twice daily and body washes with 4% chlorhexidine gluconate soap solution for five days.[6] Four of these five patients underwent a successful process of MRSA decontamination with nasal mupirocin and body washing with chlorhexidine. The fifth patient could not be assessed due to early death.

Only one patient remained VRE-colonised and no deaths were related to the outbreak. Overall, the estimated direct financial cost of this outbreak was €207,000, mainly linked to the loss of income due to temporary restriction of admissions, as a result of restriction of transfers.

In our elderly population with a high duration of hospitalisation, the decontamination measure may have played a role in the rapid control of the outbreak and helped to reduce the number of days of restricted admission.

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Epidemiology and risk factors of catheter-associated bloodstream infections among intensive care unit patients: an experience from a tertiary care hospital in Thailand☆

Madam,

Catheter-associated bloodstream infection (CABSI) is a common problem in hospitals especially among patients admitted to intensive care units (ICUs). According to the National Nosocomial Infections Surveillance (NNIS) system of the Centers for Disease Control and Prevention (CDC, Atlanta, GA, USA), the median rate of CABSI in ICUs ranges from 1.8 to 5.2 per 1000 catheter-days.[1,2] However, most studies regarding CABSI were conducted in developed countries where the epidemiology and risk factors associated with this condition may be different. This study was conducted to describe the epidemiology of CABSI and to determine factors associated with CABSI among medical ICU patients in a tertiary care hospital in Thailand.

A cohort study was conducted between 2004 and 2006 at Ramathibodi Hospital (a 1000 bed university hospital), Bangkok, Thailand. We performed a prospective surveillance as part of an infection control programme to collect information on all patients who had indwelling catheters during admission to the medical ICU. These patients were followed until one of the following events occurred: first episode of CABSI, transferring to another ward, removal of the catheter, or death. The diagnosis of CABSI was performed using CDC/NNIS definitions and criteria.[1,3] Logistic regression analysis was used to determine the factors associated with CABSI. The study was reviewed and approved by the institute review board.

A total of 235 patients were included in the analysis. Clinical characteristics of the patients are shown in Table I. Approximately three-quarters of patients had underlying condition(s). Median (interquatile range; IQR) Acute Physiology and Chronic Health Evaluation (APACHE) II score at ICU admission was 24 (12). Median (IQR) hospitalisation on the day before ICU admission was 1 (10) day. The most common catheter type was a short term catheter (ARROWgard Blue®) (65%) and the most common insertion site was the internal jugular vein (39%). The main purpose of catheter use was haemodialysis (31%). Median (IQR) duration of catheter placement was 6 (6) days. There was no statistically significant difference between the clinical characteristics and catheter-related information of patients with and without CABSI, except that

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Table I
Clinical characteristics of intensive care unit patients with and without catheter-associated bloodstream infection (CABSI)

Characteristics	Total ($N=235$)	Patients with CABSI ($N=20$)	Patients without CABSI ($N=215$)	*P*-value
Age (median, IQR), years	56 (31)	57 (29)	52.5 (44)	0.279
Males, no. (%)	113 (48.1)	10 (50.0)	103 (47.9)	0.858
With underlying condition, no. (%)	181 (77.0)	19 (95.0)	162 (75.4)	0.046
Type of catheter, no. (%)				0.927
Short term catheter	151 (64.8)	13 (65.0)	138 (64.8)	
Swan–Ganz	72 (3.9)	6 (30.0)	66 (31.0)	
PICC	2 (0.9)	0	2 (0.9)	
Others	8 (3.4)	1 (0.05)	7 (3.2)	
Insertion site, no. (%)				0.365
Internal jugular vein	84 (39.2)	5 (29.4)	79 (40.1)	
Subclavian vein	69 (32.2)	4 (23.5)	65 (33.0)	
Femoral vein	52 (24.3)	7 (41.2)	45 (22.8)	
Arm vein	9 (4.2)	1 (5.9)	8 (4.1)	
Purpose of catheter use, no. (%)[a]				
Haemodialysis	106 (30.6)	13 (36.1)	93 (30.0)	0.452
TPN support	98 (28.3)	12 (33.3)	86 (27.7)	0.560
Fluid infusion	66 (19.1)	5 (13.9)	61 (19.7)	0.403
Haemodynamic measurements	65 (18.8)	5 (13.9)	60 (19.4)	0.427
Medication	6 (1.7)	1 (2.8)	5 (1.6)	0.613
Blood transfusion	5 (1.4)	0	5 (1.6)	0.443
APACHE II (median, IQR)	24 (12)	24.5 (13)	24 (12)	0.918
Duration of catheter placement (median, IQR), days	6 (6)	12 (7.5)	5 (6)	0.001
Hospitalisation day before ICU admission (median, IQR), days	1 (10)	3 (22.5)	1 (8)	0.101

