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# Antimicrobial susceptibility profiles of aerobic and facultative Gram-negative bacilli isolated from patients with intra-abdominal infections in the Asia-Pacific region according to currently established susceptibility interpretive criteria

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Enterobacteriaceae;
Extended-spectrum β-lactamase (ESBL);
Fluoroquinolone resistance;

**Summary** *Objectives:* The Study for Monitoring Antimicrobial Resistance Trends (SMART) was intended to reveal the evolving profiles of antimicrobial resistance among Gram-negative pathogens causing intra-abdominal infections (IAIs) from Asia-Pacific region in 2009.
*Methods:* A total of 3577 aerobic and facultative Gram-negative bacilli associated with IAIs were collected from 32 centers in 12 countries. The *in vitro* susceptibilities of these isolates to 12 antimicrobial agents were determined using the broth microdilution method. Susceptibility results for selected species of Enterobacteriaceae were also compared using different MIC interpretive criteria recommended by the Clinical and Laboratory Standards Institute in 2009 (M100-S19), in January 2010 (M100-S20), in June 2010 (M100-S20-U) and the European Committee on Antimicrobial Susceptibility Testing in 2010 (EUCAST-2010).

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Carbapenems;
Interpretive susceptibility criteria

*Results:* Enterobacteriaceae comprised 89.5% of the isolates of which *Escherichia coli* was the most common species (56.7%). Enterobacteriaceae showed poor susceptibility to ampicillin-sulbactam in China (25.3%) and India (19%), and to fluoroquinolones in India (23.4%) and China (37.7%). The rates of extended-spectrum β-lactamase (ESBL)-producing *E. coli* (36.8%) and *Klebsiella pneumoniae* (26.3%) remained high. The resistance of ESBL-producing *K. pneumoniae* to carbapenems also increased, especially to ertapenem (9.9%). Using M100-S20 criteria, 19% of ESBL-producing *E. coli* and 9% of ESBL-producing *K. pneumoniae* were susceptible to ceftazidime; 5% and 10% were susceptible to cefepime, respectively. Using M100-S20-U guidelines, the susceptibility rates of ESBL-producing *K. pneumoniae* (88%) and *Enterobacter cloacae* (69%) to ertapenem were substantially decreased from those determined using M100-S20.
*Conclusions:* These up-to-date epidemiology and antimicrobial resistance surveillance data are crucial to select appropriate treatment of IAIs.


## Introduction

Data on the clinical microbial epidemiology and antimicrobial resistance profiles in different populations are invaluable tools for determining the most effective choice of antimicrobial therapy and for the prevention of spread of inappropriate therapy-related resistance.[1] Continuous surveillance of these data is needed because of their clinically important variation, including pathogens causing various infections, geographic regions, and collection periods.[2,3] Determining the extent and trends of antimicrobial resistance is also a necessary part of this surveillance.[4] Initiated in 2002, the Study for Monitoring Antimicrobial Resistance Trends (SMART) was designed to monitor the global, longitudinal trends of epidemiology and *in vitro* antimicrobial susceptibility of aerobic and facultative Gram-negative bacilli (GNB) isolated from patients with intra-abdominal infections (IAIs).[5–7] In previous analyses of SMART data, isolates from the Asia-Pacific region showed the highest levels of antimicrobial resistance among the five global regions studied.[7–9] Therefore, up-to-date and accurate information is especially important for clinicians in this region to treat patients with IAIs appropriately.[10] It is also important to note that the use of different interpretive criteria for minimum inhibitory concentrations (MIC) of antimicrobial agents can result in different sensitivity and specificity to detect several pathogens with specific resistance mechanisms, which would affect the therapeutic choice for infections.[11]

This report provides an update on the antimicrobial susceptibility patterns of isolates causing IAIs in 2009 at participating Asia-Pacific centers. Susceptibility results for selected species of Enterobacteriaceae were also compared using different MIC interpretive criteria recommended by the Clinical and Laboratory Standards Institute (CLSI) in 2009 (M100-S19), in January 2010 (M100-S20), in June 2010 (M100-S20-U) and the European Committee on Antimicrobial Susceptibility Testing in 2010 (EUCAST-2010).[12–15]

## Materials and methods

### Study countries and sites

A total of 32 medical centers from 12 countries in the Asia-Pacific region participated in the SMART 2009 project, including India ($n = 7$), Taiwan ($n = 7$), China ($n = 6$), New Zealand ($n = 2$), Malaysia ($n = 2$), Australia (n-=1), Singapore ($n = 2$), Hong Kong (n = 1), Philippines (n = 1), South Korea (n = 1), Thailand (n = 1) and Vietnam (n = 1).

### Bacterial isolates

During 2009, this study prospectively collected up to 100 consecutive, non-duplicate strains, including aerobic and facultative GNB from patients with IAIs at each center. Acceptable specimens included tissue, fluid, or deep wound cultures obtained intra-operatively, and fluid from paracentesis or percutaneous aspiration of abscesses.[3] Duplicate isolates (the same genus and species from the same patient) were excluded, regardless of the elapsed time between procurement of the specimen and differences in antimicrobial susceptibilities. Bacteria were initially identified by standard methods used in the participating clinical microbiology laboratories.[8]

Isolates collected within 48 h after admission were presumptively categorized as community-associated IAIs (CA-IAIs), and those collected more than 48 h after admission as hospital-associated IAIs (HA-IAIs).[8]

### Antimicrobial susceptibility testing

The confirmation of identification and antimicrobial susceptibility assay of all isolates (except those from China) were performed by a central laboratory (International Health Management Associates, Inc., Schaumburg, Illinois, USA). Isolates collected in China were sent to a central laboratory in Beijing (Peking Union Medical College), following the same protocols in the US central laboratory. Antimicrobial susceptibility assays were performed by the broth microdilution method, using custom-made plates (Siemens Medical Solutions Diagnostics, MicroScan, West Sacramento, CA, USA), following the recommendations of the CLSI.[13,16] This surveillance tested twelve antimicrobial agents commonly used in IAI treatment. For the antimicrobial susceptibility assays, *Escherichia coli* ATCC 25922, *E. coli* ATCC 35218, *Klebsiella pneumoniae* ATCC 700603, and *Pseudomonas aeruginosa* ATCC 27853 were included as quality control strains. Extended-spectrum β-lactamase (ESBL) production by *E. coli*, *K. pneumoniae*, *Klebsiella oxytoca*, and *Proteus mirabilis* was identified using CLSI methods.[13]