Trends of MDROs in Asia Pacific and Its Relation to HAIs

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Objectives

Sharing common scenarios in Asia

Describe epidemiology of HAIs in Asia

How to reduce/contain MDROs in this region?

Scenario

A 69 year-old, patient admitted to an 8-bed ICUs s/p neurosurgical procedure. He previously exposed to Pip/taz. 4 days after intubation, patient developed fever and CXR revealed new lung infiltration with CPIS of 8. Current MDROs in ICU: 3 pts with XDR-*Acinetobacter baumannii*, 1 ESBL-EC, 1 *Pseudomonas aerugionosa*, *1 carbapenem resistant enterobacteriaceae (CRE)*.

What is the most likely pathogen?

A) *XDR-Acinetobacter baumannii*

B) *ESBL-Escherichia coli*

C) *Pseudomonas aeurginosa*

D) Carbapenem resistant Enterobacteriaceae

E) Cannot predict

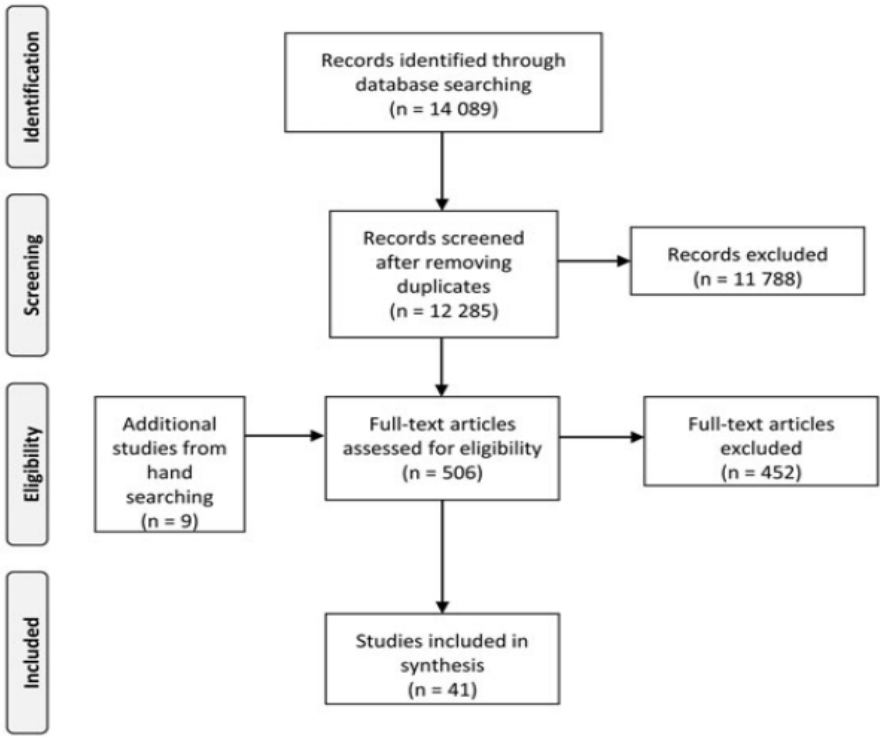
INVITED ARTICLE HEALTHCARE EPIDEMIOLOGY

Robert A. Weinstein, Section Editor

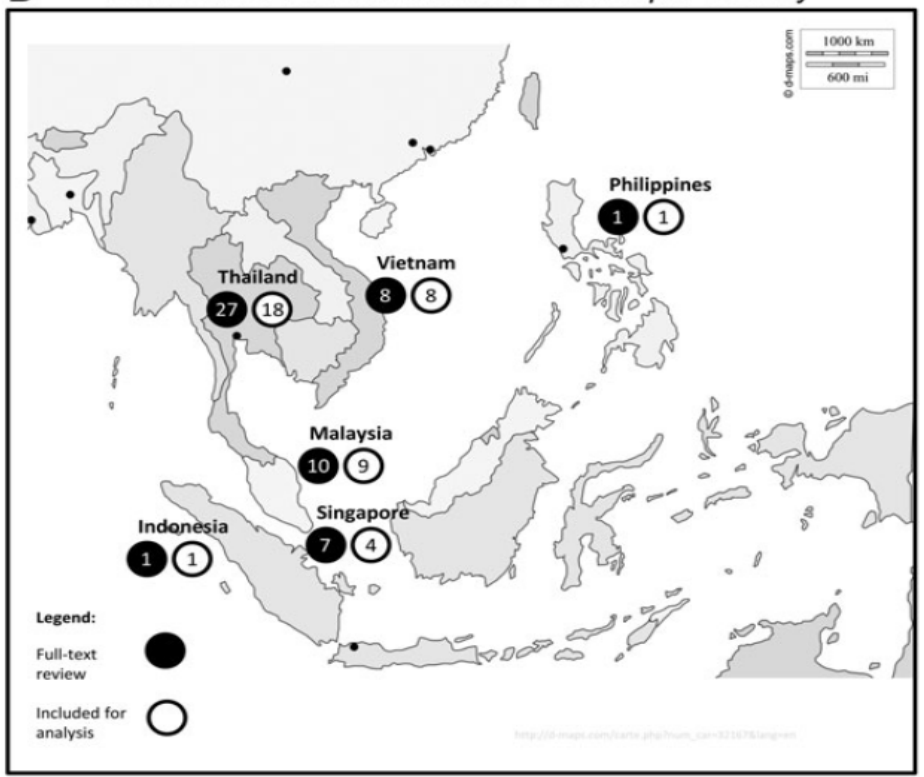
The Burden of Healthcare-Associated Infections in Southeast Asia: A Systematic Literature Review and Meta-analysis

Moi Lin Ling,[1] Anucha Apisarnthanarak,[2] and Gilbert Madriaga[3]

A *PRISMA flowchart*



B *Full-text review and included studies per country*



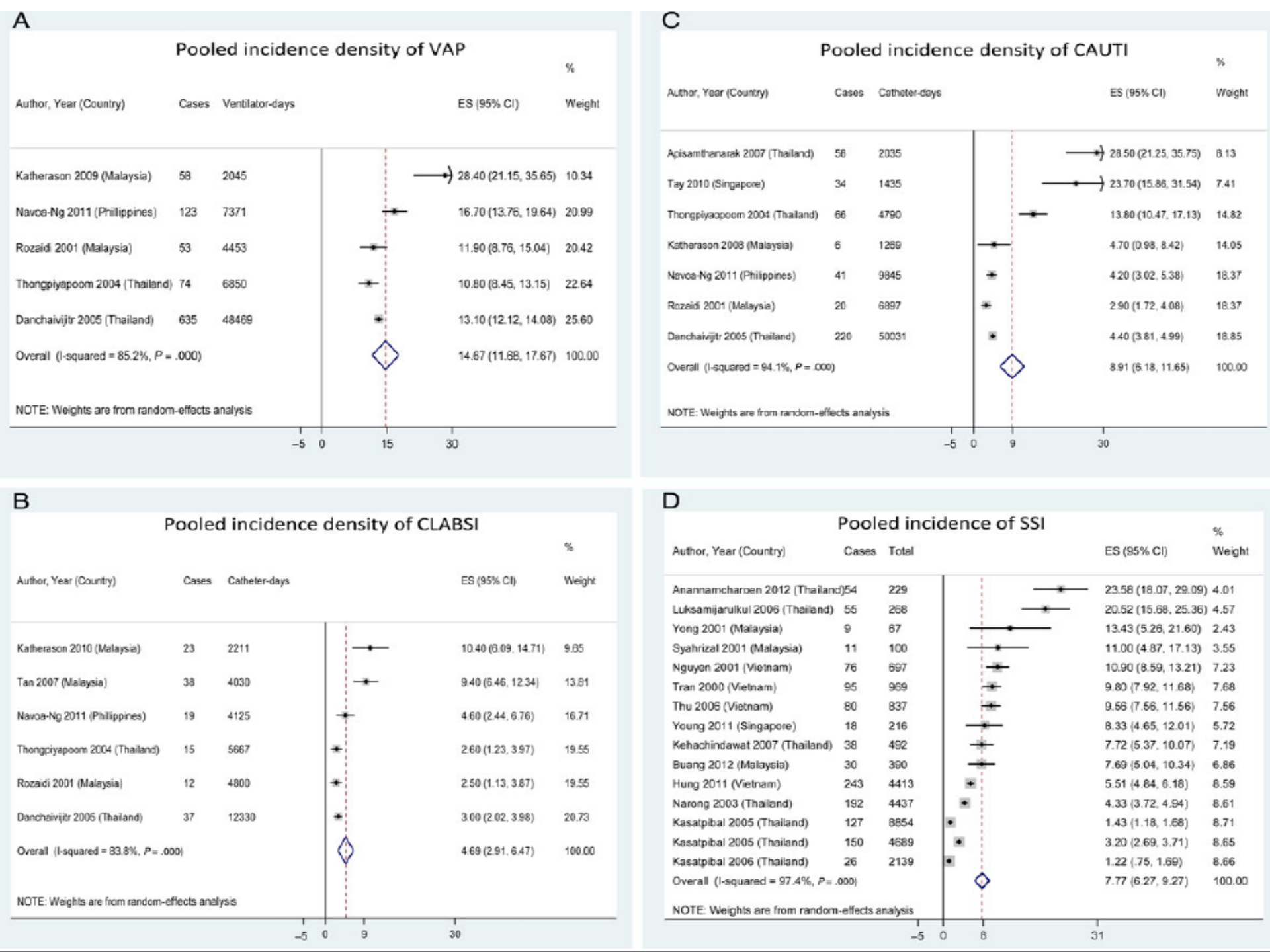

A
Pooled incidence density of VAP
Author, Year (Country) Cases Ventilator-days ES (95% CI) % Weight
Katherason 2009 (Malaysia) 58 2045 28.40 (21.15, 35.65) 10.34
Navoa-Ng 2011 (Philippines) 123 7371 16.70 (13.76, 19.64) 20.99
Rozaidi 2001 (Malaysia) 53 4453 11.90 (8.76, 15.04) 20.42
Thongpiyapoom 2004 (Thailand) 74 6850 10.80 (8.45, 13.15) 22.64
Danchaivijitr 2005 (Thailand) 635 48469 13.10 (12.12, 14.08) 25.60
Overall (I-squared = 85.2%, P = .000) 14.67 (11.68, 17.67) 100.00
NOTE: Weights are from random-effects analysis
-5 0 15 30
B
Pooled incidence density of CLABSI
Author, Year (Country) Cases Catheter-days ES (95% CI) % Weight
Katherason 2010 (Malaysia) 23 2211 10.40 (6.09, 14.71) 9.65
Tan 2007 (Malaysia) 38 4030 9.40 (6.46, 12.34) 13.81
Navoa-Ng 2011 (Philippines) 19 4125 4.60 (2.44, 6.76) 16.71
Thongpiyapoom 2004 (Thailand) 15 5667 2.60 (1.23, 3.97) 19.55
Rozaidi 2001 (Malaysia) 12 4800 2.50 (1.13, 3.87) 19.55
Danchaivijitr 2005 (Thailand) 37 12330 3.00 (2.02, 3.98) 20.73
Overall (I-squared = 83.8%, P = .000) 4.69 (2.91, 6.47) 100.00
NOTE: Weights are from random-effects analysis
-5 0 9 30
C
Pooled incidence density of CAUTI
Author, Year (Country) Cases Catheter-days ES (95% CI) % Weight
Apisamthanarak 2007 (Thailand) 58 2035 28.50 (21.25, 35.75) 8.13
Tay 2010 (Singapore) 34 1435 23.70 (15.88, 31.54) 7.41
Thongpiyapoom 2004 (Thailand) 66 4790 13.80 (10.47, 17.13) 14.82
Katherason 2008 (Malaysia) 6 1269 4.70 (0.98, 8.42) 14.05
Navoa-Ng 2011 (Philippines) 41 9845 4.20 (3.02, 5.38) 18.37
Rozaidi 2001 (Malaysia) 20 6897 2.90 (1.72, 4.08) 18.37
Danchaivijitr 2005 (Thailand) 220 50031 4.40 (3.81, 4.99) 18.85
Overall (I-squared = 94.1%, P = .000) 8.91 (6.18, 11.65) 100.00
NOTE: Weights are from random-effects analysis
-5 0 9 30
D
Pooled incidence of SSI
Author, Year (Country) Cases Total ES (95% CI) % Weight
Anannamcharoen 2012 (Thailand) 54 229 23.58 (18.07, 29.09) 4.01
Luksamijarulkul 2006 (Thailand) 55 268 20.52 (15.68, 25.36) 4.57
Yong 2001 (Malaysia) 9 67 13.43 (5.26, 21.60) 2.43
Syahrizal 2001 (Malaysia) 11 100 11.00 (4.87, 17.13) 3.55
Nguyen 2001 (Vietnam) 76 697 10.90 (8.59, 13.21) 7.23
Tran 2000 (Vietnam) 95 969 9.80 (7.92, 11.68) 7.68
Thu 2006 (Vietnam) 80 837 9.56 (7.56, 11.56) 7.56
Young 2011 (Singapore) 18 216 8.33 (4.65, 12.01) 5.72
Kehachindawat 2007 (Thailand) 38 492 7.72 (5.37, 10.07) 7.19
Buang 2012 (Malaysia) 30 390 7.69 (5.04, 10.34) 6.86
Hung 2011 (Vietnam) 243 4413 5.51 (4.84, 6.18) 8.59
Narong 2003 (Thailand) 192 4437 4.33 (3.72, 4.94) 8.61
Kasatpibal 2005 (Thailand) 127 8854 1.43 (1.18, 1.68) 8.71
Kasatpibal 2005 (Thailand) 150 4689 3.20 (2.69, 3.71) 8.65
Kasatpibal 2006 (Thailand) 26 2139 1.22 (.75, 1.69) 8.66
Overall (I-squared = 97.4%, P = .000) 7.77 (6.27, 9.27) 100.00
NOTE: Weights are from random-effects analysis
-5 0 8 31

Table 1. Common Microorganisms Extracted From Systematic Review

Type of Infection	Microorganisms	Range, %[a]	Studies
Overall HAIs	*Pseudomonas aeruginosa* *Klebsiella* spp *Acinetobacter baumanni*	13.4–31.5 10–10.9 10.7–23.3	Hughes et al, 2005 (Malaysia) [23]; Thu et al, 2011 (Vietnam) [42]; Danchaivijitr et al, 2007 (Thailand) [24]
ICU	*Acinetobacter* spp *Klebsiella* spp *P. aeruginosa*	18.42–21.13 14.1–44.74 15.8–16.9	Katherason et al, 2008 (Malaysia) [34]; Thongpiyapoom et al, 2004 (Thailand) [26]
SSI	*Escherichia coli* *Pseudomonas* spp *Staphylococcus aureus*	10.3–38.7 12–29.5 11.5–44.4	Anannamcharoen et al, 2012 (Thailand) [35]; Luksamijarulkul et al, 2006 (Thailand) [47]; Yong et al, 2001 (Malaysia) [41]; Syahrizal et al, 2001 (Malaysia) [39]; Thu et al, 2005 (Vietnam) [55]; Young et al, 2011 (Singapore) [43]; Kehachindawat et al, 2007 (Thailand) [38]; Buang et al, 2012 (Malaysia) [44]; Hung et al, 2011 (Vietnam) [40]; Narong et al, 2003 (Thailand) [45]
CAUTI	*Candida* spp *E. coli* *Klebsiella* spp	25–27.8 11.1–36.1 11.1–75	Thongpiyapoom et al, 2004 (Thailand) [26]; Katherason et al, 2008 (Malaysia) [34]; Navoa-Ng et al, 2011 (Philippines) [28]; Rozaidi et al, 2001 (Malaysia) [29]; Narong et al, 2003 (Thailand) [45]
VAP	*Acinetobacter* spp *Pseudomonas* spp *Klebsiella* spp	13.6–42.8 14.8–32.3 14.3–38.7	Katherason et al, 2009 (Malaysia) [27]; Navoa-Ng et al, 2011 (Philippines) [28]; Rozaidi et al, 2001 (Malaysia) [29]; Thongpiyapoom et al, 2004 (Thailand) [26]; Narong et al, 2003 (Thailand) [45]
CLABSI	*Acinetobacter* spp *S. aureus* *Klebsiella* spp	11.1–50 9.1–16.7 9.1–38.9	Katherason et al, 2010 (Malaysia) [31]; Tan et al, 2007 (Malaysia) [30]; Navoa-Ng et al, 2011 (Philippines) [28]; Thongpiyapoom et al, 2004 (Thailand) [26]; Rozaidi et al, 2001 (Malaysia) [29]; Narong et al, 2003 (Thailand) [45]

A Systematic Review of the Burden of Multidrug-Resistant Healthcare-Associated Infections Among Intensive Care Unit Patients in Southeast Asia: The Rise of Multidrug-Resistant *Acinetobacter baumannii*

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OBJECTIVE. To summarize the clinical burden (cumulative incidence, prevalence, case fatality rate and length of stay) and economic burden (healthcare cost) of healthcare-associated infections (HAIs) due to multidrug-resistant organisms (MDROs) among patients in intensive care units (ICUs) in Southeast Asia.

