Health-Care Associated Infections in Thailand 2011

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Objective: *To study the recent trend of health-care associated infections (HAIs) across Thailand.*
Material and Method: *Using the modified international HAI definitions, the investigators conducted a prospective, nationwide, multi-centered survey to determine a 1-day point-prevalence of HAIs among hospitalized patients in the 47 acute care, primary to tertiary hospitals in January 2011.*
Results: *Of total 10,762 patients (female 50.6%, mean age 44.2 $\pm$ 27.3 years) enrolled in the study, 780 had HAIs or the average prevalence of HAIs was 7.3% (range 2.8-8.5%). Highest rates of HAIs were found in other hospitals (other type of tertiary-care facilities), intensive care units and lower respiratory tracts when stratified by type of hospital, unit of service and site of HAIs, respectively. Gram negative bacteria remained predominant among etiologic agents causing HAIs, as in prior studies. Acinetobacter spp., however, emerged as the most common organism. At the time of study, 49.3% of all patients received one or more antimicrobial agents. Among the patients with HAIs, cephalosporins were the most commonly used.*
Conclusion: *Recently, no significant change on nationwide prevalence and trend of HAIs in Thailand were demonstrated. Notably, Acinetobacter spp. emerged as the most common etiologic agents of HAIs.*

Keywords: *Health-care associated infection, Prevalence, Etiologic agent, Type of hospital, Nationwide*

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Health-care associated infections (HAIs) or nosocomial infections are associated with significant morbidities and mortalities. Nationwide prevalence of HAIs in Thailand has been monitored periodically by The Nosocomial Infection Control Group of Thailand. From 1988 to 1992, the prevalence of HAIs were reduced from 11.7 to 7.4%[1]. Over the last two decades, the nationwide prevalences of HAIs ranged from 6.4 to 7.3% without significant change[2-5]. Previous studies were based upon patient population in secondary to tertiary-care hospitals, excluding community hospitals among which HAIs were thought to be uncommon. Until recently, as a result of health-care system change in Thailand, a large proportion of patients at risk of HAIs were transferred from secondary or tertiary-care hospitals to community hospitals for subsequent hospital care. Prevalence of nationwide HAIs may be affected by the aforementioned change. Therefore, the investigators conducted the present study with the primary objective to determine the recent national prevalence, distributions and etiologic agents of HAIs, and as the secondary objective, to describe antimicrobial use in hospitalized patients across Thailand.

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Material and Method

The investigators carried out the prospective, multi-centered, 1-day point prevalence survey among acute care hospitals including community, general, regional to university hospitals and also other types of tertiary-care hospitals in all regions across the nation. Eligible hospitals were enrolled using stratified random sampling which captures key characteristics and proportions to represent the overall hospital population across Thailand. The sampling was similar to those in previous prevalence studies[4,5]. Prior to initiation of the present study, the co-investigators who were full-time infection control nurses (ICNs) of the participating hospitals, received training on the study methods and standardized definition of HAIs modified from The US Center for Disease Control and Prevention surveillance

definition of HAIs, as described else where[6]. The co-investigators listed and reviewed the medical records of all patients admitted on the first day of study. The clinical, micro-biological and other data required by diagnostic criteria of HAIs were collected. In the community hospitals where ICN was not available, the data were collected by the regional ICNs. Statistical analysis was performed using SPSS for Windows® version 11.1. Continuous and categorical variables were expressed as mean, percentage and standard deviations as appropriate. The study protocol had been approved by The Ethics Committee of Faculty of Medicine Siriraj Hospital, Mahidol University (COA Si698/2010), prior to study initiation. As a routine data collection in patient care, an informed consent was not required.

Results

A total of 47 hospitals participated and enrolled 10,762 patients listed at the first day of study period in January 2011. The participating hospitals were located in all regions of Thailand; *i.e.*, Northern region (n = 5), North eastern region (n = 10), Central region (n = 20), Eastern region (n = 3) and Southern region (n = 9). The mean age of all patients was 44.2 $\pm$ 27.3 years. There was no gender difference among the study patients (female 50.6%). Overall study data are shown in Table 1.

