 2023. In 2022, there were 24 medical centers with 195 ICU units and 82 regional hospitals with 270 ICU units reported both HAI cases and the number of patient-days to THAS system for at least one calendar month (Table 10). The distribution of HAI rate ([number of HAIs/number of patient-days] ×1000‰) in ICUs of medical centers and regional hospitals is shown in Table 11. There were 5,215 episodes of HAI events occurred during 840,088 patient-days in the ICUs of 24 medical centers; the rate of infections was 6.2‰. However, in the ICUs of the 82 regional hospitals, there were 3,624 episodes of HAI events occurred during 869,972 patient-days; the rate of infections was 4.2‰. The HAI rates in ICUs were higher in medical centers than those in regional hospitals by corresponding types of ICU. The distribution of device-associated infection rate in ICUs ([number of device-associated infections/ number of device-days] ×1000‰) is shown in Figure 2. The pooled mean of central line-associated bloodstream infection (CLABSI) rates was 4.2‰ in medical centers and 2.6‰ in regional hospitals, and the pooled mean of catheter-associated urinary tract infection (CAUTI) rates were 3.1‰ and 2.2‰ respectively, the rate of CAUTI and the rate of CLABSI in ICUs of medical centers were higher than those in regional hospitals; the pooled mean of ventilator-associated pneumonia (VAP) rates in regional hospitals was higher than that in medical centers, which were 0.6‰ and 0.5‰ respectively.

The distribution of site-specific HAIs in ICUs is shown in Table 12, with the bloodstream infections topped the list in medical centers (47.4%), followed by urinary tract infections (UTIs) (32.4%), and other (9.5%). In regional hospitals, the bloodstream infections topped the list (40.5%), followed by UTIs (37.5%), and pneumonia (10.9%). The common pathogens for HAIs in ICUs are shown in Table 13 and Table 14. The top three pathogens in ICUs were *Enterococcus faecium, Klebsiella pneumoniae*, and *Candida* spp. in medical centers, and *Klebsiella pneumoniae*, *Candida albicans*, and *Enterococcus faecium* in regional hospitals. The proportion of antimicrobial resistance among selected pathogens identified from patients in the ICUs with HAIs is shown in Figure 3. In the ICUs of medical centers, 82.8% of *Acinetobacter baumannii* isolates were resistant to carbapenem (CRAB), 43.0% of *K. pneumoniae* isolates were resistant to carbapenem (CRKP), 26.0% of *Pseudomonas aeruginosa* isolates were resistant to carbapenem (CRPA), 50.9% of *Enterococci* isolates were resistant to vancomycin (VRE), and 50.9% of *Staphylococcus aureus* isolates were resistant to oxacillin (MRSA). Meanwhile, the antimicrobial resistance percentage of selected pathogens isolated from patients with HAIs in the ICUs of regional hospitals were 80.8%, 44.8%, 15.6%, 44.2% and 54.8% for CRAB, CRKP, CRPA, VRE and MRSA, respectively.

VI. 2022 Data analyses of HAI in the ICUs of medical centers and regional hospitals

Table 10 Number of medical centers and regional hospitals contributing ICU HAI data, 2022

Hospital level	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter	
	No. of hospitals	No. of HAIs	No. of hospitals	No. of HAIs	No. of hospitals	No. of HAIs	No. of hospitals	No. of HAIs
Medical center	23	1,279	24	1,251	23	1,434	23	1,495
Regional hospital	81	894	81	845	82	1,001	80	1,051

Note: Data updated to 2023/7/13

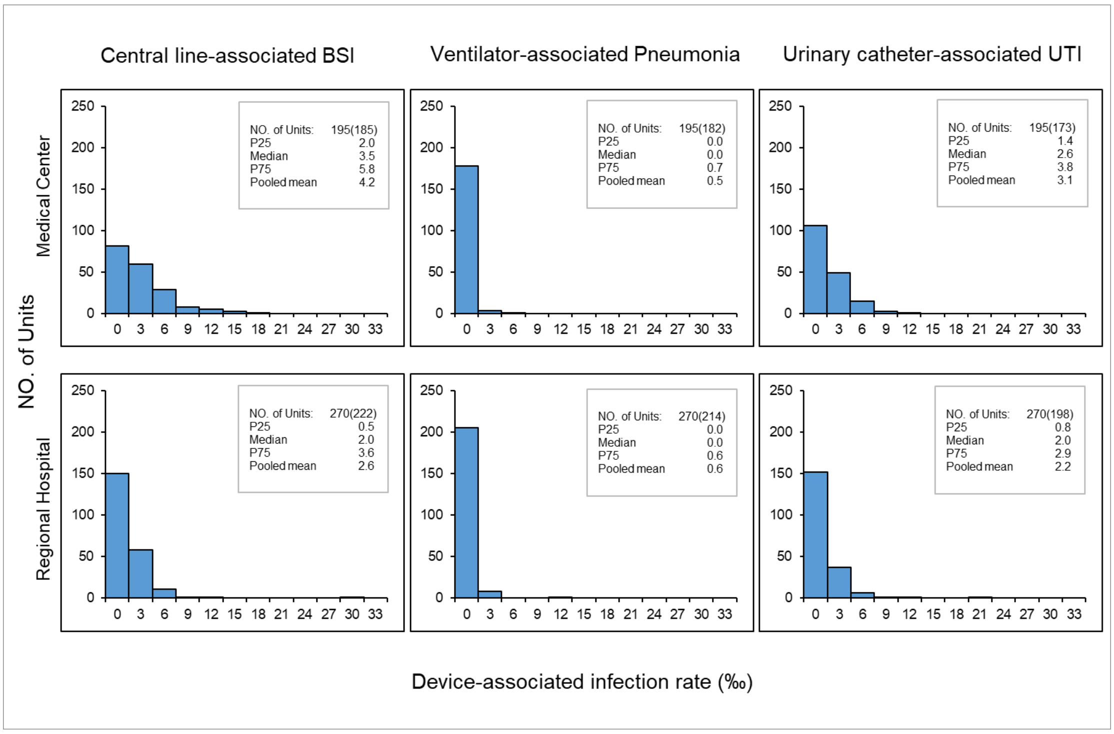
Table 11 Distribution of healthcare-associated infection rates by type of locations in the ICUs of medical centers and regional hospitals, 2022