APACHE, Acute Physiology and Chronic Health Evaluation; ICU, intensive care unit; IQR, interquartile range; PICC, peripherally inserted central catheter; TPN, total parenteral nutrition.
[a] Some patients might have more than one purpose of catheter use.

a higher proportion of patients with underlying condition and a longer median duration of catheter placement were found among patients with CABSI.

Twenty patients had CABSI with cumulative incidence of 8.5% and incidence density of 10.7 (95% CI: 6.4–16.7) per 1000 catheter-days. The median time from catheter insertion to CABSI was 33 (95% CI: 16–∞) days. Aetiological organisms were *Enterococcus* spp. (5, 23.8%), *Acinetobacter baumannii* (5, 23.8%), Candida albicans (3, 14.3%), and one each of meticillin-resistant *Staphylococcus aureus*, *Staphylococcus hominis*, *Leuconostoc* spp., *Corynebacterium* spp., *Escherichia coli*, *Klebsiella pneumoniae*, *Stenotrophomonas maltophilia* and Candida tropicalis.

By univariate analysis, underlying condition [odds ratio (OR): 6.22; $P=0.078$], insertion in the femoral vein (OR: 2.36; $P=0.099$), TPN support (OR: 2.25; $P=0.089$), haemodialysis (OR: 2.43; $P=0.068$) and duration of catheter placement (OR: 1.14; $P<0.001$) were associated with CABSI. By multivariate analysis, only haemodialysis was a dependent factor associated with CABSI (OR: 1.94; 95% confidence interval: 0.99–3.80; $P=0.054$).

The authors investigated the incidence, risk factors, and micro-organisms of CABSI in a medical ICU of a tertiary care hospital in Thailand. The incidence of 10.7 per 1000 catheter-days is higher than that reported in other studies.[2,4,5] This might be explained by the fact that most of our patients had severe medical conditions represented by high APACHE II score and had significant underlying conditions. In addition, clinical practice guidelines for central venous catheter insertion had not been fully implemented in our hospital during the study period, as evidenced by the high proportion of insertions in the internal jugular instead of subclavian vein, although the maximum sterile barrier during insertion and aseptic technique during catheter care has been emphasised.

Overall, the micro-organisms isolated from blood and catheters in our patients were consistent with the results from other published studies.[4,6] We found a roughly equal proportion of Gram-positive cocci and Gram-negative bacilli. Individual microbiological data from each institute are important for empirical antimicrobial therapy guidance.

The duration of catheterisation is a significant risk factor for the development of CABSI by univariate analysis, as found in other studies.[4,6] Catheter removal as soon as possible is one of the strategies to prevent CABSI. Haemodialysis is the only dependent associated risk factor for CABSI by multivariate analysis. Bacterial contaminants in haemodialysis systems are of concern as potential causes of bloodstream infection.[7] In addition, the high likelihood of blood contamination and breakdown of aseptic technique while accessing the patients' vascular system make the haemodialysis setting unique.[7]

In conclusion, a high rate of CABSI among medical ICU patients was found in our setting. Reducing CABSI among ICU patients is still a challenge for healthcare providers. More stringent infection control guidelines should be implemented with regard to catheter use and risk factor control to prevent CABSI, especially in patients who need haemodialysis.