In overall, among 10,762 patients enrolled in the study, 780 had HAIs or the prevalence of HAIs was 7.3%. Among the patients with HAIs, the mean age was 54.4 $\pm$ 27.8 years, female to male ratio was 1:1. When stratified by types of hospital, highest rate of HAIs was found in the other hospitals which were the other types of tertiary-care, non Ministry of Public Health-affliated hospitals and secondly, in the regional hospitals (8.5%, 272/3,211 patients and 7.7%, 238/3,098 patients, respectively). Lowest rate of HAIs was found in the group of community hospitals, (2.8%, 31/1,123 patients).

As shown in Table 2, stratified by types of service, HAIs are most commonly found in the intensive care units (26.7% of total patients), followed in ranks by medicine, surgery, pediatrics, orthopedics and gynecology (range 3.6 to 9.5% of total patients). HAIs were the least common in obstetric patients (0.4% of total patients).

When stratified by sites of HAIs, as shown in Table 3, lower respiratory tract was the most common site, followed by urinary tract, surgical site, blood stream and skin/soft tissue (47.7, 28.2, 11.2, 8.2 and 6.4% of total patients, respectively). Regarding etiologic agents of HAIs, 69.5% of total patients with HAIs were culture-positive, of which most of the isolates were considered pathogenic, based on standardized HAI definition used in the present study. Among all of the organisms isolated, Gram negative bacilli (GNB) were predominant. Non-fermentative GNB, particularly, *Acinetobacter* spp. were the most common etiologic agents among all of those causing HAIs, followed by *Pseudomonas aeruginosa* and *Enterobacteriaceae*, (17.4, 13.6, 12.8, and 11.9% of total total patients with HAIs, respectively), as shown in Table 4.

There was no Gram positive bacteria isolated in the group of community hospital which was also associated with highest rate of undetermined etiologic agents (42.0 % of total patients with HAIs). However, higher rate of *Enterobacteriaceae* was found in the community and other hospitals. It was found that 49.3%

Table 1. Demographic data and prevalence of overall health-care associated infections stratified by types of hospital

Categories	Types of hospital					Total
	University	Regional	General	Community	Others*	
No of hospitals	2	5	4	22	14	47
No of patients,	2,443	3,098	887	1,123	3,211	10,762
no (%)	(22.7)	(28.8)	(8.2)	(10.4)	(29.8)	(100)
Female,	1,257	1,498	465	598	1,591	5,409
no (%)	(52.1)	(48.5)	(52.7)	(53.4)	(49.9)	(50.6)
Mean age $\pm$ SD (years)	45.0 $\pm$ 27.0	43.4 $\pm$ 26.2	46.7 $\pm$ 27.0	39.2 $\pm$ 28.7	45.3 $\pm$ 27.9	44.2 $\pm$ 27.3
HAI Prevalence, %	7.4	7.7	6.5	2.8	8.5	7.3
(no of patients)	(181)	(238)	(58)	(31)	(272)	(780)

*Others = other types of tertiary-care, non Ministry of Public Health-affliated hospitals. SD = standard deviation, HAI = health-care associated infection

Table 2. Prevalence of health-care associated infections stratified by types of service and hospital (%)

Types of service	Types of hospital (no of patients)					Total (n = 10,762)
	University (n = 2,443)	Regional (n = 3,098)	General (n = 887)	Community (n = 1,123)	Others* (n = 3,211)	
ICU	22.0	38.2	23.7	11.8	27.4	26.7
Medicine	10.2	10.9	10.0	3.7	9.1	9.5
Surgery	6.2	8.4	2.5	6.9	9.6	7.8
Pediatrics	10.8	4.7	4.0	3.8	6.7	6.5
Orthopedics	6.8	5.1	6.1	4.3	5.5	5.6
Gynecology	7.2	1.7	0.0	0.0	2.9	3.6
EENT	2.0	0.9	3.6	0.0	1.0	1.5
Obstetrics	0.0	0.3	0.0	0.0	1.6	0.4
Miscellaneous	4.8	0.0	0.0	1.7	6.3	3.2

*Others = other types of tertiary-care, non Ministry of Public Health-affliated hospitals. ICU = intensive care unit, EENT = ophthalmology and otorhinolaryngology

Table 3. Prevalence of health-care associated infections stratified by site of infections (%)