DESIGN. Systematic review.

METHODS. We conducted a comprehensive literature search in PubMed, EMBASE, CINAHL, EconLit, and the Cochrane Library databases from their inception through September 30, 2016. Clinical and economic burdens and study quality were assessed for each included study.

RESULTS. In total, 41 studies met our inclusion criteria; together, 22,876 ICU patients from 7 Southeast Asian countries were included. The cumulative incidence of HAI caused by *A. baumannii* (AB) in Southeast Asia is substantially higher than has been reported in other regions, especially carbapenem-resistant AB (CRAB; 64.91%) and multidrug-resistant AB (MDR-AB) (58.51%). Evidence of a dose–response relationship between different degrees of drug resistance and excess mortality due to AB infections was observed. Adjusted odds ratios were 1.23 (95% confidence interval [CI], 0.51–3.00) for MDR-AB, 1.72 (95% CI, 0.77–3.80) for extensively drug-resistant AB (XDR-AB), and 1.82 (95% CI, 0.55–6.00) for pandrug-resistant AB (PDR-AB). There is, however, a paucity of published data on additional length of stay and costs attributable to MDROs.

CONCLUSIONS. This review highlights the challenges in addressing MDROs in Southeast Asia, where HAIs caused by MDR gram-negative bacteria are abundant and have a strong impact on society. With our findings, we hope to draw the attention of clinicians and policy makers to the problem of antibiotic resistance and to issue a call for action in the management of MDROs.

Infect Control Hosp Epidemiol 2018;39:525–533

TABLE 1. Aggregate Description of Included Studies

Characteristics	No. of Studies	References
Country of publication		
Singapore	14	15, 21, 28, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49
Thailand	13	22, 26, 27, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59
Malaysia	7	25, 60, 61, 62, 63, 64, 65
Vietnam	3	66, 67, 68
Philippines	2	69, 70
Cambodia	1	14
Indonesia	1	71
Reported MDRO		
MRSA	23	15, 21, 22, 39, 42, 43, 44, 45, 48, 49, 50, 53, 54, 55, 59, 60, 61, 62, 63, 65, 66, 67, 69
MDR-AB	14	15, 22, 25, 42, 45, 46, 47, 50, 51, 52, 55, 59, 63, 68
ESBL-producers	10	14, 50, 54, 60, 61, 62, 63, 64, 67, 71
CRAB	7	14, 21, 26, 56, 57, 66, 68
MDR-PsA	5	42, 45, 50, 54, 59
XDR-AB	5	22, 52, 54, 55, 58
PDR-AB	3	22, 27, 52
VRE	3	50, 59, 69
CRE	2	40, 66

Length of stay and healthcare costs. The comparison of LOS between patients infected with an MDR strain and those with a drug-susceptible strain are displayed in Table 2. Of 8 studies reporting LOS, 7 reported that total hospital or ICU LOS tended to be longer for patients with MDR infections. For example, Janahiraman et al[25] found that, on average, patients infected with MDR-AB stayed in the ICU for an additional 15.3 days, compared to 17.9 days for those without MDR-AB. Importantly, not all studies performed statistical adjustments to minimize potential confounders between groups.

Currently, only a few studies reported the healthcare costs associated with MDRO infections in Southeast Asia. Thatrimontrichai et al[26] reported that patients with CRAB VAP had a higher median total hospital cost when compared to patients with CSAB VAP (US$11,773 vs US$9,735). Apisarnthanarak et al[27] did not compare the costs between MDR and non-MDR but demonstrated that the average total hospitalization cost per patient colonized or infected with PDR-AB was high (US$366 ± 100) and was lower after a multifaceted infection control intervention (US$204 ±88). Ng et al[28] reported that the hospitalization costs in patients with MDR BSI were higher (USD 8,638) than those with non-MDR BSI.

TABLE 2. Cumulative Incidence of Hospital-Acquired Infection (HAI) and Colonization, Excess Mortality, and Excess Length of Stay (LOS) due to MDROs in Southeast Asia

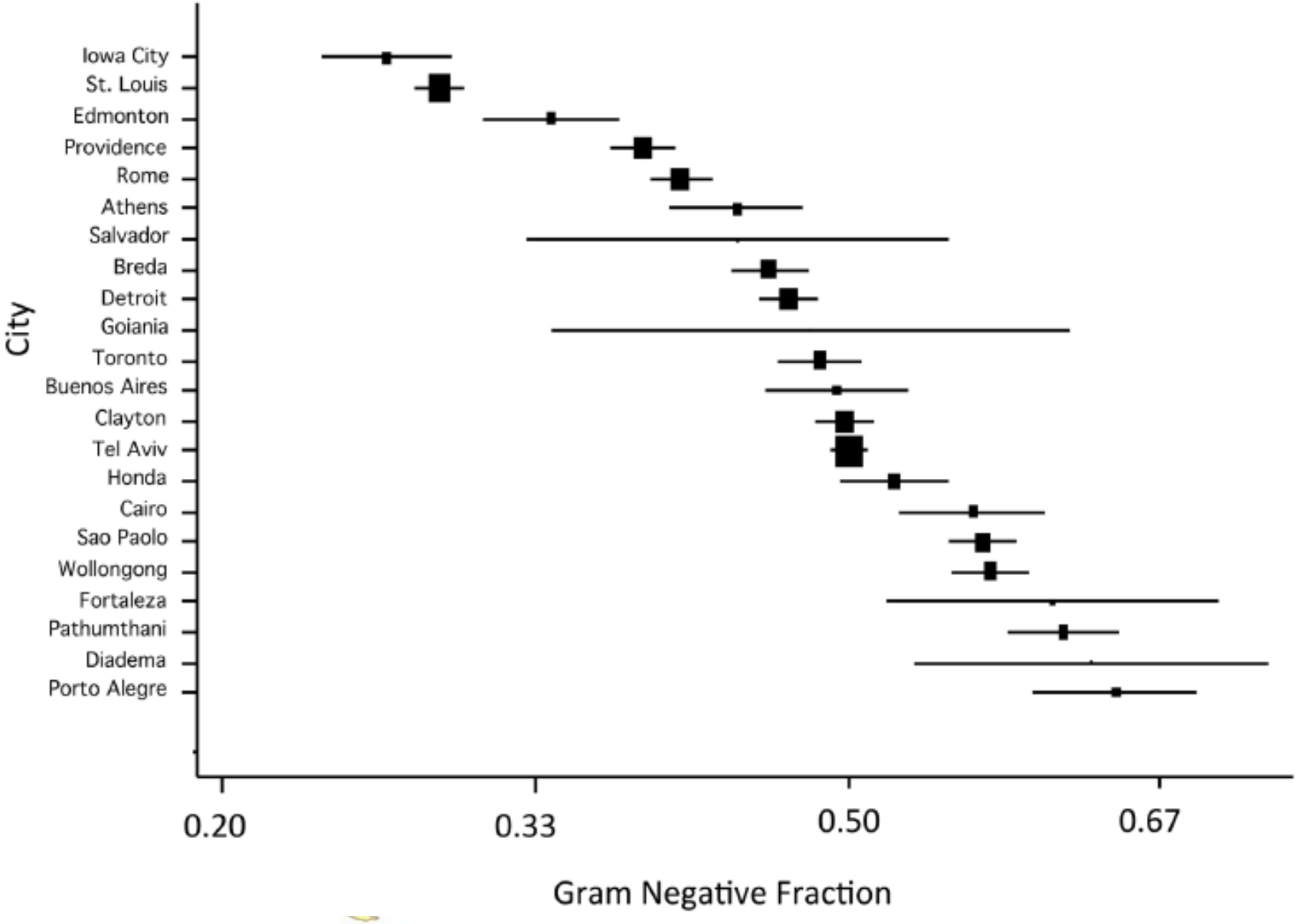
Microorganism	HAI, % Range or %		Colonization, % Range or %		Excess mortality, OR (95% CI)		Excess LOS, OR (95% CI)	
ESBL-producing GNB	BSI	1.56–2.79[60,62]	Any site	11.08–36.86[50]	Any HAI	1.40 (0.46–4.23)[71]		
	CLABSI	1.41[63]	Rectal	21.95–85.89[14,64]				
	Pneumonia	0.78[62]						
	VAP	2.79[61]						
CRAB	Any HAI	1.76–64.91[21,66]	Rectal	5.71[14]	BSI	4.95 (1.20–20.40)[56];		
						9.33 (0.89–97.62)[57]		
	BSI	0.32[57]			VAP	2.26 (0.26–19.42)[26]		
CR-PsA	Any HAI	1.76[66]						
CRE	Any HAI	1.03[66]					Acquisition	1.27 (1.20–1.34)[40]
CR-KP	Any HAI	1.69[66]						
MDR-AB	Any HAI	4.61–58.51[15,59]	Any site	10.05[50]	VAP	1.23 (0.51–3.00)[22];	VAP	1.04 (1.01–1.07)[25]
						2.97 (1.14–7.72)[52]		
	BSI	5.06–20.21[15,45]						
	CLABSI	0.81–25.53[15,63]						
	UTI	5.32[15]						
	VAP	28.72[15]						
	Wound infection	23.40[15]						
MDR-PsA	Any HAI	1.44[59]	Any site	3.87[50]				
	BSI	0.72[45]						
MDR-Enterobacteriaceae	Any HAI	1.15[59]						
MDR-GNB	BSI	19.55[70]	Any site	55.54[70]	VAP	1.39 (0.59–3.31)[55]		
XDR-GNB					VAP	2.22 (1.16–4.27)[55]		
XDR-AB	VAP	1.04[58]			VAP	1.72 (0.77–3.80)[22];		
						6.13 (2.55–14.75)[52]		
PDR-AB					VAP	1.82 (0.55–6.00)[22];		
						7.43 (1.72–32.05)[52]		
MRSA	Any HAI	0.86–32.98[15,39,49,59,66]	Any site	2.00–33.67[39,43,44,49,50,53,69]				
	BSI	0.15–10.64[15,39,45,60,62]	Wound	10.98[21]				
	CLABSI	1.01–14.89[15,63]						
	VAP	3.26–11.70[15,61]						
	Wound infection	11.70[15]						
VRE	Any HAI	0.58[59]	Any site	0.65–1.03[50,69]				
MDR-GPC					VAP	1.33 (0.07–26.62)[55]		
Any MDR					Any HAI	0.73 (0.20–2.74)[59]		
					BSI	5.01 (2.18–11.50)[45]		

High prevalence of Acinetobacter in skin

Types of Organisms Cultured from Forearm & Sternum of Outpatients & Inpatients

Organism	350 Outpatients		500 Inpatients	
	Forearm	Sternum	Forearm	Sternum
Gram-negatives bacteria				
Klebsiella spp.	5 (1.4%)	5 (1.4%)	10 (2%)	10 (2%)
Acinetobacter spp.	58 (16.6%)	60 (17.1%)	177 (35.4%)	178 (35.6%)
Nonfermentative GNR	18 (5.1%)	23 (6.6%)	20 (4%)	17 (3.4%)
Pseudomonas aeruginasa	3 (0.9%)	2 (0.6%)	5 (1%)	6 (1.2%)
Proteus spp.	5 (1.4%)	2 (0.6%)	-	1 (0.2%)
Enterobacter spp.	1 (2.8%)	2 (0.6%)	5 (1%)	-
Fungus				
Yeast	1 (0.3%)	1 (0.3%)	1 (0.2%)	1 (0.2%)

Thamlikitkul V, et.al. Am J Infect Control 2003.


Iowa City
St. Louis
Edmonton
Providence
Rome
Athens
Salvador
Breda
Detroit
Goiania
Toronto
Buenos Aires
Clayton
Tel Aviv
Honda
Cairo
Sao Paolo
Wollongong
Fortaleza
Pathumthani
Diadema
Porto Alegre
City
0.20
0.33
0.50
0.67
Gram Negative Fraction

Geographical Variability in the Likelihood of Bloodstream Infections Due to Gram-Negative Bacteria: Correlation with Proximity to the Equator and Health Care Expenditure

