Taiwan Healthcare-associated infection and Antimicrobial resistance Surveillance System

I. Preface

The "nosocomial infection" is limited to describing infections that acquired in hospitals, while the "healthcare-associated infection" (HAI) generally refers to infections that patients acquire while receiving treatment for medical or surgical conditions. HAIs may occur in all settings of care, including hospitals, long-term care facilities, homecare facilities, or outpatient departments. In order to respond to continuous evolving in the contents of medical services and the expansion of surveillance range, "healthcare-associated infection" instead of "nosocomial infection" was commonly used internationally as well as in the definition of infection surveillance in the acute care settings that published by the US CDC in 2008. To monitor the occurrence of HAIs effectively, to evaluate the epidemiologic trend of HAIs in Taiwan, and to analyze surveillance data using well-recognized indicators, so that all the information could be made use of collectively to serve as important references for policy making, Taiwan CDC had launched the Taiwan Nosocomial Infections Surveillance System (TNIS System) in 2007 and revised to Taiwan Healthcare-associated infection and Antimicrobial resistance Surveillance System (THAS System) in 2020. Moreover, strengthening in functions and the utility of the surveillance system is continuously going on. TNIS system not only helps to gather demographic data as well as laboratory results of pathogen identified and antimicrobial susceptibility test for each HAI case, but also provides simple analytical function, so that reporting hospitals can analyze their own data on line as a reference in developing quality improvement initiatives.

II. Objectives

1. Establish the epidemiological database of HAI in Taiwan
2. Discovery of HAI trends
3. Facilitation of inter- and intra-hospital comparisons that can be used for quality improvement activities
4. Assistance for hospitals in developing the appropriate surveillance mechanism that permits timely recognition of infection control problems

III. Reporting methods, data analysis, and feedback

THAS system adopts voluntary reporting, and each hospital may provide their data either through web-based entry or convey their data electronically through interchange platform. The web-based report mechanism mainly serves

for the hospitals which lack HAI surveillance system of their own. Hospital staff enters the HAI data on the THAS system website directly. The other mechanism, conveying surveillance data electronically through interchange platform or WebAPI, serves for the hospitals which had built their own HAI surveillance system. However, to enable interoperability between hospital information systems (HIS) and THAS system, infection control practitioner has to work on vocabularies mapping from local to standard codes and hospital information technology staff has to 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 routinely transferred from hospital information systems to the THAS system automatically. This can save the hospital staff a lot of time because they would not need to repeatedly enter the data to both of hospital surveillance system and THAS system. At present, more than 500 hospitals enrolled in THAS system. Hospitals may use THAS system to manage HAI cases and generate individual hospital reports. Also, Taiwan CDC periodically feedback hospitals with national report as a reference for inter- and intra-hospital comparisons, hope to facilitate hospitals to improve their quality in controlling HAIs 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 this report in 2021.
2. Distribution of HAI rates by type of location in the ICUs of medical centers and regional hospitals in 2021.
3. Distribution of device-associated infection rates in the ICUs of medical centers and regional hospitals in 2021.
4. Distribution of major sites of HAI in ICU patients from medical centers and regional hospitals in 2021.
5. Common pathogens of HAI for patients in the ICUs of medical centers in 2021.
6. Common pathogens of HAI for patients in the ICUs of regional hospitals in 2021.
7. Antimicrobial resistance proportions of selected pathogens of HAI in the ICUs of medical centers and regional hospitals in 2021.

V. Surveillance method and main results

All the analytical results in this report were derived from THAS system

database with data updated to May 12, 2022. In 2021, there were 23 medical centers (191 ICU units) and 77 regional hospitals (251 ICU units) reported both HAI cases and the number of patient-days to THAS system for at least one calendar month (Table 10). The distributions of HAI rate ((number of HAIs/number of patient-days) ×1000‰) in ICUs of medical centers and regional hospitals are shown in Table 11. There were 4,679 episodes of HAI events occurred during 783,792 patient-days in the ICUs of 23 medical centers; the rate of infections was 6.0‰. However, in the ICUs of the 77 regional hospitals, there were 3,537 episodes of HAI events occurred during 779,263 patient-days; the rate of infections was 4.5‰. The HAI rates of ICUs were higher in medical centers than those in regional hospitals by corresponding types of ICU. The distributions of device-associated infection rate in ICUs ((number of device-associated infections/ number of device-days) ×1000‰) are shown in Figure 2. The pooled mean of central line-associated bloodstream infection (CLABSI) rates was 4.1‰ in medical centers and 2.8‰ in regional hospitals, and the pooled mean of catheter-associated urinary tract infection (CAUTI) rates were 3.0‰ and 2.4‰ respectively, the rate of CAUTI and the rate of CLABSI in ICUs of medical centers are higher than those in regional hospitals; the pooled mean of ventilator-associated pneumonia (VAP) rates in regional hospitals is higher than that in medical centers, which are 0.7‰ and 0.4‰ respectively.