Category	Types of hospital (no of patients)					Total (n = 10,762)
	University (n = 2,443)	Regional (n = 3,098)	General (n = 887)	Community (n = 1,123)	Others* (n = 3,211)	
LRTI	47.5	59.7	55.2	38.7	36.6	47.7
UTI	23.8	19.3	19.0	25.8	41.2	28.2
SSI	13.3	10.1	10.3	9.7	11.0	11.2
BSI	9.4	6.7	3.4	3.2	10.3	8.2
SSTI	7.2	3.8	10.3	12.9	6.6	6.4
IAI	1.7	2.1	1.7	3.2	4.4	2.8
URTI	1.1	0.4	0.0	3.2	1.5	1.0
Miscellaneous	6.1	5.5	6.9	6.5	5.9	5.9

*Others = other types of tertiary-care, non Ministry of Public Health-affliated hospitals, LRT = lower respiratory tract infection , UTI = urinary tract infection, SSI = surgical site infection, BSI = blood stream infection, SSTI = skin and soft tissue infection, IAI = intrabdominal infection, URTI = upper respiratory tract infection, Miscellaneous = infections involving genital tracts, oral cavities, eyes, central nervous systems, neonatal umbilicus, etc

of all patients received one or more classes of antimicrobial agents for therapy or prophylaxis at the time of study. Interestingly, the highest rate of antimicrobial use was found in the community hospitals, as shown in Table 5.

Cephalosporins were the most common antimicrobial agent used in all types of hospital, followed by penicillins, beta-lactam/beta-lactamase inhibitors (BL/BIs) and fluoroquinolones (FQs). In the patients with HAIs, cephalosporins were also most commonly used; however, a significantly higher rate of carbapenems was used, ranking them the second most common antimicrobial agents, followed by BL/BIs, FQs and aminoglycosides, respectively, as shown in Table 6.

Discussion

Surveillance of HAIs may be performed using hospital wide or targeted (e.g., device-associated infection, etc) format. Hospitalwide,or in a larger scale, nationwide surveillance, may provide informations on trend change of HAIs, including distribution of sites, etiologic agents of HAIs and antimicrobial agents used, when serially conducted. Based on the recent worldwide studies, national prevalence ranged from 4.5 to 6.7% in

Table 4. Etiologic agents of health-care associated infections stratified by type of hospital (% of patients with HAIs)

Categories	Types of hospital (no of patients)					Total (n = 780)
	University (n = 181)	Regional (n = 238)	General (n = 58)	Community (n =31)	Others** (n = 272)	
Culture positive	66.9	66.4	69.0	41.9	77.2	69.5
Culture negative	9.9	5.9	6.9	16.1	5.9	7.3
Culture undetermined**	23.2	27.7	24.1	42.0	16.9	23.2
Gram positive bacteria						
MRSA	9.4	8.8	5.2	0.0	6.6	7.6
MSSA	2.2	2.5	0.0	0.0	1.1	1.7
Enterococcus spp.	3.9	4.6	1.7	0.0	9.6	5.8
Others	3.3	3.4	8.6	0.0	5.1	4.2
Total	18.8	19.3	15.5	0.0	22.4	19.3
Gram negative bacteria						
Acinetobacter spp.	18.2	20.2	20.7	3.2	15.4	17.4
P. aeruginosa	13.3	9.2	22.4	6.5	16.5	13.6
E. coli	7.7	8.8	13.8	12.9	19.5	12.8
Klebsiella spp.	8.8	13.0	12.1	19.4	12.1	11.9
Others	13.8	8.4	6.9	0.0	14.7	11.4
Total	61.8	59.6	75.9	42.0	78.2	67.1
Fungi	6.6	3.4	8.6	9.7	10.3	7.2
Virus	1.7	0.0	0.0	0.0	0.4	0.5

* Others = other types of tertiary-care, non Ministry of Public Health-affliated hospitals
** Culture undetermined = culture not done, culture result not availableAbbreviation,
MRSA = methicillin-resistant Staphylococcus aureus, MSSA = methicillin-sensitive Staphylococcus aureus

Table 5. Proportion of study patients with antimicrobial use* stratified by type of hospital (%)