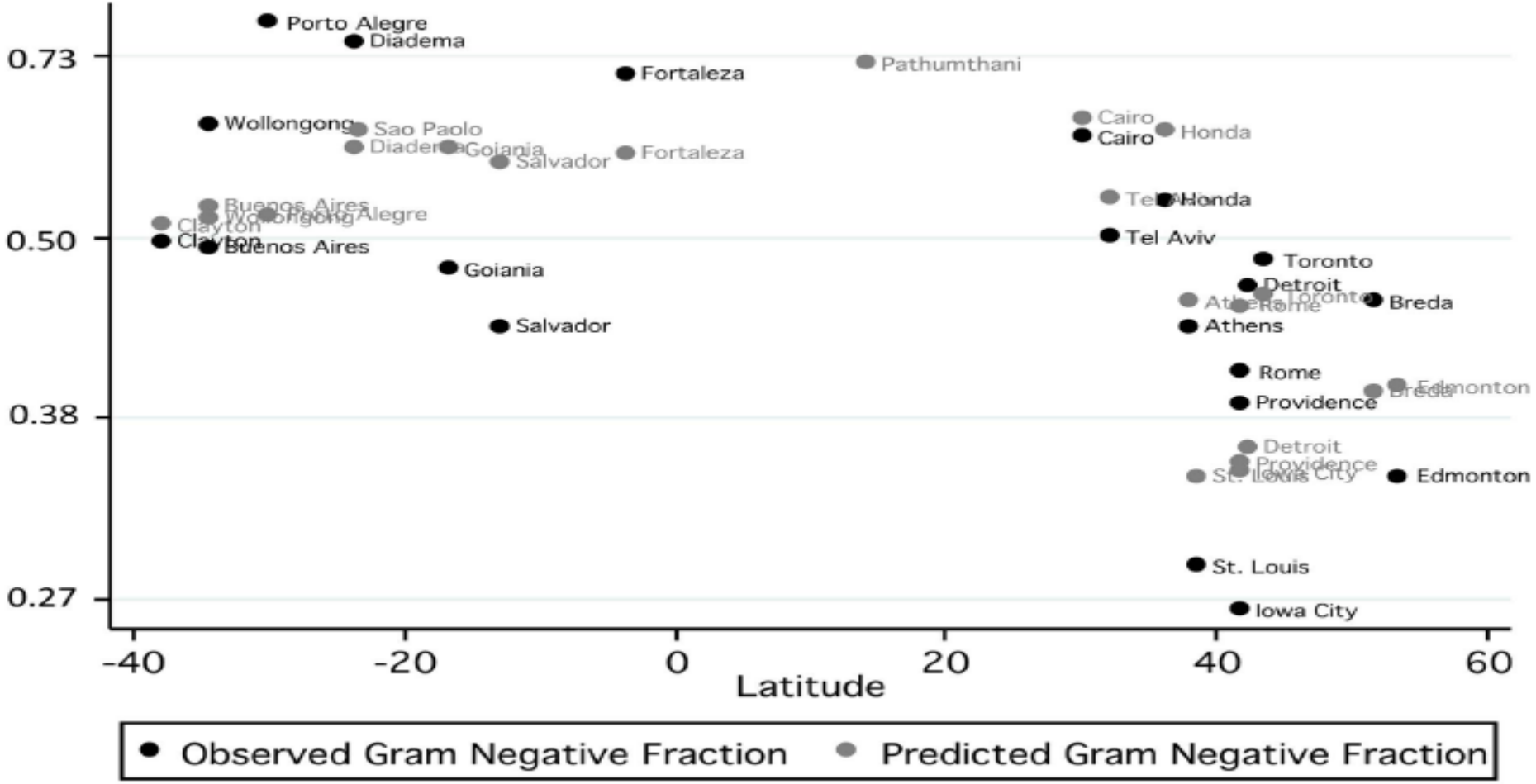
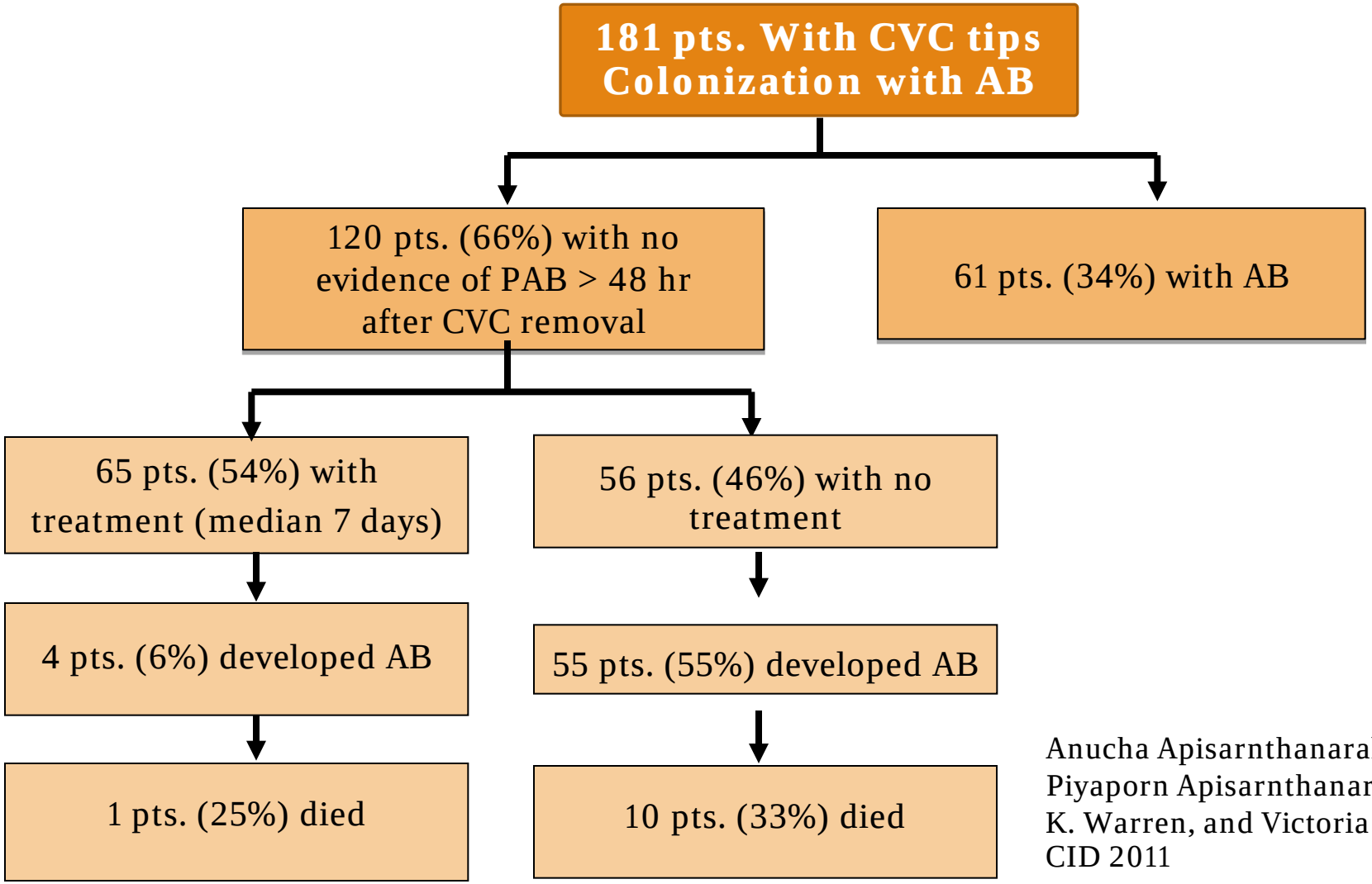


TABLE 2. Multivariate Model of Risk Factors for Extensively Drug-Resistant (XDR) *Acinetobacter baumannii* Bacteremia with Non-XDR *A. baumannii* as Control Group

	Time-adjusted comparison of case group 1[a] and case group 2[b]	
Variable	aOR (95% CI)	*P*
Male	1.970 (1.005–3.858)	.048
Time at risk from admission	0.991 (0.969–1.013)	.424
Renal disease	0.748 (0.340–1.644)	.470
Pitt bacteremia score	0.928 (0.815–1.055)	.252
Central intravascular access	1.010 (0.456–2.238)	.980
Use of urinary catheter	1.033 (0.462–2.311)	.937
Enteral tube feeding	1.852 (0.895–3.832)	.096
Carbapenems	2.378 (1.001–5.651)	.050
Piperacillin-tazobactam	4.889 (2.130–11.218)	<.0001

Is Central Venous Catheter Tip Colonization With *A. baumannii* a Predictor for Subsequent Bacteremia?



Anucha Apisarnthanarak, Piyaporn Apisarnthanarak, David K. Warren, and Victoria J. Fraser CID 2011

Do you screen patients for MRSA and de-colonize for MRSA prior to surgery?

Screen	De-colonize
A) Yes	Yes
B) Yes	No
C) No	No

You are consulted on a patient in orthopedic ward that had isolate from rectal swab positive for ESBL. Patient had no known MDRO risk factors. Which of the statement is true?

A) This patient had significant risk for ESBL infection

B) This patient had significant risk for SSI

C) This patient had no significant risk for SSI than normal patient

D) This patient should have carbapenem for surgical prophylaxis

E) No conclusion can be drawn from this

Table 1. Common Microorganisms Extracted From Systematic Review

Type of Infection	Microorganisms	Range, %[a]	Studies
Overall HAIs	*Pseudomonas aeruginosa* *Klebsiella* spp *Acinetobacter baumanni*	13.4–31.5 10–10.9 10.7–23.3	Hughes et al, 2005 (Malaysia) [23]; Thu et al, 2011 (Vietnam) [42]; Danchaivijitr et al, 2007 (Thailand) [24]
ICU	*Acinetobacter* spp *Klebsiella* spp *P. aeruginosa*	18.42–21.13 14.1–44.74 15.8–16.9	Katherason et al, 2008 (Malaysia) [34]; Thongpiyapoom et al, 2004 (Thailand) [26]
SSI	*Escherichia coli* *Pseudomonas* spp *Staphylococcus aureus*	10.3–38.7 12–29.5 11.5–44.4	Anannamcharoen et al, 2012 (Thailand) [35]; Luksamijarulkul et al, 2006 (Thailand) [47]; Yong et al, 2001 (Malaysia) [41]; Syahrizal et al, 2001 (Malaysia) [39]; Thu et al, 2005 (Vietnam) [55]; Young et al, 2011 (Singapore) [43]; Kehachindawat et al, 2007 (Thailand) [38]; Buang et al, 2012 (Malaysia) [44]; Hung et al, 2011 (Vietnam) [40]; Narong et al, 2003 (Thailand) [45]
CAUTI	*Candida* spp *E. coli* *Klebsiella* spp	25–27.8 11.1–36.1 11.1–75	Thongpiyapoom et al, 2004 (Thailand) [26]; Katherason et al, 2008 (Malaysia) [34]; Navoa-Ng et al, 2011 (Philippines) [28]; Rozaidi et al, 2001 (Malaysia) [29]; Narong et al, 2003 (Thailand) [45]
VAP	*Acinetobacter* spp *Pseudomonas* spp *Klebsiella* spp	13.6–42.8 14.8–32.3 14.3–38.7	Katherason et al, 2009 (Malaysia) [27]; Navoa-Ng et al, 2011 (Philippines) [28]; Rozaidi et al, 2001 (Malaysia) [29]; Thongpiyapoom et al, 2004 (Thailand) [26]; Narong et al, 2003 (Thailand) [45]
CLABSI	*Acinetobacter* spp *S. aureus* *Klebsiella* spp	11.1–50 9.1–16.7 9.1–38.9	Katherason et al, 2010 (Malaysia) [31]; Tan et al, 2007 (Malaysia) [30]; Navoa-Ng et al, 2011 (Philippines) [28]; Thongpiyapoom et al, 2004 (Thailand) [26]; Rozaidi et al, 2001 (Malaysia) [29]; Narong et al, 2003 (Thailand) [45]

TABLE 2. Cumulative Incidence of Hospital-Acquired Infection (HAI) and Colonization, Excess Mortality, and Excess Length of Stay (LOS) due to MDROs in Southeast Asia

Microorganism	HAI, % Range or %		Colonization, % Range or %		Excess mortality, OR (95% CI)		Excess LOS, OR (95% CI)	
ESBL-producing GNB	BSI	1.56–2.79[60,62]	Any site	11.08–36.86[50]	Any HAI	1.40 (0.46–4.23)[71]		
	CLABSI	1.41[63]	Rectal	21.95–85.89[14,64]				
	Pneumonia	0.78[62]						
	VAP	2.79[61]						
CRAB	Any HAI	1.76–64.91[21,66]	Rectal	5.71[14]	BSI	4.95 (1.20–20.40)[56]; 9.33 (0.89–97.62)[57]		
	BSI	0.32[57]			VAP	2.26 (0.26–19.42)[26]		
CR-PsA	Any HAI	1.76[66]						
CRE	Any HAI	1.03[66]					Acquisition	1.27 (1.20–1.34)[40]
CR-KP	Any HAI	1.69[66]						
MDR-AB	Any HAI	4.61–58.51[15,59]	Any site	10.05[50]	VAP	1.23 (0.51–3.00)[22]; 2.97 (1.14–7.72)[52]	VAP	1.04 (1.01–1.07)[25]
	BSI	5.06–20.21[15,45]						
	CLABSI	0.81–25.53[15,63]						
	UTI	5.32[15]						
	VAP	28.72[15]						
	Wound infection	23.40[15]						
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	BSI	0.72[45]						
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MDR-GNB	BSI	19.55[70]	Any site	55.54[70]	VAP	1.39 (0.59–3.31)[55]		
XDR-GNB					VAP	2.22 (1.16–4.27)[55]		
XDR-AB	VAP	1.04[58]			VAP	1.72 (0.77–3.80)[22]; 6.13 (2.55–14.75)[52]		
PDR-AB					VAP	1.82 (0.55–6.00)[22]; 7.43 (1.72–32.05)[52]		
MRSA	Any HAI	0.86–32.98[15,39,49,59,66]	Any site	2.00–33.67[39,43,44,49,50,53,69]				
	BSI	0.15–10.64[15,39,45,60,62]	Wound	10.98[21]				
	CLABSI	1.01–14.89[15,63]						
	VAP	3.26–11.70[15,61]						
	Wound infection	11.70[15]						
VRE	Any HAI	0.58[59]	Any site	0.65–1.03[50,69]				
MDR-GPC					VAP	1.33 (0.07–26.62)[55]		
Any MDR					Any HAI	0.73 (0.20–2.74)[59]		
					BSI	5.01 (2.18–11.50)[45]		

Teerawatanapong N, et al. ICHE 2018

GLOBAL GUIDELINES FOR THE PREVENTION OF SURGICAL SITE INFECTION

World Health Organization

4.3 Screening for extended-spectrum beta-lactamase colonization and the impact on surgical antibiotic prophylaxis

Recommendation

The panel decided not to formulate a recommendation due to the lack of evidence.

4.2 Decolonization with mupirocin ointment with or without chlorhexidine gluconate body wash for the prevention of *Staphylococcus aureus* infection in nasal carriers undergoing surgery

Recommendations

1. The panel recommends that patients undergoing cardiothoracic and orthopaedic surgery with known nasal carriage of *S. aureus* should receive perioperative intranasal applications of mupirocin 2% ointment with or without a combination of CHG body wash.
   (Strong recommendation, moderate quality of evidence)
2. The panel suggests considering to treat also patients with known nasal carriage of *S. aureus* undergoing other types of surgery with perioperative intranasal applications of mupirocin 2% ointment with or without a combination of CHG body wash.
   (Conditional recommendation, moderate quality of evidence)

Incidence and Risk Factors for Multidrug-Resistance Organisms (MDROs) Colonization among Patients Undergoing Elective Orthopedic Surgery at Thammasat University Hospital

Sirikwun Umpunthongsiri[1], Anucha Apisarnthanarak[2], Pojanee Srimanoj[3], Thana Khawcharoenporn[2]
Chayanin Aungthong[4], Narisara, Mungkornkaew[5], Pansachee Damronglerd[2], Sasinuch Rutjanawech[2], Nuntra Suwantarat[6]*

Results: Of 384 swabs tested from 96 patients (median age, 58 years), 31 rectal swabs (31/96, 32.3%) and 7 groin swabs (7/96, 7.3%) were identified as ESBL-producing *E. coli*. Seven patients (7.3%) had diagnosed with SSIs. A higher rate of SSIs was found among patients with ESBL-E. coli colonization (6/31, 19.4%) compared to patient without ESBL-*E. coli* colonization (1/65, 1.5%; *P*= 0.004, OR 15.36, 95%CI 1.7-356.3). In multivariate logistic regression analysis, SSIs was significantly associated with ESBL-*E.coli* colonization (P=0.009, adjusted OR 18.29, 95% CI 2.05-162.99). In addition, in multivariate logistic regression analysis, ESBL-*E.coli* is a significantly risk factor associated with SSIs (6/7, 85.7%, *P*=0.014, adjusted OR 16.53, 95% CI 1.78-153.44).

- In addition, community-acquired ESBLs infections have been reported and associated with high morbidity and mortality.[1]
- High rate of ESBLs colonization (29-63%) in healthy adult has been found, especially in endemic region such as Southeast Asia.[2]
- This problem raised the concern of MDROs colonization in healthy patients who undergoing elective orthopedic surgery.

Methods

Study design : Prospective cohort

MDROs screening x 6 months: March –August 2016

- Inform consent
- Collect patient characteristic
- Type of procedures
- Swab samples (nose, throat, groin, rectum)
- Cultures (MDROs screening*)

MDROs screening* = Tryptic soy broth containing a 10-µg ceftriaxone disk and incubated at 37°C for up to 48 hours[3] tubid/ positive → identification + susceptibility test

MDROs: ESBLs, CREs, MDR-*A. baumanni*, MDR-*P. aeruginosa* MRSA, VRE

- Positive MDROs: Follow patient clinical outcome (clinical infection or death) at 1, 3, 6 mo by chart review/phone

Incidence of SSIs
Risk factors identify & comparison Positive vs Negative screening
Outcomes / admission

- MDROs surveillance screening from patients undergoing elective orthopedic surgery at Thammasat University Hospital.
- MDROs identification was performed using the Vitek®2 automated system.
- Antimicrobial susceptibility testing (disk diffusion test) was performed using the CLSI Guidelines.[7]
- Incidence of MDROs colonization, patient's clinical characteristics, risk factors of MDROs infection, procedure types and antibiotic prophylaxis were determined.
- Surgical sites infections (SSIs) and complications up to 12 months after surgery among the patients with and without MDROs colonization were compared.

Variable	colonization (n = 31) No. (%)	colonization (n = 65) No. (%)	OR	95% CI	P-value
Age, median year (IQR)	59 (37-68)	57 (37-68)	-	-	0.836
Male	15 (42)	38 (57.7)	1.89	0.74-5.1	0.171
Diabetes	8 (25.8)	14 (21.5)	1.20	0.5-2.7	0.796
History of systemic steroids / immunosuppressive drugs	2 (6.5)	5 (7.7)	0.83	0.1-6.5	1
History of MDRO infection	0	0	-	-	1
Admission in the past year	0	0	-	-	1
Antimicrobial treatment in the past year	0	1(1.5)	-	1	1
Procedure					
Total knee arthroplasty (TKA)	7 (23.6)	21 (32.3)	0.61	0.2-1.8	0.472
Spine	6 (19.4)	7 (10.8)	1.23	0.3-4.3	0.743
Hip	6 (19.4)	9 (13.8)	1.49	0.4-5.3	0.632
Prosthesis relate procedures(any site)	27(87.1)	47(72.3)	2.69	0.7-10.1	0.136
Antibiotic prophylaxis					
Cefazolin	26 (83.6)	79 (68.8)	0.52	0.04-2.7	0.211
Operation time, median hour (IQR)	90 (70-150)	90 (70-150)	-	-	0.396
Estimated blood loss relate to procedures, median ml. (IQR)	3 (1-5)	3 (1-5)	-	-	0.368
Total length of stay, median day (IQR)	5 (3-8)	5 (3-8) 2.45 (1.2-5.3)	-	-	0.631
Surgical site infections (SSIs)	**6 (18.4)**	**1 (1.5)**	**15.36**	**1.7-356.3**	**0.004***
Non glucose fermenting Gram-negative bacteria colonization (number members)	5 (16.1)	9 (13.8)	1.2	0.3-4.5	0.766
Re-hospitalization during 6 months after operation	2 (6.5)	1 (1.5)	4.4	0.3-126.6	0.243

analysis of patients' characteristics (male sex and clindamycin perioperative prophylaxis)

- SSIs is significantly outcomes associated with ESBL-*E.coli* colonization (P=0.009, adjusted odd ratio 18.29, 95% CI 2.05-162.99).