The distribution of site-specific HAIs in ICUs is shown in Table 12, with the bloodstream infections topped the list in medical centers (45.9%), followed by urinary tract (31.4%), and other (10.8%). In regional hospitals, the bloodstream infections topped the list (38.7%), followed by urinary tract infections (36.1%), and pneumonia (13.0%).The common pathogens for HAIs in ICUs are shown in Table 13 and Table 14. The top three pathogens in the ICUs were *Klebsiella pneumoniae, Enterococcus faecium, Candida* spp. in medical centers and *Klebsiella pneumoniae*, *Escherichia coli, Candida albicans* in regional hospitals. The proportions of antimicrobial resistance among selected pathogens identified from patients in the ICUs with HAIs are shown in Figure 3. In the ICUs of medical centers, the proportion of *Acinetobacter baumannii* isolates those were resistant to carbapenem (CRAB) is 75.6%, the proportion of *K. pneumoniae* isolates those were resistant to carbapenem (CRKP) is 38.3%, the proportion of *Pseudomonas aeruginosa* isolates those were resistant to carbapenem (CRPA) is 25.5%, the proportion of *Enterococci* isolates those were resistant to vancomycin (VRE) is 51.2%, and the proportion of *Staphylococcus aureus* isolates those were resistant to oxacillin (MRSA) is 52.3%. Meanwhile, the antimicrobial resistance proportions of selected pathogens isolated from patients acquired HAIs in the ICUs of regional hospitals were 75.8%, 43.5%, 16.2%, 46.9% and 54.3% for CRAB, CRKP,

CRPA, VRE and MRSA, respectively.

VI. 2021 Data analysis of HAI in the ICUs of medical centers and regional hospitals

Table 10 Number of medical centers and regional hospitals contributing ICU HAI data in this report, 2021

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	22	1,188	23	1,207	21	1,281	21	1,291
Regional hospital	77	995	76	969	74	970	73	984

Note: Data updated to 2022/5/12

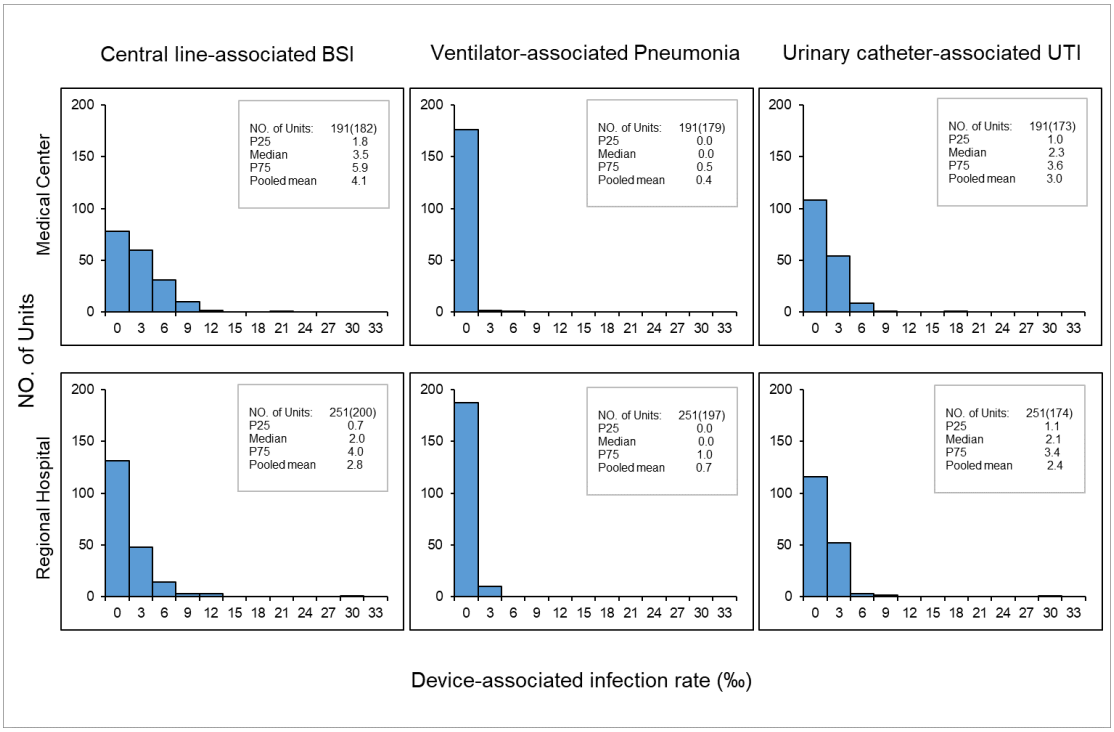
Table 11 Distribution of healthcare-associated infection rates by type of locations in the ICUs of medical centers and regional hospitals, 2021