Type of antimicrobials	Types of hospital (no of patients)					Total (n = 10,762)
	University (n = 2,443)	Regional (n = 3,098)	General (n = 887)	Community (n = 1,123)	Others** (n = 3,211)	
Any agent	43.1	57.8	56.6	58.1	40.7	49.3
Cephalosporins	20.8	26.4	28.2	32.0	17.0	23.0
Penicillins	4.7	10.6	13.5	14.7	6.7	8.8
BL/BIs	4.4	8.1	5.5	2.0	5.6	5.7
Fluoroquinolones	4.2	4.8	6.0	4.6	5.9	5.1
Aminoglycosides	2.5	6.7	5.5	3.7	5.6	5.0
Carbapenems	5.4	5.9	1.8	0.7	4.0	4.3
Metronidazole	4.2	6.1	3.4	3.7	2.8	4.2
Macrolides	2.8	4.6	4.2	4.5	2.9	3.6
Cotrimoxazole	1.2	0.6	0.1	1.0	1.5	1.0
Others	9.5	8.9	6.0	6.0	7.9	8.2

* The antimicrobial use in the study patients included the use for therapy and prophylaxis
** Others = other types of tertiary-care, non Ministry of Public Health-affliated hospitals Abbreviation, BL/BIs = Beta-lactam/Beta-lactamase inhibitors

Table 6. Proportion of the HAI patients with antimicrobial use* stratified by type of hospital (%)

Type of antimicrobials	Types of hospital (no of patients)					Total (n = 780)
	University (n = 181)	Regional (n =238)	General (n = 58)	Community (n =31)	Others** (n = 272)	
Cephalosporins	33.1	24.8	29.3	35.5	24.3	27.3
Carbapenems	29.8	31.1	6.9	12.9	26.5	26.7
BL/BIs	14.4	26.9	25.9	6.5	22.4	21.5
Fluoroquinolones	8.8	12.6	17.2	16.1	23.2	15.9
Aminoglycosides	5.5	16.4	8.6	22.6	13.2	12.4
Penicillins	6.1	5.9	10.3	12.9	5.1	6.3
Metronidazole	8.8	4.2	3.4	6.5	4.8	5.5
Macrolides	3.9	4.2	8.6	16.1	2.9	4.5
Cotrimoxazole	3.3	0.4	0.0	0.0	3.7	0.2
Others	38.7	32.8	12.1	19.4	28.7	30.6

* The antimicrobial use in the HAI patients included the use for therapy and prophylaxis
** Others = other types of tertiary-care, non Ministry of Public Health-affliated hospitals, BL/BIs = Beta-lactam/Beta-lactamase inhibitors

developed countries[7-9] and 7.8% in developing countries[10]. The rates of device-associated infections e.g., ventilator-associated pneumonia, central line-associated blood stream infection, catheter-associated urinary tract infection, etc. were 3 to 5 times higher in resource-limited countries than those in resource-rich countries[11]. In the present study, the prevalence rate of HAIs was comparable to our previous studies[4,5]. However, the HAI rates appeared to be higher than those of recent studies in developed countries and as well, HAIs rates in particular types of hospital were higher than those studied in 2006, e.g., other hospitals (other types of tertiary-care facilities) 8.5 vs. 7.6%, regional hospitals 7.7 vs. 4.9% and general hospitals 6.5 vs. 6.0%[5]. The prevalence of HAIs in community hospitals, which were previously believed to be low, were not available for comparison. These findings may suggest increasing prevalence rates of HAIs in secondary to tertiary-care facilities in Thailand. Lower respiratory tract was the most common site of HAIs and Gram negative bacilli (GNB) were the most common etiologic agents of HAIs during 2001 to 2006 and also, in the present study (range 67.1-75.3% of all HAI episodes, respectively). These findings are comparable to prior international studies in which lower respiratory tract infections and Gram negative bacteria tend to predominate in developing countries, whereas urinary tract infections and Gram positive bacteria were more common in developed countries[12]. In the present study, highest rates of HAIs were found in the other hospitals and the intensive care units (ICUs). As a result of above findings, infection prevention and control program in Thailand should be prioritized in the other hospitals, ICUs and lower respiratory tracts. Gram negative bacteria continued to predominate among the etiologic agents of HAIs in the present study. However, *Acinetobacter spp*., has emerged as the most common etiologic agents of HAIs for the first time in over a decade of nationwide surveillances, with the prevalence increasing from 13.0 to 17.4% of all HAI episodes[4,5]. *Acinetobacter spp*. particularly, *Acinetobacter baumannii* have recently become the most common etiologic agents of nosocomial pneumonia and more common agents in nosocomial blood stream infections among tertiary care hospitals[13,14]. This may be associated with the large-scale clonal spread of the organisms among several tertiary care hospitals in Thailand and worldwide[15-17]. The high rates of antimicrobial agent use unrelated to types of hospital may reflect infectious disease as a common disorder or an antimicrobial overuse in hospitalized patients. Cephalosporins have been the most commonly used antimicrobial agents for decades, given the fact that penicillins excluding beta-lactam/beta-lactamase inhibitors were less frequently used among inpatients. Carbapenems, which were infrequently used among hospitalized patients in developed countries[18], were increasingly used among the patients from the 2006 to the present study. Over a quarter of patients with HAIs were treated with carbapenems, this reflected increasing prevalence of multi-drug resistant organisms in Thai hospitals associated with broad spectrum