Hospital level	Type of locations	No. of units[1]	No. of HAIs	Patient -days	HAI Rate[2] (‰)	Percentile 25th	Percentile 50th	Percentile 75th
Medical center	Medical ICU	48(48)	1,729	228,751	7.6	4.9	6.7	9.8
	Surgical ICU	63(60)	1,709	244,914	7.0	5.1	6.6	8.3
	Cardiology ICU	15(15)	499	68,639	7.3	-	6.9	-
	Pediatric ICU	45(45)	382	173,908	2.2	0.9	1.7	2.9
	Medical/surgical ICU	24(23)	896	123,876	7.2	5.2	6.5	7.9
	Total	195(191)	5,215	840,088	6.2	3.2	5.9	7.9
Regional hospital	Medical ICU	52(51)	1,142	240,243	4.8	3.5	4.2	5.8
	Surgical ICU	45(43)	818	175,819	4.7	2.3	4.0	5.5
	Cardiology ICU	11(9)	129	38,349	3.4	-	-	-
	Pediatric ICU	66(55)	59	49,789	1.2	0.0	0.0	1.3
	Medical/surgical ICU	96(89)	1,476	365,772	4.0	2.2	3.7	5.3
	Total	270(247)	3,624	869,972	4.2	1.5	3.1	5.0

Note: 1. If a unit changes type of location, each type of locations will be counted separately, but only one will be counted when totaled. Units with patient-days < 50 are not included in percentile distribution; the number in parentheses is the number of units meeting minimum requirement for percentile distribution.

2. For the number of units < 20 but > 10, only 50th percentile distribution is provided; for the number of units ≤ 10, percentile distribution is not provided.

3. Healthcare-associated infection rate= (number of HAIs/number of patient-days) ×1000‰. For each unit, monthly data is included for analysis only when the patient days and number of HAI cases are both available.



Note: 1. device-associated infection rate= (number of HAIs/number of device-days) ×1000‰;

2. BSI, bloodstream infection; UTI, urinary tract infection;

3. Units with device-days < 50 are not included in percentile distribution; the number in parentheses is the number of units that meets the minimum requirement for percentile distribution.

Figure 2 Distribution of device-associated infection rates in the ICUs of medical centers and regional hospitals, 2022

Table12 Distribution of major types of healthcare-associated infection in the ICU patients from medical centers and regional hospitals, 2022

Types of infection	Medical center		Regional hospital	
	No.	%	No.	%
Bloodstream	2,590	47.4	1,536	40.5
Urinary tract	343	6.3	412	10.9
Pneumonia	1,771	32.4	1,422	37.5
Surgical site	235	4.3	162	4.3
Other	520	9.5	259	6.8
Total	5,459	100	3,791	100

Note: proportion of specific infection type= (number of specific infection type /number of overall infection)×100%

Table 13 Common pathogens of healthcare-associated infections in the ICUs of medical centers, 2022