Conclusions

- We found a high incidence of ESBL-*E. coli* colonization and rate of SSIs in patient who underwent elective orthopedic surgery without others risk factors of MDROs infection.
- ESBL-*E. coli* colonization is an independent risk factor associated with SSIs.
- Further screening and antibiotic prophylaxis modification is considered in endemic region especially for MDR-GN pathogens.

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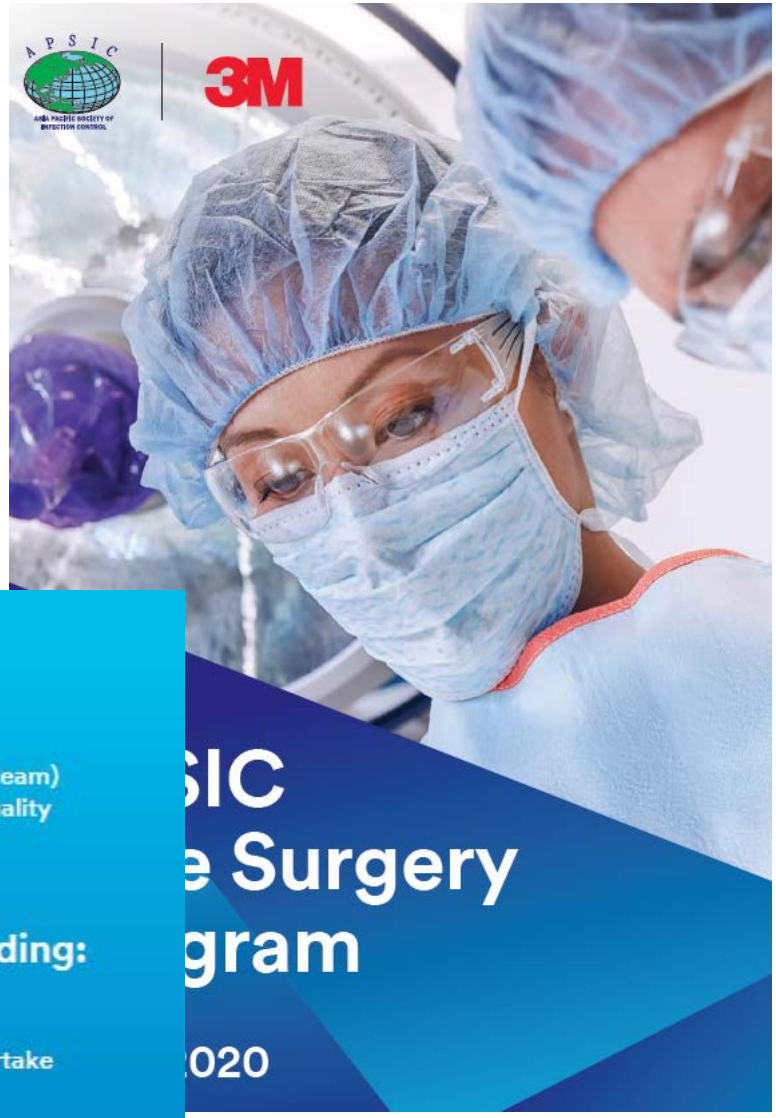
ESBL colonization among Abdominal Surgery

- 360 patients were prospective followed after abdominal surgery (clean contaminated surgery, contaminated surgery, dirty surgery)
- 129 patients (36%) had detected ESBL colonization and 49 patients (13.6%) developed surgical site infections.
- ESBL colonization was associated with surgical site infections (aOR = 2.4), but due to non-ESBL microorganisms (e.g., *S. aureus*, *Streptococcus* spp, *Pseudomonas aeruginosa*, *non-ESBL E. coli*)
- ESBL colonization was associated with deep surgical site infections (aOR = 4.9) due to ESBL producing microorganisms.
- No clear association between carbapenem pre-operative and reduction of surgical site infection among ESBL colonizers.

Apisarnthanarak A, et al. Under prepartion

ASIA PACIFIC SOCIETY OF INFECTION CONTROL



About the Recognition Award

What is APSIC Safe Surgery?

APSIC Safe Surgery is a team of people (Surgical team, Infection Control, Critical care team) that promotes collaboration and use of guidelines as well as best practices to deliver quality surgical care for those served.

At APSIC and 3M, we define a hospital as a Centre of Excellence when it fulfils all of the strategic criteria including:

- Delivers the highest level of patient safety and quality patient outcome
- Committed to ensuring dedicated surgical site infection (SSI) control teams to undertake SSI surveillance
- Takes on a leadership role and follows the recommendations of APSIC Guidelines for Prevention of SSI
- Implements quality improvement projects to achieve significant reduction in surgical site infections

The hospital identified as a Centre of Excellence will be invited to the next APSIC International Congress to receive the APSIC Safe Surgery Award.

Scenario

A 56 year-old patient who developed for HAP with unknown pathogens and expose to several antibiotics include 3rd generation cephalosporin, Pip/taz and carbapenem before getting better. However, he started to developed fever where urinary exam taken from Foley's catheter revealed WBC 50-100 cells/HPF, urine gram stain revealed multiple gram negative rods.

Which of the following pathogen is likely to occur in this patients?

A) ESBL-producing Enterobacteriaceae

B) *MDR-Acinetobacter baumannii*

C) *MDR-Pseudomonas aeruginosa*

D) Carbapenem resistant Enterobacteriaceae

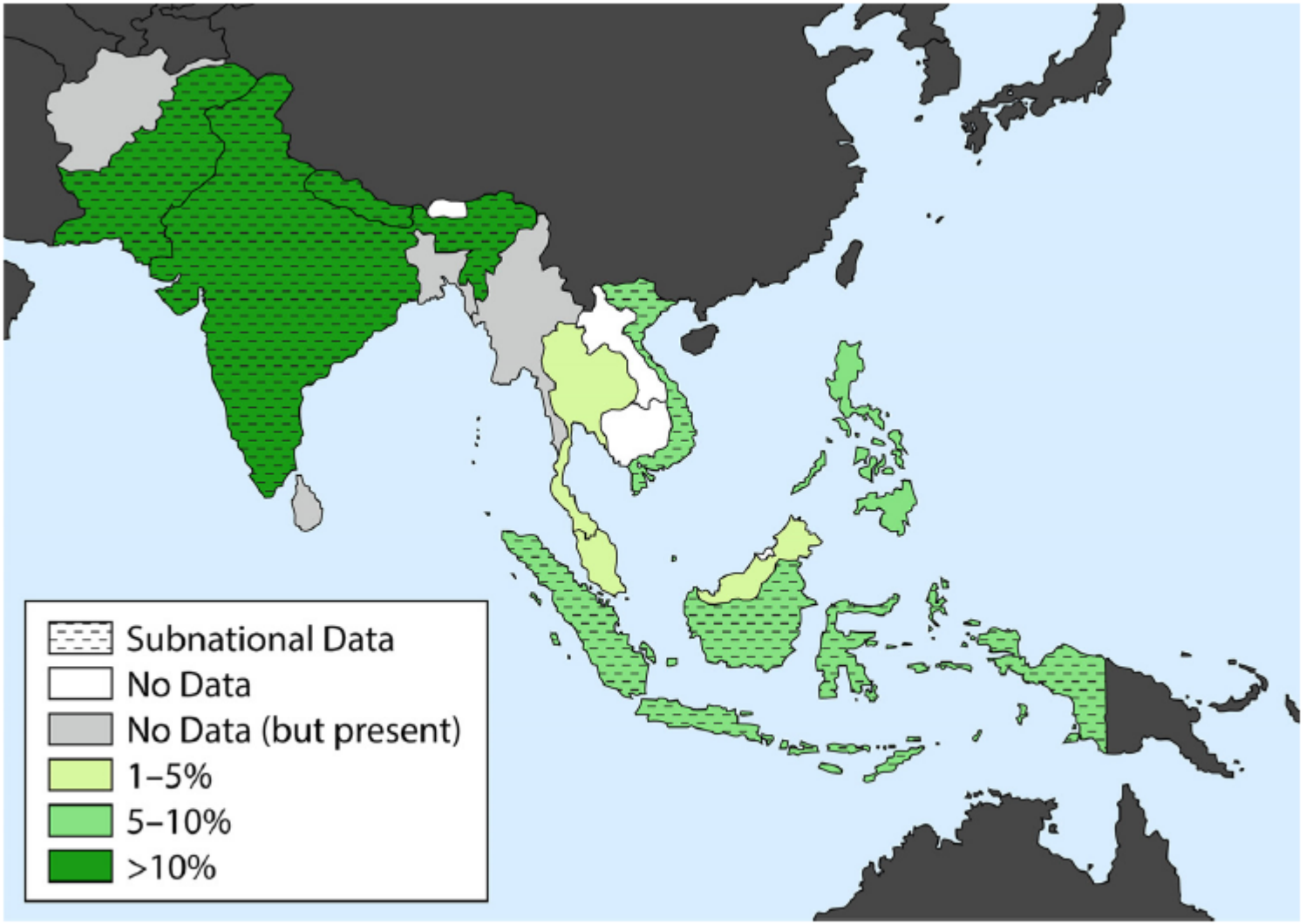


FIG 2 Estimated prevalence of carbapenem-resistant *Enterobacteriaceae* in South and Southeast Asian countries.

Carbapenem-Resistant *Acinetobacter baumannii* and *Enterobacteriaceae* in South and Southeast Asia

Li-Yang Hsu,[a,b,c] Anucha Apisarnthanarak,[d] Erum Khan,[e] Nuntra Suwantarat,[f] Abdul Ghafur,[g] Paul Anantharajah Tambyah[b]

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Sporadic cases of MCR-1 have been reported in several countries.

Challenge to contain CRE in Asia!






World Health Organization

Guidelines for the prevention and control of carbapenem-resistant Enterobacteriaceae, *Acinetobacter baumannii* and *Pseudomonas aeruginosa* in health care facilities

3.3 Recommendation 3: Surveillance of CRE-CRAB-CRPsA infection and surveillance cultures for asymptomatic CRE colonization

The panel recommends that:

a) **surveillance of CRE-CRAB-CRPsA infection(s) should be performed, and**

b) **surveillance cultures for asymptomatic CRE colonization should also be performed, guided by local epidemiology and risk assessment. Populations to be considered for such surveillance include patients with previous CRE colonization, patient contacts of CRE colonized or infected patients and patients with a history of recent hospitalization in endemic CRE settings.**

(Strong recommendation, very low quality of evidence)

Rationale for the recommendation

Surveillance for CRE-CRAB-CRPsA infection/s

- Given the clinical importance of CRE-CRAB-CRPsA infection(s), the GDG considered that regular ongoing active surveillance of infections was required.

Surveillance cultures for asymptomatic CRE colonization

- Only limited evidence was available for undertaking surveillance cultures for colonization with CRAB and CRPsA. Thus, the GDG decided that this recommendation should focus on CRE surveillance for colonization (see *Additional remarks* below).
- The GDG recognized that colonization with CRE usually precedes or is co-existent with CRE infection. Thus, early recognition of CRE colonization helps to identify patients most at-risk of subsequent CRE infection, as well as allowing the earlier introduction of IPC measures (especially those indicated in Recommendation 1) to prevent CRE transmission to other patients and the hospital environment.
- Among CRE studies, 10 of 11 included active patient surveillance (for example, rectal swab collection among at-risk patients on admission and weekly, contact screening) as part of their assessed intervention *(28, 48-53, 55, 56, 63)*. Eight of the 10 reported a significant decrease in CRE outcomes post-intervention *(28, 48, 49, 51-53, 55, 56)*.
- Among CRAB studies, three of five included active patient surveillance as part of their assessed intervention *(50, 57, 58)*. Two of the three reported a significant decrease in CRAB outcomes post-intervention *(50, 57)*.
- Among three CRPsA studies, all included active patient surveillance as part of their assessed intervention *(58, 60, 61)*. Two studies reported a significant decrease in CRPsA outcomes post-intervention *(60, 61)*.
- Despite the limited available evidence and its very low to low quality, the GDG unanimously agreed that this recommendation should be strong. This decision was based on the:
  - panel's conviction about the benefit of surveillance as a key core component to prevent and control CRE-CRAB-CRPsA, which is consistent with the reviewed evidence that led to the development and content of the *WHO guidelines on core components of infection prevention and control programmes at the national and acute health care facility level (13)* where surveillance is already the object of a strong recommendation;
  - evidence and international concern about the burden and impact of CRE-CRAB-CRPsA infection and CRE colonization (in particular, see epidemiological data in section 1.1 and specific reasons for developing these recommendations in section 1.2).

3.7 Recommendation 7: Surveillance cultures of the environment for CRE-CRAB-CRPsA colonization/contamination

The panel recommends that surveillance cultures of the environment for CRE-CRAB-CRPsA may be considered when epidemiologically indicated.

(Conditional recommendation, very low quality of evidence)

Rationale for the recommendation

- Among the 11 CRE studies, only one included environmental surveillance cultures as part of their assessed intervention and reported a significant reduction in CRE outcomes post-intervention *(55)*.
- Among the five CRAB studies, only one included environmental surveillance cultures as part of their assessed intervention and reported a significant reduction in CRAB outcomes after the intervention *(59)*. In addition, one study monitored environmental contamination after cleaning using an adenosine triphosphate (ATP) bioluminescence assay as part of their intervention and found a significant reduction in CRAB outcomes after the intervention *(50)*.
- Among the three CRPsA studies, two included environmental surveillance cultures as part of their assessed intervention and reported a significant reduction in CRPsA outcomes post-intervention *(60, 61)*.
- The panel noted that environmental contamination with CRE-CRAB-CRPsA is commonly associated with increased rates of patient colonization and infection with these pathogens, particularly CRAB and CRPsA. All studies used environmental surveillance cultures to monitor the efficacy of hospital cleaning, which was one of the key elements of their multimodal IPC interventions.
- The evidence was not uniform, of very low quality, and appeared to be strongest for CRAB and CRPsA, rather than CRE. Thus, the GDG considered surveillance cultures of the environment to be a conditional recommendation.