antimicrobial use as previously reported[14,19,20].

Regarding limitations of the present study, various diagnostic tests to confirm HAIs were selected at the discretion of attending doctors. The isolation of organisms in the community hospitals was likely to be suboptimal. Also, variation among laboratories of participating hospitals may be present.

Conclusion

In this nationwide survey in acute care hospitals across Thailand, the authors demonstrated the point prevalence of HAIs comparable to those studied during 1992 to 2006; nevertheless, the HAI rates in secondary and tertiary care facilities showed an increased trend. Gram negative bacteria remained predominant and *Acinetobacter spp*., emerged as the most common etiologic agent. Broad spectrum antimicrobial agents were increasingly used. Continuous surveillance of nationwide HAIs is required to determine future trends and appropriate control measures.

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Potential conflicts of interest

None.

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การติดเชื้อที่สัมพันธ์กับการบริการสุขภาพในประเทศไทย พ.ศ. 2554

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วัตถุประสงค์*: เพื่อศึกษาความชุกและแนวโน้มปัจจุบันของการติดเชื้อที่สัมพันธ์กับการบริการสุขภาพในโรงพยาบาลในประเทศไทย*

วัสดุและวิธีการ*: ผู้นิพนธ์ศึกษาในหลายสถานที่วิจัยแบบไปข้างหน้าโดยการสำรวจผู้ป่วยที่รับไว้ในโรงพยาบาลทุกระดับจำนวน 47 แห่งทั่วประเทศไทยในรอบหนึ่งวันที่ศึกษาในเดือนมกราคม พ.ศ. 2554 เกณฑ์การวินิจฉัยการติดเชื้อที่ใช้ในการศึกษาได้ดัดแปลงจากเกณฑ์ระหว่างประเทศ*

ผลการศึกษา*: ในผู้ป่วยจำนวนทั้งสิ้น 10,762 ราย (เพศหญิง ร้อยละ 50.6, อายุเฉลี่ย 44.2 $\pm$ 27.3 ปี) ผู้ป่วยจำนวน 780 ราย ได้รับการวินิจฉัยการติดเชื้อหรืออัตราชุกของการติดเชื้อที่สัมพันธ์กับการบริการสุขภาพโดยเฉลี่ยเท่ากับร้อยละ 7.3 (พิสัยร้อยละ 2.8 ถึง 8.5) อัตราชุกสูงสุดพบในโรงพยาบาลตติยภูมิประเภทอื่นๆ และหออภิบาลผู้ป่วยวิกฤตทางเดินหายใจส่วนล่างเป็นตำแหน่งการติดเชื้อที่พบบ่อยที่สุด ประเภทของเชื้อก่อโรคที่พบบ่อยที่สุดได้แก่ แบคทีเรียกรัมลบโดยเฉพาะ Acinetobacter spp. ร้อยละ 49.3 ของผู้ป่วยในโรงพยาบาลได้รับยาต้านจุลชีพ ตั้งแต่ 1 ชนิดขึ้นไป ยาต้านจุลชีพประเภทที่ใช้บ่อยที่สุดในผู้ป่วยกลุ่มที่ติดเชื้อที่สัมพันธ์กับการบริการสุขภาพ ได้แก่ cephalosporins*

สรุป*: ในปัจจุบันแนวโน้มของความชุกการติดเชื้อที่สัมพันธ์กับการบริการสุขภาพไม่เปลี่ยนแปลงจากอัตราเดิม Acinetobacter spp. มีความชุกเพิ่มขึ้นเป็นเชื้อก่อโรคที่พบบ่อยที่สุด*