Hospital level	Type of locations	No. of units[1]	No. of HAIs	Patient -days	HAI Rate[2] (‰)	Percentile		
						25th	50th	75th
Medical center	Medical ICU	47(46)	1,642	215,979	7.6	5.0	6.8	9.4
	Surgical ICU	64(61)	1,583	231,661	6.8	5.0	6.8	8.3
	Cardiology ICU	14(14)	433	64,389	6.7	-	6.2	-
	Pediatric ICU	43(43)	385	169,001	2.3	0.6	1.7	3.4
	Medical/surgical ICU	24(23)	636	102,762	6.2	3.3	5.0	7.8
	Total	191(186)	4,679	783,792	6.0	3.3	5.6	7.8
Regional hospital	Medical ICU	49(45)	1,070	215,119	5.0	3.1	4.2	6.1
	Surgical ICU	42(40)	816	154,622	5.3	3.6	5.2	6.3
	Cardiology ICU	12(10)	221	36,253	6.1	-	-	-
	Pediatric ICU	65(54)	101	50,738	2.0	0.0	0.0	1.6
	Medical/surgical ICU	83(77)	1,329	322,531	4.1	2.2	3.7	5.9
	Total	251(226)	3,537	779,263	4.5	1.6	3.6	5.6

Note: 1. If 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. The number of units<20 only provide 50th percentile distribution; the number of units≤10 not provide percentile distribution.

3. Healthcare-associated infection rate= (number of HAIs/number of patient-days) ×1000‰. For every unit, monthly data was included for analysis only when the patient days and number of HAI cases were 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 meeting minimum requirement for percentile distribution.

Figure 2 Distribution of device-associated infection rates in the ICUs of medical centers and regional hospitals, 2021

Table12 Distribution of major types of healthcare-associated infection in the ICU patients from medical centers and regional hospitals, 2021

Types of infection	Medical center		Regional hospital	
	No.	%	No.	%
Bloodstream	2,281	45.9	1,515	38.7
Urinary tract	357	7.2	510	13.0
Pneumonia	1,560	31.4	1,414	36.1
Surgical site	232	4.7	156	4.0
Other	537	10.8	323	8.2
Total	4,967	100	3,918	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, 2021