Table 2. Recommendation resource implications and feasibility considerations

Recommendation	Resource implications and feasibility considerations
1. Implementation of IPC multimodal strategies **Strong recommendation**	• Multimodal strategies can be complex and require a multidisciplinary approach including executive leadership, stakeholder commitment, coordination, local champions or role models and possible modifications to workforce structure and process. Preventing or controlling the spread of CRE-CRAB-CRPsA should be advocated for as a priority patient safety issue and response to AMR. • Human resource capacity including trained IPC professionals, dedicated IPC budgets and good quality microbiological laboratory support are critical to effective IPC programmes. • Most data on IPC programme implementation come from high- and middle-income countries. However, the panel believed that the resources invested for IPC programmes are worth the net gain, irrespective of context. In settings with limited resources, prioritization should be based on local/regional needs.
2. Importance of hand hygiene compliance for the control of CRE-CRAB-CRPsA **Strong recommendation**	• Practical approaches to hand hygiene improvement and implementation should be considered according to the WHO recommendations (http://www.who.int/infection-prevention/tools/hand-hygiene/) with appropriate local adaptation. • Hand hygiene compliance and the use of alcohol-based handrub are influenced by appropriate product placement and availability. Thus, it is critical to ensure that these adequate resources are in place.
3. Surveillance cultures for asymptomatic CRE colonization and surveillance of CRE infection **Strong recommendation**	• Laboratory testing and identification of carbapenem resistance among potential CRE-CRAB-CRPsA isolates may not be available or routine in limited resource settings. However, given the threat represented by AMR spread, the panel believed that testing for carbapenem resistance in these pathogens should now be considered as routine in all microbiology laboratories to ensure the accurate and timely recognition of CRE-CRAB-CRPsA. For this reason, enhanced efforts and training related to laboratory testing, analysis and interpretation of results may be required. • To support surveillance, enhanced training on epidemiological methods and appropriate data collection and management infrastructure may also be required. • Information regarding a patient's CRE colonization status does not (yet) constitute routine standard of care provided by health systems. However, in an outbreak or high-risk situation, it was determined that CRE colonization status should be known and such information considered an important patient safety issue. This may not have an immediate benefit to the screened patient, but instead it will contribute to the overall IPC response to CRE. • In some limited resource settings, the improvement of IPC infrastructure and best practices may deserve prioritization over surveillance. The panel agreed that there is no one single best approach, but instead the decision should be guided by local epidemiology, resource availability and the likely clinical impact of a CRE outbreak. • The panel noted that although surveillance cultures of fecal material were preferred for the identification of CRE colonization, rectal swabs may be a more practical clinical specimen to collect in many health care situations. • There is growing evidence of the role of genotyping and whole genome sequencing of CRE isolates. Integrating this information into the epidemiological investigation of outbreaks is valuable to decide upon the consequent actions needed for their control. However, some questions remain unanswered, including the criteria that accurately define when a patient is no longer colonized with CRE. The panel believed that at least two consequent negative cultures should be available in order to consider a patient no longer colonized.
4. Contact precautions **Strong recommendation**	• The application of contact precautions involves an increase in workload to health care workers managing these patients, including technical expertise for their overall coordination and programme management. • The application of contact precautions requires an increase in resource usage (for example, gowns and gloves), as well as the cost for their appropriate disposal. It was noted that the use of gloves could occasionally be associated with some occupational exposure issues, such as cutaneous reactions.
5. Patient isolation **Strong recommendation**	• The preference is for colonized/infected patients to be managed in single rooms where possible. Cohorting is reserved for situations where there are insufficient single rooms or where cohorting of patients colonized/infected with the same pathogen is a more efficient use of hospital rooms and resources. However, the panel believed that patient isolation should always apply in an outbreak situation. • The use of dedicated health care workers to exclusively manage isolated/cohorted patients is recommended when feasible, although the panel acknowledged that this may be challenging in limited resource settings. • Patient isolation should be undertaken with care and sensitivity to avoid misunderstanding and increased suffering by some patients.
6. Environmental cleaning **Strong recommendation**	• Strengthening environmental cleaning could have resource implications depending on the type of cleaning product used. Most cleaning products, including hypochlorite, are generally low cost. Some cleaning agents (for example, hydrogen peroxide), while seemingly effective, can be disruptive to hospital workflow and bed utilization given the time and equipment required for their use. Products should be used according to correct instructions to prevent occupational health issues. • There may be an increased workload for hospital cleaners, although their salaries are often relatively low. • Some limited resource settings may face basic WASH challenges. A sufficient and reliable water supply is essential for basic cleaning. • All furniture should be easily cleanable as damaged furniture can prevent adequate cleaning. Environmental cleaning could also potentially lead to the enhanced degradation of some vinyl and other surfaces in hospitals.
7. Surveillance cultures of the environment for CRE-CRAB-CRPsA colonization/ contamination **Conditional recommendation**	• Environmental surveillance cultures may be resource-intensive in terms of human resources and laboratory, information technology and data management infrastructures. The GDG believed that the resources invested are worth the net gain in certain conditions, particularly for CRAB outbreaks. • The collection and microbiological testing of environmental cultures can require a specialized approach necessitating capacity-building, particularly in limited resource settings. • Additional education will likely be required to help standardize the cleaning techniques and surveillance methods.
8. Monitoring, auditing and feedback	• Appropriate training of staff who undertake monitoring of the implementation of multimodal strategies and the feedback of results is crucial. • The GDG agreed that IPC monitoring should encourage improvement and promote learning from experience in a non-punitive institutional culture, thus contributing to better patient care and quality outcomes.

What should be done in Asia Pacific?

ASP IS A CRITICAL COMPONENT TO STOP EMERGENCE OF MDROS

Antibiotic Stewardship in Asia is Not New!

Clinical Infectious Diseases

SUPPLEMENT ARTICLE

Antimicrobial Stewardship in Inpatient Settings in the Asia Pacific Region: A Systematic Review and Meta-analysis

Hitoshi Honda,[1] Norio Ohmagari,[2] Yasuharu Tokuda,[3] Caline Mattar,[4] and David K. Warren[4]

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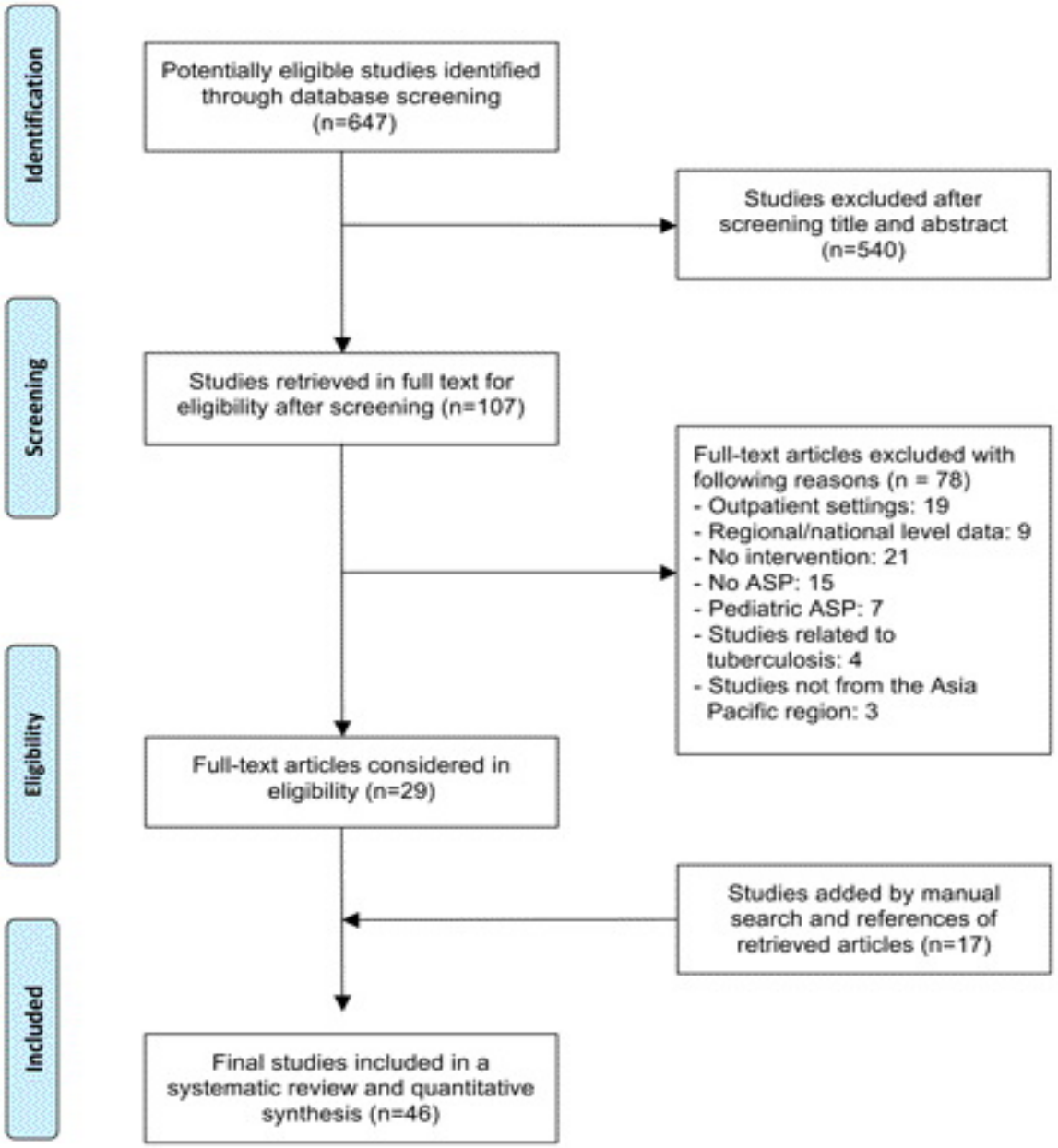
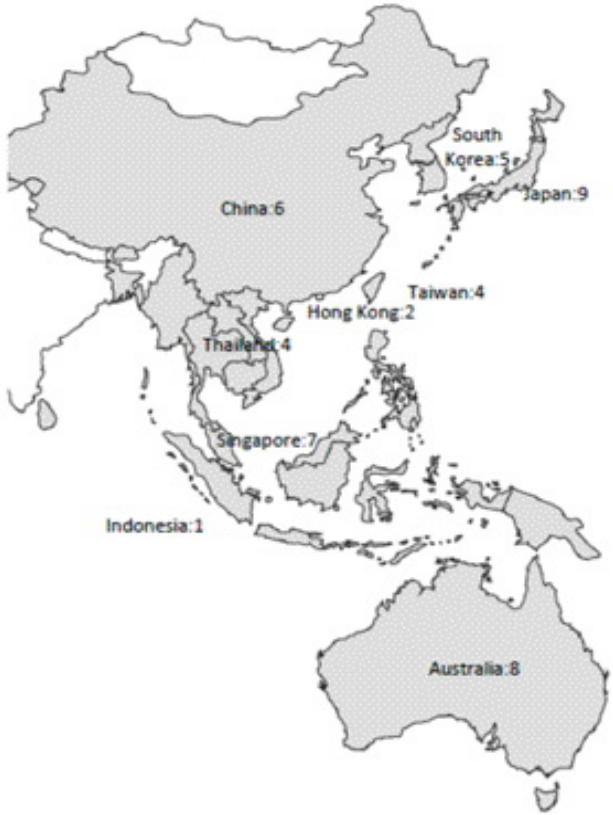
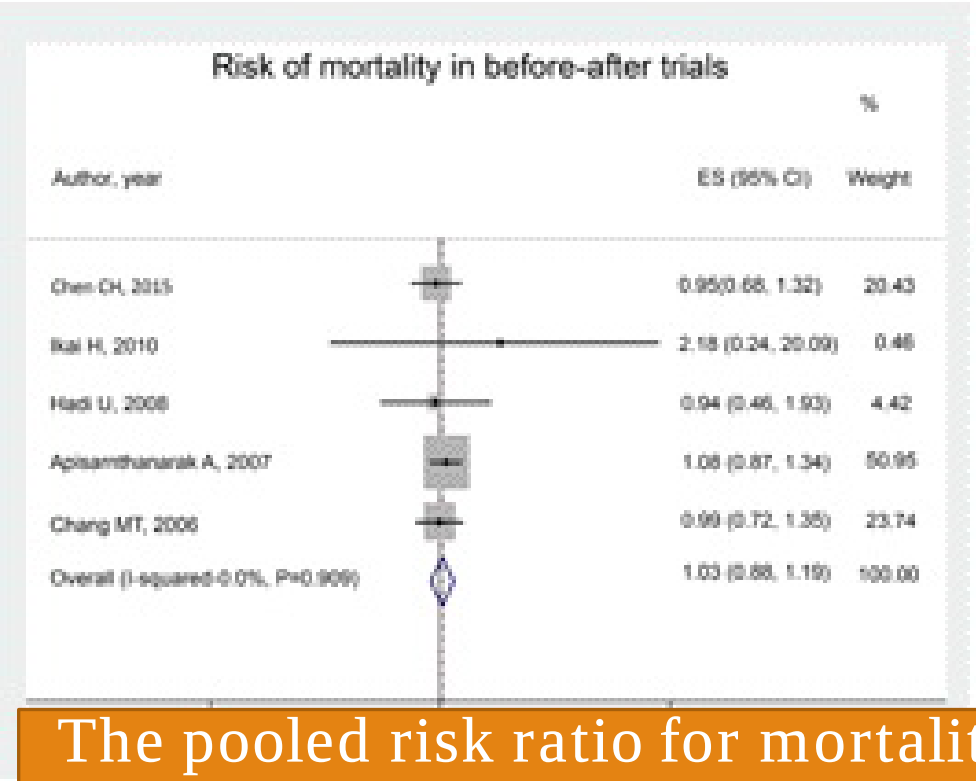
TO EVALUATE THE IMPACT OF ASP ON VARIOUS OUTCOMES (E.G., PATIENT CLINICAL OUTCOMES, ANTIMICROBIAL PRESCRIPTION OUTCOMES, MICROBIOLOGICAL OUTCOMES, AND EXPENDITURE)





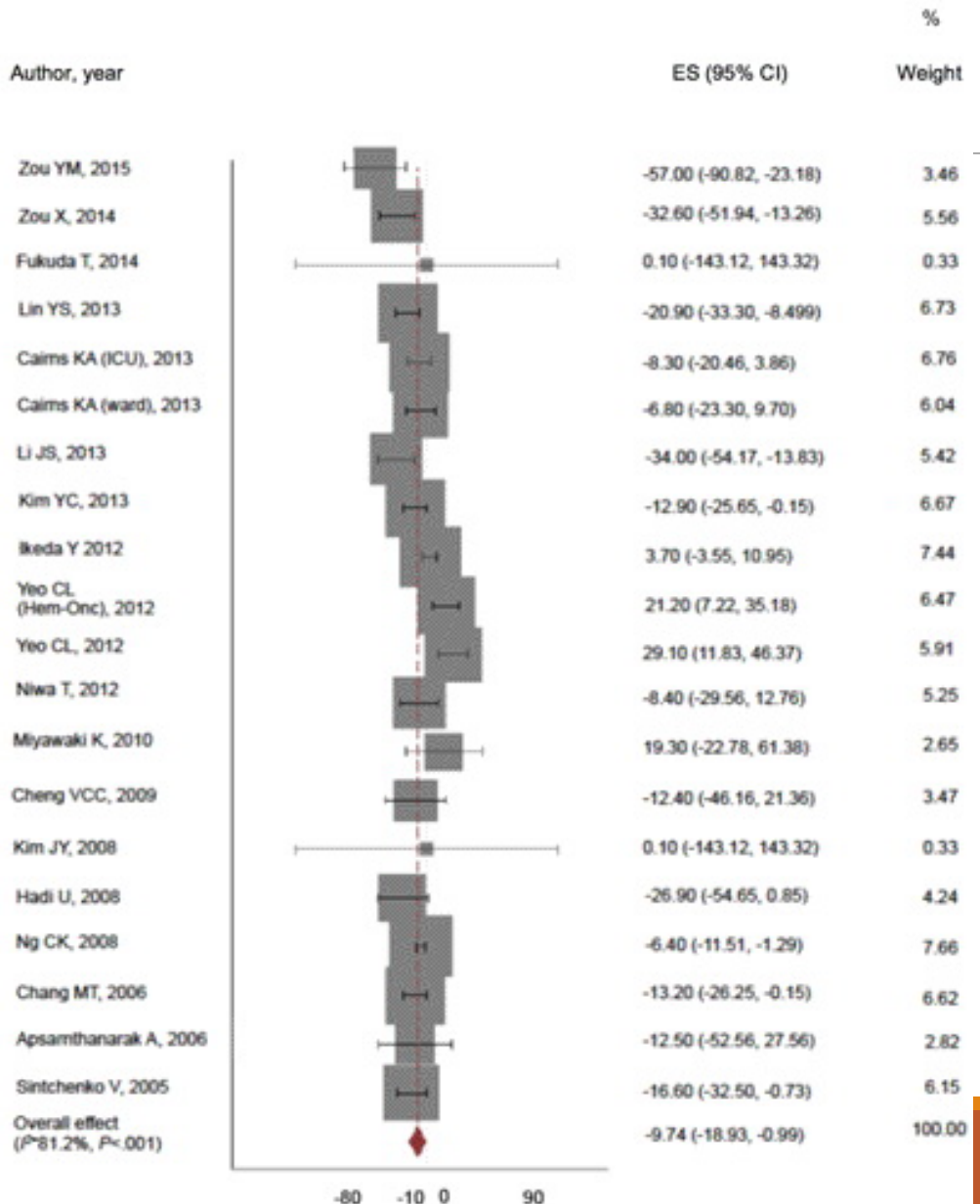
NOTE. Name of country or region: number of studies