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Corynebacterium striatum as an emerging pathogen

Madam,

Corynebacterium striatum, previously considered a saprophyte on skin and nasal mucosa, is increasingly recognised as a potential pathogen in both immunocompromised and normal hosts.[1] We studied a cluster of *C. striatum* isolates from patients in a 110 bed subacute respiratory care centre. Between January 2006 and June 2007, 23 clinical isolates of *C. striatum* from 17 patients were identified by Gram staining, colonial morphology and the API Coryne system. Another commercial kit, RapID CB Plus, was used when necessary. When results from the API Coryne system and the RapID CB Plus did not concur, the organism was reported as *Corynebacterium* sp. and was not included in our analysis. Minimum inhibitory concentration for penicillin carried out using *E*-test and that for erythromycin, levofloxacin and vancomycin was performed using disc diffusion method. We defined *C. striatum* as a pathogen when Gram staining of the specimen showed abundant organisms with neutrophils and a pure growth in culture, together with clinical and radiological evidence of infection. In nine patients, *C. striatum* was responsible for community-acquired pneumonia (CAP), empyema, pneumonia or acute bronchitis. With regard to *C. striatum* bronchitis, patients were required to have two of the following: (i) fever; (ii) increased sputum volume or purulence; (iii) newly developed or worsening hypoxaemia. Only half of those patients who received antibiotics active against the bacterium survived the infection.

Five patients either had multiple organisms isolated, or had additional foci of infection. We consider the role of *C. striatum* in these patients as indeterminate, as any pathogenic role would be impossible to demonstrate. *C. striatum* was regarded as a contaminant or transient coloniser in three patients as there was no clinical evidence of infection.

C. striatum was cultured in a chest wound swab, sputum and pleural fluid in a patient with underlying silicosis, old tuberculosis and chronic obstructive pulmonary disease (COPD). He was hospitalised for a right pneumothorax with persistent airleak. The chest drain slipped out twice. Purulent pleural fluid and severe wound pain were noticed after placement of the third chest drain. It is possible that introduction of *C. striatum* by multiple drain insertions led to a fatal empyema. In four patients with *C. striatum* pneumonia, the lower lobes were uniformly involved suggesting the possibility of silent aspiration.

An outpatient with underlying bronchiectasis that had been antibiotic free for 3 months, presented with community-acquired pneumonia (CAP) of the right lower lobe. *C. striatum* was isolated from sputum collected on the first day of hospitalisation and in bronchial lavage fluid. This strain was susceptible to penicillin and the patient improved with antibiotic therapy.

Except for the patient with CAP, all patients were severely debilitated with a prolonged hospital stay (median stay was 53 days, with a range of 8 days to more than 2 years). They were exposed to multiple antibiotics or antituberculous treatment. Most patients received ventilatory support (13 out of 16) using non-invasive ventilators (12 patients) and/or invasive mechanical ventilators (five patients). Three bed-bound patients who did not receive ventilatory support required nasal oxygen therapy and nasogastric tube feeding. The presence of multiple medical devices and the exposure to antimicrobials had possibly facilitated colonisation with *C. striatum* of the upper respiratory tract with subsequent invasive infection.

All *C. striatum* isolates were resistant to at least one antibiotic. Eleven patients carried *C. striatum* that were resistant to both penicillin and erythromycin and susceptible to vancomycin only. Levofloxacin susceptibility was performed for isolates from 13 patients and the tests uniformly showed resistance.

Using the API Coryne system for organism identification, a 97.6% concordance with conventional methods was reported.[2] Additional tests for identification were needed in 21.8–55.1% of the isolates.[2–4] The rate of misidentification has been low at 1.2–3.8%.[2–4] Thus, isolation of pure, heavy growth of *C. striatum* in the absence of other pathogens together with clinical deterioration provided strong evidence for its pathogenic role in our patients. However, we could not ascertain how many of the fatalities could be attributed to *C. striatum* infection rather than to underlying conditions.

A major limitation of our study was the lack of gene sequencing to document cross-infection. In a study using DNA genotyping, a single *C. striatum* strain was isolated from surfaces and air-sampled in the direct vicinity of the *C. striatum*-infected patients and was cultured from hands of hospital personnel. This suggested nosocomial spread of *C. striatum* by healthcare workers.[5] Outbreaks caused by multidrug-resistant *C. striatum* have been reported in long-term hospitalised patients, with prolonged exposure to broad spectrum antibiotics, in both COPD patients and in intensive care units.[5–8]

In conclusion, our analysis showed that *C. striatum* was responsible for serious hospital-acquired respiratory infection and CAP. *C. striatum* should not be simply discarded as a contaminant, especially when isolated as pure growth in chronic debilitated patients with multiple medical devices in situ. Stringent infection control measures should be considered to prevent nosocomial spread.

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