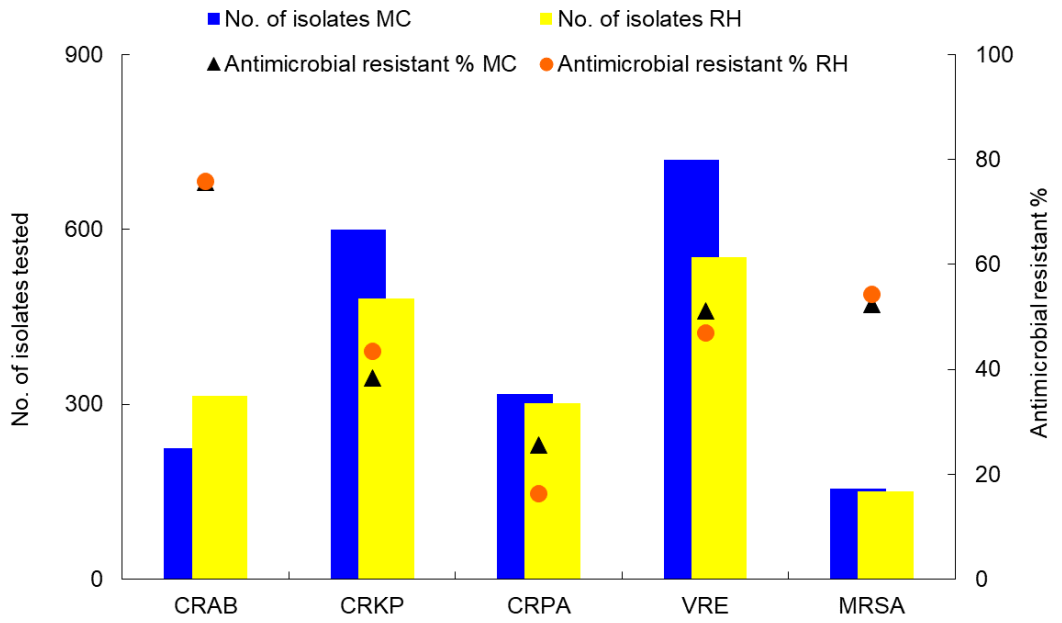
Pathogens	Total		Types of Infection									
			Bloodstream		Urinary tract		Pneumonia		Surgical site		Others	
	Rank	No.	Rank	No.	Rank	No.	Rank	No.	Rank	No.	Rank	No.
Klebsiella pneumoniae	1	618	1	319	2	63	6	148	1	42	3	46
Enterococcus faecium	2	527	2	251	23	2	4	197	3	35	4	42
Candida spp.	3	439	3	245	15	3	5	167	11	9	10	15
Escherichia coli	4	431	8	109	6	14	1	250	3	35	7	23
Candida albicans	5	425	5	148	13	6	3	227	8	20	6	24
Pseudomonas aeruginosa	6	335	6	124	1	69	8	81	2	41	8	20
Yeast-like	7	274	22	17	23	2	2	237	20	3	10	15
Acinetobacter baumannii	8	234	4	154	4	29	11	27	11	9	10	15
Enterobacter spp.	9	202	9	106	7	13	9	37	5	29	9	17
E.cloacae		101		62		4		17		11		7
Other *Enterobacter* spp. or NOS		101		44		9		20		18		10
Enterococcus faecalis	10	194	12	70	30	1	7	85	7	23	10	15
OTHERS		1,957		1,160		177		170		157		293
Total		5,636		2,703		379		1,626		403		525

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

Table 14 Common pathogens of healthcare-associated infections in the ICUs of regional hospitals, 2021

Pathogens	Total		Types of Infection									
			Bloodstream		Urinary tract		Pneumonia		Surgical site		Others	
	Rank	No.	Rank	No.	Rank	No.	Rank	No.	Rank	No.	Rank	No.
Klebsiella pneumoniae	1	493	1	214	1	104	5	126	6	24	3	25
Escherichia coli	2	437	8	86	6	25	2	284	3	28	7	14
Candida albicans	3	424	6	90	8	14	1	294	7	19	13	7
Enterococcus faecium	4	369	3	134	12	3	3	189	4	26	6	17
Candida spp.	5	332	4	124	12	3	4	184	8	12	11	9
Acinetobacter baumannii	6	325	2	161	3	71	9	47	9	9	2	37
Pseudomonas aeruginosa	7	317	7	89	2	94	7	81	1	40	8	13
Enterobacter spp.	8	188	5	94	6	25	11	27	2	30	9	12
E.cloacae		119		64		14		16		17		8
Other *Enterobacter* spp. or NOS		69		30		11		11		13		4
Enterococcus faecalis	9	165	12	53	22	1	8	75	4	26	10	10
Staphylococcus aureus	10	157	9	84	4	31	12	20	13	3	5	19
OTHERS		1,114		591		86		259		59		119
Total		4,321		1,720		457		1,586		276		282

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



Note: 1. "Antimicrobial resistant %" indicates the % of Isolates with susceptibility tested 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), 2021