Patient Outcome: Mortality



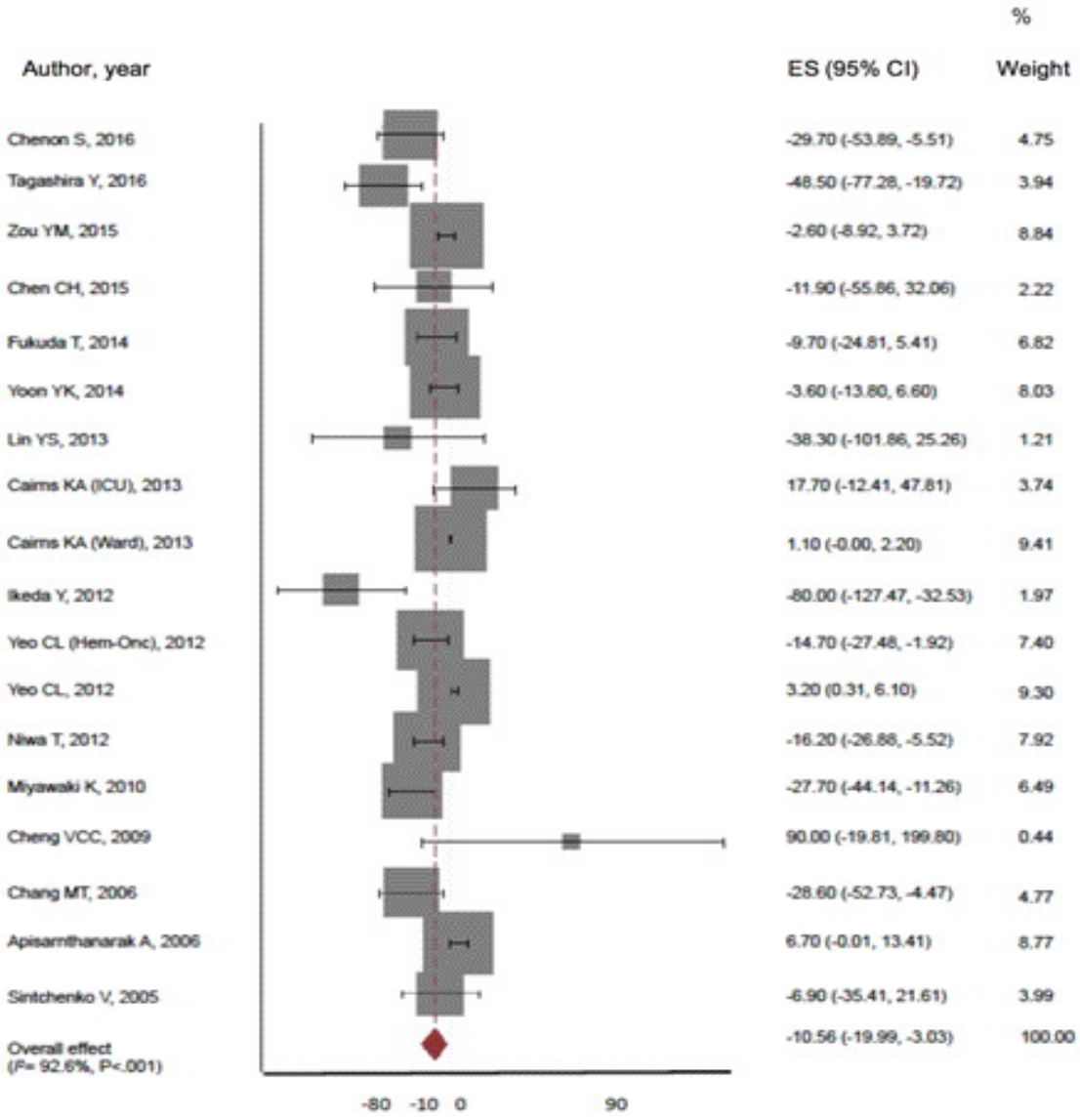
The pooled risk ratio for mortality from ASP before-after trials and two-group comparative studies were 1.03 (95% confidence interval [CI], 0.88-1.19) and 0.69 (95% CI, 0.56-0.86), respectively.

Impact of ASP on Antibiotic Consumption (Overall)



The pooled effect size for change in overall antimicrobial consumption (% difference) were -9.74 % (95% CI, -18.93 to -0.99).

Impact of ASP on Carbapenem Consumption



The pooled effect size for change in carbapenem consumption (% difference) was -10.56 % (95% CI, -19.99 to -3.03), respectively.

Infection Control & Hospital Epidemiology (2018), page 1 of 9
doi:10.1017/ice.2018.188

Review

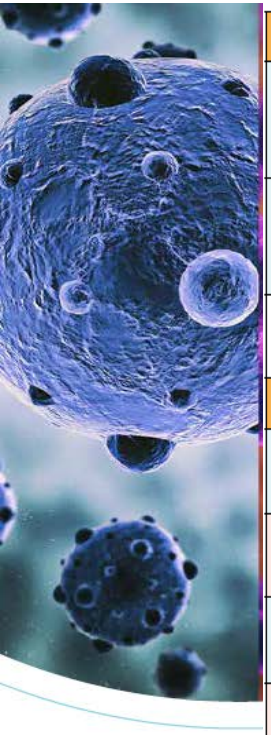
Antimicrobial stewardship for acute-care hospitals: An Asian perspective

Anucha Apisarnthanarak MD[1], Andrea Lay-Hoon Kwa PharmD[2,3,4], Cheng-Hsun Chiu MD[5], Suresh Kumar MRCP[6], Le Thi Anh Thu MD, PhD[7], Ban Hock Tan FRCP(UK)[8], Zhiyong Zong PhD[9], Yin Ching Chuang MD[10,11], Anis Karuniawati MD, PhD[12,13], Maria Fe Tayzon MD[14,15], Thomas Man-Kit So FRCP[16] and Lance R. Peterson MD[17,18]

Table 2. Common Gaps and Challenges in Relation to Implementing AMS Programs in Hospitals in Asia

Common Gaps and Challenges in Implementing Hospital AMS Programs in Asia[a]	Potential Solutions to Overcoming Gaps in Hospital AMS Programs[b]
Lack of epidemiological data and surveillance systems	• Prioritize obtaining support for microbiology laboratory services for reliable culture-guided therapy, AMR surveillance and provision of hospital antibiograms
Lack of awareness of AMR	• Provide regular report of AMR data and AMS program performance to relevant hospital departments and hospital administration
Weak infrastructure	• If there is no infrastructure to set up IT systems to support a hospital AMS program, a paper-based system can be used in conjunction with syndrome-specific guidelines.
Insufficient education and training of hospital staff	• Obtain formal support from hospital administration for infectious disease and AMS training, and appropriate time commitment and remuneration for AMS providers based on the size of the hospital • Consider obtaining external infectious disease specialist advice and training from a more well-resourced hospital
Limited funding	• Provide hospital administrators with credible business case to persuade them that funding of an AMS program is beneficial to the hospital • Start small and build capacity over time; gradually introduce AMS interventions by hospital unit or ward
Prescriber resistance to AMS	• Provide regular feedback and education to prescribers in an easily interpreted format • Make efforts to understand the reasons for noncompliance to AMS recommendations and rectify the problems.
Poor infection control	• Include an infection control personnel in the AMS core team • AMS and infection control teams work together under the same leadership to achieve the goal of reducing the rate of multidrug-resistant infections.

Perform Gap Analysis



Hospital leadership support	
C1	Does your hospital have a hospital leadership that s antibiotic use?
C2	Does your hospital alloca AMS activities (eg, suppo microbiology and inform

AMS team and infectious disease	
C3	Does your hospital have a responsible for AMS activ
S1	If you answered 'Yes' to C **infectious disease trainir**
C4	Does your hospital have a activities?
S2	If the answer to question **pharmacist** or does this p **disease training**?
	Do any of the following s antibiotic use:
C5	Infection control?
C6	Microbiology?
S3	Nursing?
S4	IT?

AMS program interventi	
C7	Do specified an pharmacist prio at your hospital AND/OR Does a physician provide suggest of prescription a
S5	Does your hosp in relation to an
C8	Does your hosp **guidelines** for c
If you answered 'Yes' to C for the following infectio	
S6	Community-acq
S7	Hospital-acquire
S8	Skin and soft tis
S9	Sepsis?
S10	Urinary tract inf
S11	Intra-abdominal
S12	Does your hosp broad-spectrum
S13	Does your hosp of antibiotics?
S14	If you answered **guidelines read**

AMS monitoring and reporting	
C9	Does your hospital moni therapy (**DOT**) or define
S15	Does your hospital **moni**
S16	Does your hospital **moni** treatment guidelines?
C10	Does your hospital **regul** data and outcomes mea
S17	Are **results** of antibiotic **prescribers**?
C11	Is there a **hospital antibi**
S18	If the answer to C11 is 'Ye **updated**?
S19	If the answer to C11 is 'Ye
S20	If the answer to C11 is 'Ye **antibiograms**?

Hospital infrastructure	
S21	Does your hospital have AMS data?
S22	Does your hospital use **e**
S23	Does your hospital use **c**
C12	Does your hospital have access to a **timely and r**
S24	If the answer to C12 is 'Ye make use of **rapid diagn**
S25	If the answer to C12 is 'Ye **selective susceptibility**

Education			
S26	Does your hospital provide **educational activities** for clinicians and other relevant staff on improving antibiotic prescribing?	**Yes** ☐	**No** ☐
S27	If the answer to S26 is 'Yes', is this **mandatory and certified training**?	**Yes** ☐	**No** ☐

Scores	
• C-score (number of 'Yes' responses to questions tagged 'C')	/12
• S-score (number of 'Yes' responses to questions tagged 'S')	/27
• Total score	/39

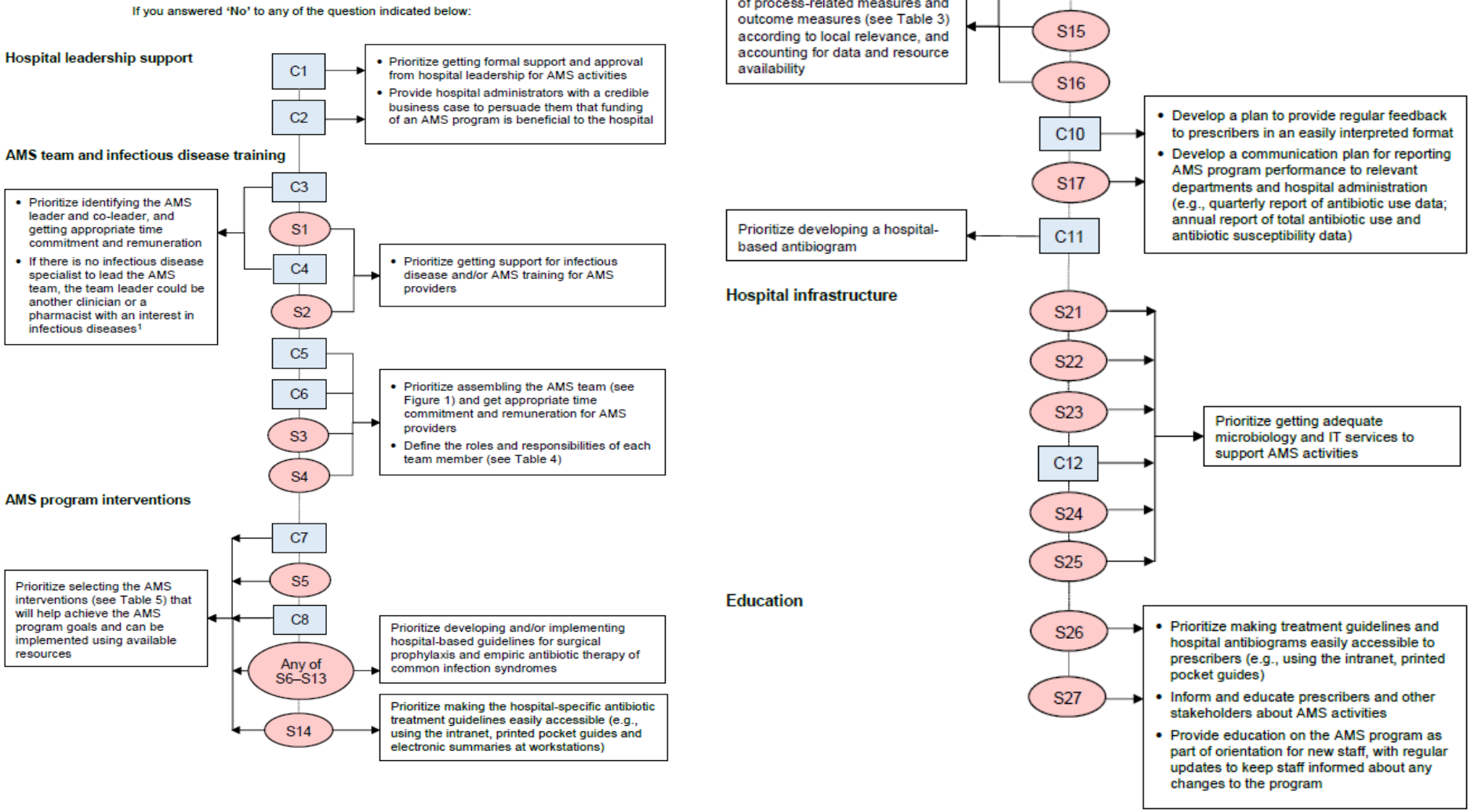
If you answered 'Yes' to all 12 core questions (C-score of 12), your hospital has all of the essential elements of a functioning AMS program in place. However, if you answered 'No' to any of the supplementary questions (S-score <27), you can still improve your AMS program by focusing on the missing supplementary elements.

If you answered 'No' to any of the core questions (C-score <12), you should focus on fulfilling the missing core elements to improve your hospital's AMS program. Although the elements in this checklist all help to improve antibiotic use in hospitals, not all elements may be feasible in all hospitals. Rather than trying to address all missing elements at once, you should initially focus on elements that could be feasibly implemented using available resources and then advance the AMS program from there.

Overcome gaps and

Supplementary Material S2. Flowchart of potential next steps to overcome gaps and challenges in antimicrobial stewardship programs in Asian hospitals

Complete the AMS assessment checklist (Supplementary Material S1) and note down the questions you answered 'No' to. Refer to the flowchart below for potential next steps and priorities to overcome the gaps in your hospital AMS program.



What should be done in Asia Pacific?