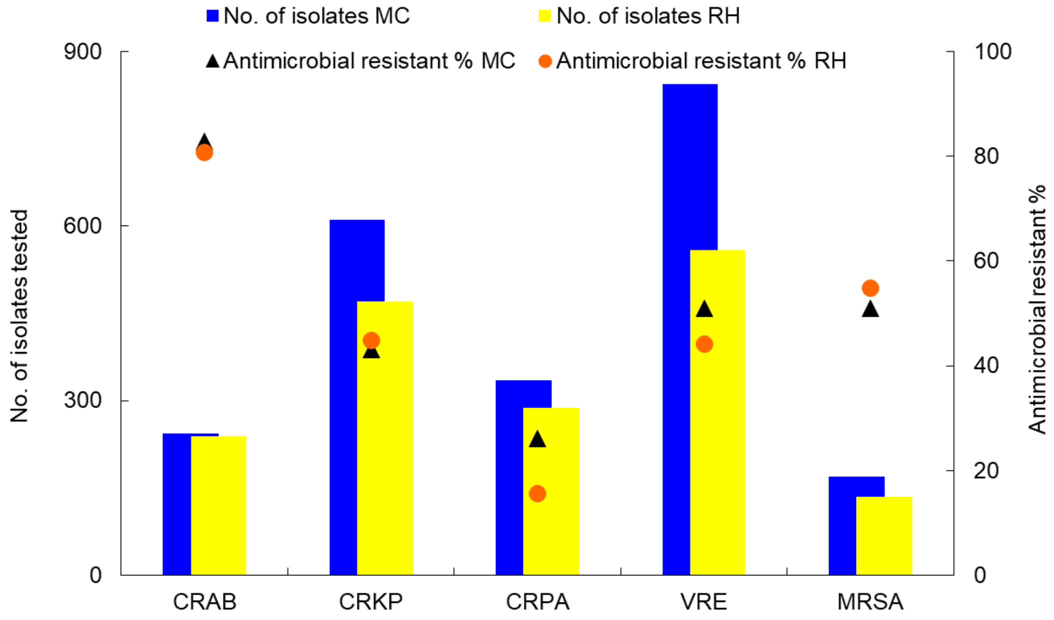
Pathogens	Total		Types of Infection									
			Bloodstream		Pneumonia		Urinary tract		Surgical site		Others	
	Rank	No.	Rank	No.	Rank	No.	Rank	No.	Rank	No.	Rank	No.
Enterococcus faecium	1	663	2	338	22	3	4	243	1	40	3	39
Klebsiella pneumoniae	2	645	1	348	1	75	6	152	2	37	5	33
Candida spp.	3	629	3	314	11	9	3	264	7	22	7	20
Candida albicans	4	485	6	153	9	11	2	270	6	26	6	25
Escherichia coli	5	423	9	103	11	9	1	271	8	21	9	19
Pseudomonas aeruginosa	6	358	7	142	2	62	7	104	4	30	7	20
Acinetobacter baumannii	7	270	4	173	4	29	9	43	13	8	10	17
Yeast-like	8	267	22	26	34	1	5	225	16	6	13	9
Stenotrophomonas maltophilia	9	242	5	156	3	54	18	9	10	14	13	9
Enterococcus faecalis	10	226	13	92	34	1	8	89	3	35	13	9
Others		2,169		1,344		163		227		163		272
Total		6,377		3,189		417		1,897		402		472

Note: Isolates of the same species of bacteria, regardless of antimicrobial susceptibility pattern, are counted only once per patient per infection. No duplicate isolates are included.

Table 14 Common pathogens of healthcare-associated infections in the ICUs of regional hospitals, 2022

Pathogens	Total		Types of Infection									
			Bloodstream		Pneumonia		Urinary tract		Surgical site		Others	
	Rank	No.	Rank	No.	Rank	No.	Rank	No.	Rank	No.	Rank	No.
Klebsiella pneumoniae	1	483	1	221	1	84	5	139	3	26	5	13
Candida albicans	2	400	5	97	8	14	1	258	6	19	6	12
Enterococcus faecium	3	394	2	154	-	-	3	205	5	20	3	15
Escherichia coli	4	374	8	81	7	16	2	252	7	18	11	7
Candida spp.	5	309	4	106	11	4	4	192	13	3	14	4
Pseudomonas aeruginosa	6	295	8	81	2	71	6	95	1	36	6	12
Acinetobacter baumannii	7	251	3	152	3	45	9	34	8	9	8	11
Enterobacter spp.	8	170	7	82	5	22	10	30	2	28	10	8
E.cloacae		111		54		14		21		20		2
Other *Enterobacter* spp. or NOS		59		28		8		9		8		6
Enterococcus faecalis	9	163	13	50	21	1	8	82	4	25	12	5
Staphylococcus aureus	10	146	6	91	5	22	13	12	10	6	3	15
Others		1,124		603		93		234		73		121
Total		4,109		1,718		372		1,533		263		223

Note: 1.Isolates of the same species of bacteria, regardless of antimicrobial susceptibility pattern, are counted only once per patient per infection. No duplicate isolates are included.
2.NOS: not otherwise specified.



Note: 1. "Antimicrobial resistant %" indicates the % of Isolates with susceptibility testing and found to be intermediate or resistant to the antimicrobial specified.

2. CRAB: carbapenem (imipenem or meropenem)-resistant *Acinetobacter baumannii*;
CRKP: carbapenem (imipenem, meropenem, or ertapenem)-resistant *Klebsiella pneumoniae*;
CRPA: carbapenem (imipenem or meropenem)-resistant *Pseudomonas aeruginosa*;
VRE: vancomycin-resistant *enterococci* (*Enterococcus faecalis*, *Enterococcus faecium*...etc.);
MRSA: oxacillin-resistant *Staphylococcus aureus*.

Figure 3 Antimicrobial resistances of selected pathogens of healthcare-associated infections in the ICUs of medical centers(MC) and regional hospitals(RH), 2022