SELECT INFECTION CONTROL WISELY

Evidences on Effective Control Measures

Clinical Infectious Diseases

SUPPLEMENT ARTICLE

Prevention and Control of Multidrug-Resistant Gram-Negative Bacteria in Adult Intensive Care Units: A Systematic Review and Network Meta-analysis

Nattawat Teerawattanapong,[1] Kirati Kengkla,[2] Piyameth Dilokthornsakul,[3] Surasak Saokaew,[2,3,4] Anucha Apisarnthanarak,[5] and Nathorn Chaiyakunapruk[3,4,6,7]

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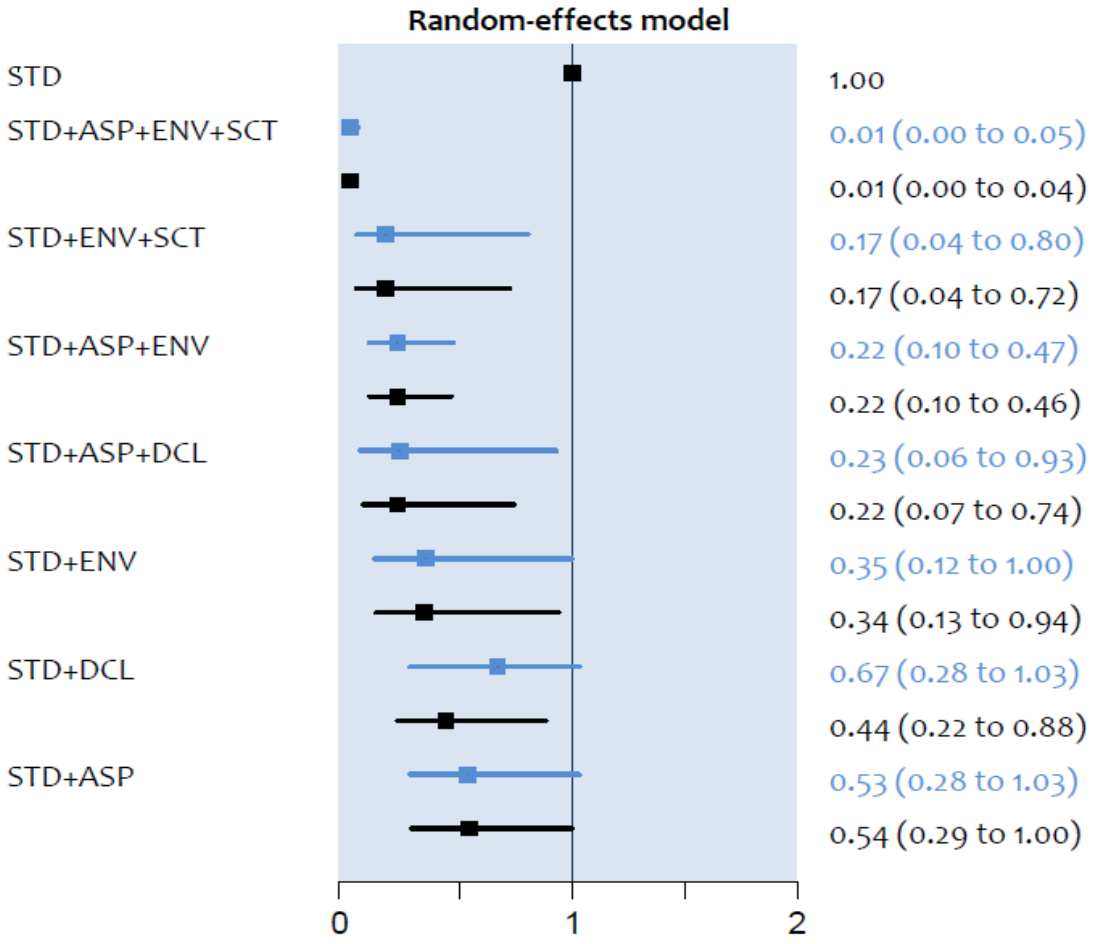
Rationale

To evaluate the existing evidence (RCT & observational studies) on the control of MDROs Gram negative

Interventions: standard of care (STD), antimicrobial stewardship (ASP), environmental cleaning (ENV), decolonization method (DCL), and source control (STC)

Outcomes: MDR-GNB acquisition as well as mortality

Figure 2 Summary of network meta-analyses results for MDR-GNB acquisition compared with standard care



eFigure 10.1 Network estimated rate ratios (95% confidence intervals) of IPC strategy for prevention of MDR- *Acinetobacter baumannii* acquisition.*

STD+ASP+ ENV+SCT						
0.08 (0.03, 0.24)	**STD+ASP+ ENV**					
0.02 (0.00, 0.39)	0.26 (0.01, 5.56)	**STD+ENV+ SCT**				
0.02 (0.00, 0.35)	0.18 (0.01, 4.95)	0.70 (0.18, 2.64)	**STD+DCL**			
0.02 (0.01, 0.07)	**0.28 (0.18, 0.43)**	1.07 (0.05, 23.55)	1.53 (0.05, 43.25)	**STD+ASP**		
0.01 (0.00, 0.18)	0.13 (0.01, 2.64)	**0.48 (0.35, 0.66)**	0.69 (0.19, 2.53)	0.45 (0.02, 9.83)	**STD+ENV**	
0.01 (0.00, 0.17)	0.09 (0.00, 2.37)	0.35 (0.11, 1.15)	**0.50 (0.28, 0.92)**	0.33 (0.01, 8.80)	0.73 (0.23, 2.29)	**STD**

eFigure 10.2 Network estimated rate ratios (95% confidence intervals) of IPC strategy for prevention of MDR- *Pseduomonas aeruginosa* acquisition.*

STD+DCL				
0.60 (0.12, 3.13)	**STD+SCT**			
0.50 (0.14, 1.88)	0.84 (0.16, 4.50)	**STD+ASP**		
0.41 (0.05, 3.51)	0.68 (0.06, 7.31)	0.81 (0.09, 7.14)	**STD+ENV**	
0.42 (0.17, 1.04)	0.69 (0.18, 2.71)	0.82 (0.31, 2.19)	1.02 (0.15, 7.13)	**STD**

eFigure 10.3 Network estimated rate ratios (95% confidence intervals) of IPC strategy for prevention of Extended-Spectrum Beta-Lactamases Enterobacteriaceae acquisition.*

STD+ASP+ ENV+SCT								
0.02 (0.00, 0.46)	**STD+ASP+ DCL**							
0.01 (0.00, 0.27)	0.84 (0.18, 3.87)	**STD+ASP+ ENV**						
0.01 (0.00, 0.21)	0.58 (0.11, 2.95)	0.69 (0.27, 1.76)	**STD+ENV**					
0.01 (0.00, 0.20)	0.49 (0.12, 2.09)	0.58 (0.18, 1.92)	0.85 (0.23, 3.12)	**STD+DCL**				
0.01 (0.00, 0.16)	0.41 (0.14, 1.16)	0.49 (0.16, 1.48)	0.71 (0.20, 2.45)	0.83 (0.31, 2.23)	**STD+ASP**			
0.00 (0.00, 0.09)	**0.23 (0.07, 0.80)**	**0.28 (0.11, 0.69)**	0.41 (0.14, 1.17)	0.48 (0.22, 1.01)	0.57 (0.30, 1.09)	**STD**		
0.00 (0.00, 0.02)	**0.03 (0.00, 0.31)**	**0.04 (0.01, 0.32)**	**0.06 (0.01, 0.49)**	**0.07 (0.01, 0.50)**	**0.09 (0.01, 0.58)**	**0.15 (0.02, 0.91)**	**STD+SCT**	
0.00 (0.00, 0.01)	**0.00 (0.00, 0.19)**	**0.00 (0.00, 0.20)**	**0.01 (0.00, 0.31)**	**0.01 (0.00, 0.33)**	**0.01 (0.00, 0.39)**	**0.02 (0.00, 0.65)**	0.12 (0.01, 2.67)	**NO**

eFigure 10.4 Network estimated rate ratios (95% confidence intervals) of IPC strategy for prevention of carbepenem resistant Enterobacteriaceae acquisition.*

STD+ASP+ ENV+SCT			
0.18 (0.08, 0.37)	**STD+ENV**		
0.07 (0.01, 0.42)	0.38 (0.08, 1.87)	**STD**	
0.03 (0.00, 0.80)	0.15 (0.01, 4.02)	0.39 (0.02, 7.09)	**STD+ASP**

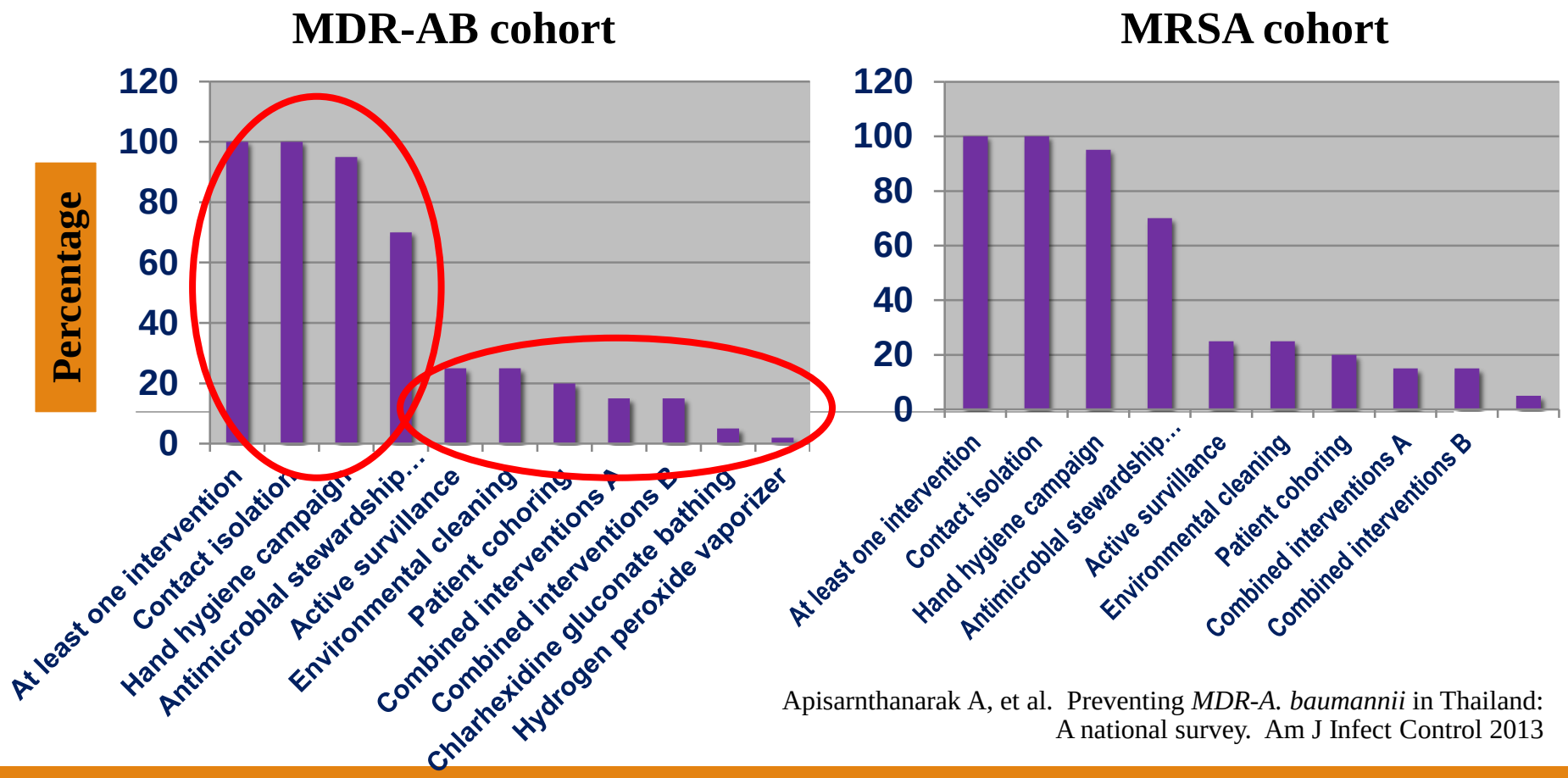
In Summary

CRE:	Practices all 4 core components
XDR-AB:	ENV featuring measures
ESBL:	ASP featuring measures
XDR-PA:	None

What should be done in Asia Pacific?

UNDERSTAND BARRIER AND PREDICTOR FOR SUCCESS!

Understanding Why Some Hospitals are Doing Better Than Others in Preventing MDR-*A. baumannii*



Apisarnthanarak A, et al. Preventing *MDR-A. baumannii* in Thailand: A national survey. Am J Infect Control 2013

Preventing MDR-*A. baumannii* and MRSA: Policy, Process and Outcomes Survey

- National survey on policy, process and outcomes to prevent MDR-*A. baumannii* in tertiary care hospitals in Thailand

- Face-to-face interview with IC chair person and site visits to hospital across Thailand during January 2014 until October 2014

- 214 of 256 tertiary care hospitals (85%) were surveyed

- Infection Control policy, process and outcomes for *MDR-Acinetobacter buamannii* were surveyed

Apisarnthanarak A, et al. National Survey on policy, process and outcomes for prevention of *MDR-Acinetobacter baumannii*.
Clin Infect Dis (Suppl) 2017

Table 2. Characteristics Significantly Associated With Regular Use of Specific Methicillin-Resistant *Staphylococcus aureus* and Multidrug-Resistant *Acinetobacter baumannii* Prevention Practices

Characteristic	OR	(95% CI)	*P* Value	Infection Prevention Practice	Regular Use
Practices specific to MDR-AB prevention					
Facilities maintenance department	2.39	(1.06–5.37)	.04	Contact precautions while caring for infected patients	77.40%
Good/excellent support of infection control program	2.20	(1.09–4.46)	.03		
Lead infection preventionist certified in infection control	4.19	(1.26–13.96)	.02		
Type of ownership				Private rooms or cohorting of infected patients	72.20%
Private	4.22	(1.38–12.93)	.01		
Government-owned		Ref			
Military	2.11	(.61–7.33)	.24		
Good/excellent support of infection control program	2.37	(1.22–4.61)	.01		
Lead infection preventionist certified in infection control	3.41	(1.11–11.41)	.05		
Involved with a collaborative effort to reduce HAI	2.86	(1.13–7.22)	.03	Appropriate hand hygiene	84.00%
Good/excellent support of infection control program	3.33	(1.46–7.62)	.004		
Lead infection preventionist certified in infection control	5.74	(1.43–23.05)	.01	Antibiotic stewardship program	54.20%
Good/excellent support of infection control program	3.97	(1.70–9.27)	.001	Environmental cleaning of infected patients' room and surroundings	85.40%
Good/excellent support of infection control program	2.21	(1.10–4.46)	.03	Chlorhexidine bathing for infected patients	31.10%
Medical school affiliation	0.36	(.17–.74)	.01	Active surveillance cultures	36.30%
Facilities maintenance department	3.63	(1.57–8.43)	.003		
HAI collaborative	2.50	(1.24–5.03)	.01		

Table 4. Rates of Multidrug-Resistant *Acinetobacter baumannii*—Multivariable Regression

Characteristic	Estimate	(95% CI)	*P* Value
Type of ownership			
Government-owned		Ref	
Private	−0.0042	(−.3871 to .3786)	.98
Military	0.4359	(−.0389 to .9108)	.07
No. of acute care beds	0.0003	(−.0001 to .0007)	.10
Medical school affiliation	0.128	(−.1806 to .4365)	.42
Environmental cleaning service	−0.4126	(−.7353 to −.09)	.01
Facilities maintenance department	−0.3331	(−.651 to −.0153)	.04
Microbiology laboratory	−0.828	(−1.4996 to −.1565)	.02
Hospitalists	0.4603	(−.3563 to 1.277)	.27
HAI collaborative	−0.11	(−.4141 to .1941)	.48
Good/excellent support of infection control program	0.1502	(−.1409 to .4412)	.31
Hospital epidemiologist	−0.134	(−.4252 to .1572)	.37
Total FTE for all infection preventionists	−0.0267	(−.0747 to .0214)	.28
Lead infection preventionist certified in infection control	0.0767	(−.4493 to .6028)	.77
Gram-negative bacteria bundle: hand hygiene + contact isolation + antibiotic stewardship + patient cohorting + at least 1 of active surveillance, environmental cleaning, chlorhexidine gluconate bathing, or hydrogen peroxide vaporizer	−0.1572	(−.4534 to .1389)	.30

Conclusions

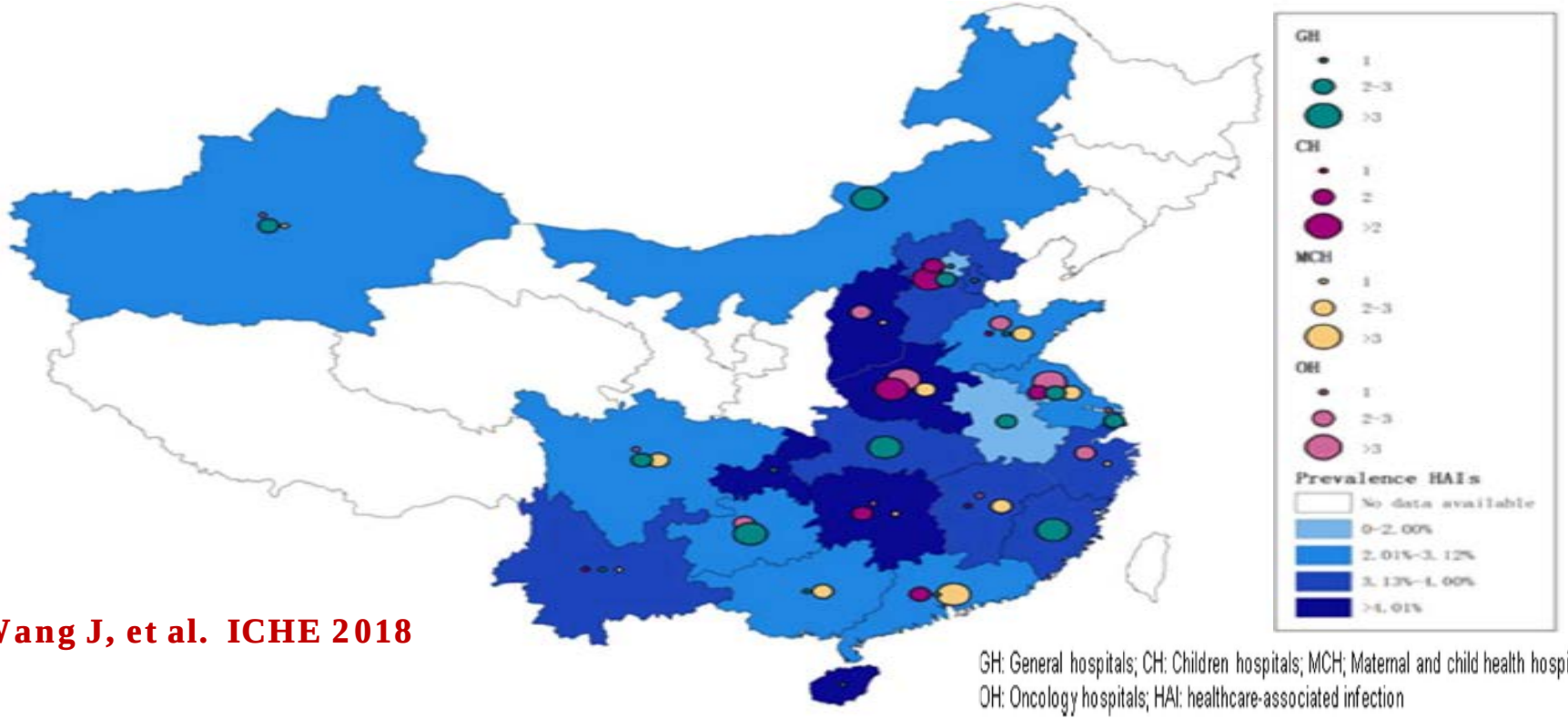
HAIs remain a challenging problem in this regions.

MDROs are increasing with continuously changing in patterns in this region.

Implementation of ASP and infection control intervention wisely will be a key to contain MDROs in this region.

Regional, national, inter-national collaboration will help contain the emerging of MDROs in this regions.

Thank you for your attention!



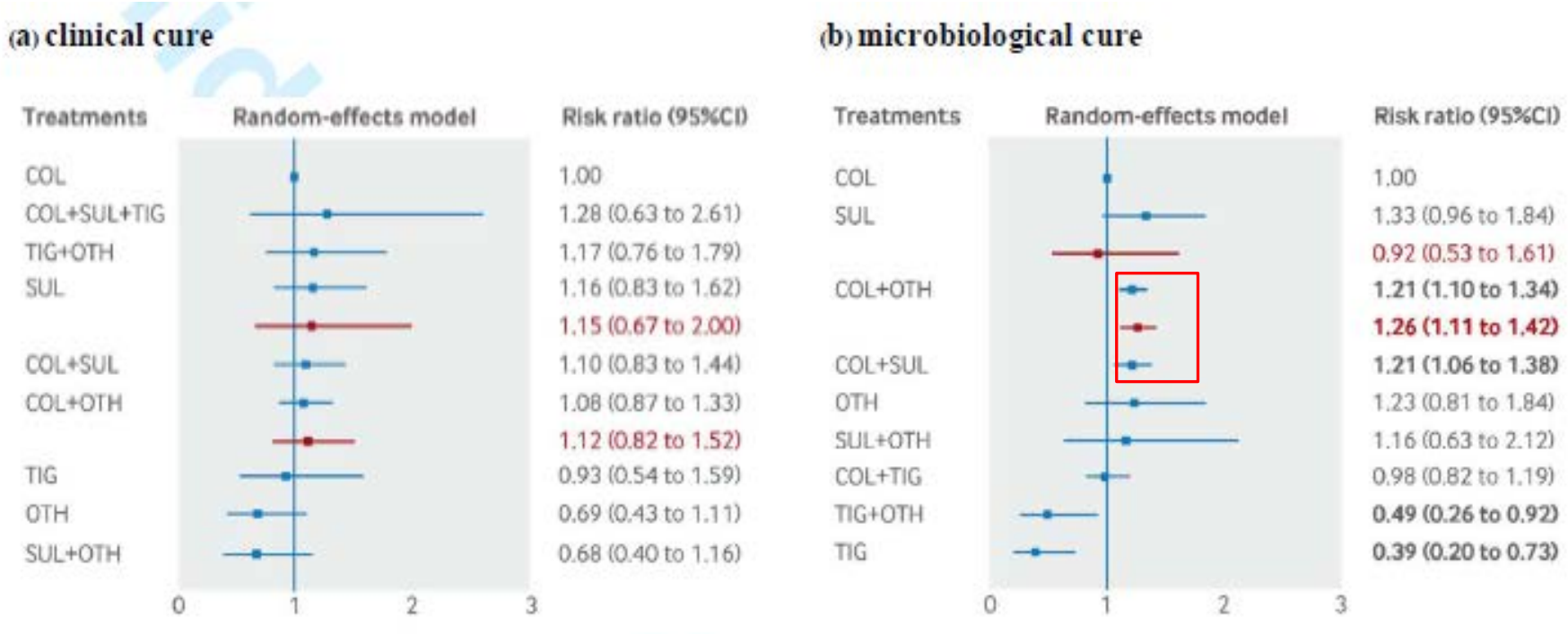
Wang J, et al. ICHE 2018

GH: General hospitals; CH: Children hospitals; MCH; Maternal and child health hospitals; OH: Oncology hospitals; HAI: healthcare-associated infection

TABLE 3. Distribution of Reported Pathogens Causing Healthcare-Associated Infections (HAIs) in Mainland China, 2006–2016

	General Hospitals [a]		Children's Hospitals [b]		Maternal and Child Health Hospitals [c]		Oncology Hospitals [d]	
Rank	Pathogen	No. (%)	Pathogen	No. (%)	Pathogen	No. (%)	Pathogen	No. (%)
1	*Pseudomonas aeruginosa*	3,395 (14.91)	*Klebsiella pneumoniae*	66 (19.08)	*K. pneumoniae*	22 (23.66)	*Escherichia coli*	150 (19.04)
2	*Escherichia coli*	2,918 (12.82)	*E. coli*	34 (9.83)	*E. coli*	17 (18.28)	*K. pneumoniae*	119 (15.10)
3	*Acinetobacter baumannii*	2,567 (11.28)	*Staphylococcus aureus*	24 (6.94)	*P. aeruginosa*	13 (13.98)	*A. baumannii*	112 (14.21)
4	*Klebsiella pneumoniae*	2,285 (10.04)	*A. baumannii*	24 (6.94)	*Staphylococcus epidermidis*	6 (6.45)	*P. aeruginosa*	70 (8.88)
5	*S. aureus*	1,816 (7.98)	*P. aeruginosa*	23 (6.65)	*Streptococci* spp	4 (4.30)	*S. aureus*	61 (7.74)
6	Other	9,783 (42.98)	Other	175 (50.58)	Other	31 (33.33)	Other	276 (35.03)
	Overall	22,764 (100)	Overall	346 (100)	Overall	93 (100)	Overall	788 (100)

Impact of combination treatments on CR-*Acinetobacter baumannii*



Comparative efficacy and safety of treatment options for multidrug-resistant and extensively drug-resistant Acinetobacter baumannii infections: a systematic review and network meta-analysis.

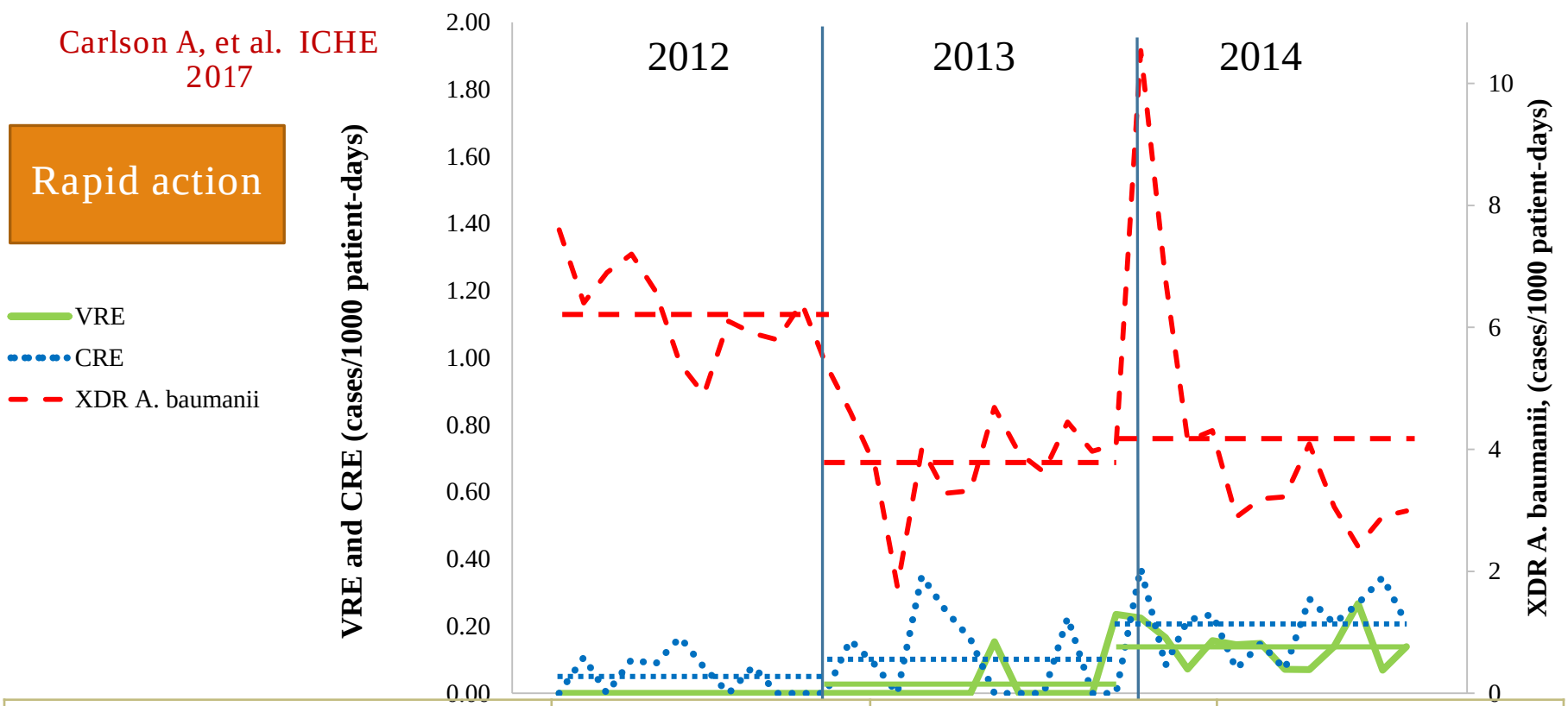
Journal of Antimicrobial Chemotherapy

Kirati Kengkla[1], Khachen Kongpakwattana[2], Surasak Saokaew[1,3], Anucha Apisarnthanarak[4], Nathorn Chaiyakunapruk[2,3,5,6]*

Journal of Antimicrobial Chemotherapy

Carlson A, et al. ICHE 2017

Rapid action



Compliance (%)	2012				2013				2014			
Hand Hygiene	66	74	74	76	90	90	88	90	88	88	73	82
Contact Precautions	40	36	38	40	66	59	56	56	43	61	58	53
Environmental Cleaning	36	37	37	37	67	63	60	58	45	61	59	58
Antibiotic Use (DDD/10000patient-days)												
Cephalosporins, 3rd Generation	51				54				55			
Quinolones	8.9				8.2				9.1			
Carbapenems	37				38				42			

Interventions Commonly Employed

Primary intervention: Optimizing dosing (n=2)						
Masuda N, 2015	Japan	N/A	Therapeutic drug monitoring (TDM) by clinical pharmacist for vancomycin usage	5 years (5/2007-5/2012)	Retrospective comparative study between two groups: Non-pharmacist intervention group (n=508) vs. Pharmacist intervention group (n=102)	High
Sime FB, 2015	Australia	N/A	TDM of piperacillin/tazobactam for 3 consecutive days.	8 months (3/2014-11/2014)	Prospective randomized controlled trial TDM performed group (n=16) vs. No TDM performed group (n=16)	Low
Primary intervention: Rapid diagnostic testing (n=2)						
Taniguchi T, 2015	Japan	550-bed, tertiary care center	Improved diagnostics (point of care of Gram-stain based antimicrobial therapy)	1 year (5/2013-4/2014)	Retrospective comparative study between Gram stain group (n=208) and guideline group (n=208)	High
Davies J, 2012	Australia	n/a	Improved diagnostics (GeneXpert)	8 months (12/2010-7/2011)	Prospective evaluation for positive blood culture for Gram-positive cocci in cluster	High
Primary intervention: Computerized clinical decision support system (n=2)						
Yong MK, 2010	Australia	24-bed ICU	Computer support decision system; web-based approval system	Pre-intervention: 2.5 years (1/2000-6/2002) Post-intervention: 4.5 years	Before after trial using segmented linear regression	High

Table 1. Changes in cost after the implementation of antimicrobial stewardship program

Study	Country or region	Type of costs	Cost changes between intervention vs. control or prior to intervention (% change)	Statistical significance
Two-group comparative study				
Cai Y, 2016	Singapore	Cost of total antimicrobial use	Reduced SGD 90,045 after intervention (details N/A)	N/D
Taniguchi T, 2016	Japan	Cost of total antimicrobial use	JPY5,409,051 vs. JPY 12,894,159 (58.1% reduction)	N/D
Shen J, 2011	China	Cost of individual antimicrobial use (mean ± SD) and individual hospital hospitalization (mean ± SD)	Antimicrobial use: USD 832.0 ± 373.0 vs. 943.9 ± 412.0 (13.3% reduction) Hospitalization: USD 1442.3 ± 684.9 vs. $1729.6 ± 773.7 (16.6% reduction)	*P*=0.01 *P*<0.001
Before-after trial				
Fukuda T, 2014	Japan	Cost of antimicrobial therapy per 1,000 patient-days (mean)	USD 4,555.0 vs. 6,133.5 per 1,000 patient-days (25.8% reduction)	*P*=0.005
Lin YS, 2013	Taiwan	Cost of antimicrobial therapy per 1,000 patient-days (mean)	USD 12,146 vs. 21,464 per 1,000 patient-days (43.4% reduction)	*P*=0.02 in trend analysis
Teo J, 2012	Singapore	Cost of total and audited antimicrobial use in 12 months periods	Total antimicrobials: reduced USD 141,554 in (7.1% reduction) after intervention Audited antimicrobials: reduced USD 198,575 (13.2% reduction) after intervention.	*P*=0.15 *P*=0.01
Ikeda Y, 2012	Japan	Cost of total antimicrobial use in 14 month periods	USD 2.73 million vs. 3.49 million (21.7% reduction)	N/D
Niwa T, 2012	Japan	Annual cost of total antimicrobial use	USD 1.86 million vs. 2.02 million (11.7% reduction)	N/D
Mlyawaki K, 2010	Japan	Annual cost of total antimicrobial use	JPY 262,528,000 vs. 290,596,000 (9.7% reduction)	N/D
Cheng VCC, 2009	Hong Kong	Annual cost of total	USD 1.32 million vs. 1.50 million (12.0%	N/D

Table 1. Changes in cost after the implementation of antimicrobial stewardship program

Study	Country or region	Type of costs	Cost changes between intervention vs. control or prior to intervention (% change)	Statistical significance
Before-after trial				
Ng CK, 2008	Hong Kong	Annual cost of total antimicrobial use.	USD 1.65 million vs.1.96 million (15.8% reduction)	N/D
		Monthly cost of restricted antimicrobial use per 1,000 patient-days	USD 3,906 vs. 7,293 (46.4% reduction)	*P*<0.001
		Monthly cost of non-restricted antimicrobial use per 1,000 patient-days	USD 3,946 vs. 4,414 (11.9% increase)	*P*=0.003
Apisarnthanarak A, 2007	Thailand	Mean cost of antibiotics and hospitalization for treatment of VAP per patient	Antibiotics: USD 2,378 vs. 4,769 (45-50% reduction)	*P*<0.001
			Hospitalization: USD 254 vs. 466 (37-45% reduction)	*P*<0.001
Apisarnthanarak A, 2006	Thailand	Total cost saving from the reduction in antimicrobial use	USD 52,219 vs. 84,450 (38.2% reduction)	*P*<0.001