ELSEVIER

Institut Pasteur

Microbes and Infection xx (2015) 1–9

www.elsevier.com/locate/micinf

Original article

Bacterial-resistance among outpatients of county hospitals in China: significant geographic distinctions and minor differences between central cities

Yonghong Xiao [a,*], Zeqing Wei [a], Ping Shen [a], Jinru Ji [a], Ziyong Sun [b], Hua Yu [c], Tiantuo Zhang [d], Ping Ji [e], Yuxing Ni [f], Zhidong Hu [g], Yunzhuo Chu [h], Lanjuan Li [a,*]

[a] *State Key Laboratory for Diagnosis and Treatment of Infectious Diseases, Collaborative Initiative Center for Diagnosis and Treatment of Infectious Diseases, First Affiliated Hospital, School of Medicine, Zhejiang University, Hangzhou 310003, China*
[b] *Tongji Hospital, Tongji Medical College, Huazhong University of Science and Technology, Wuhan 430030, China*
[c] *Sichuan Provincial People's Hospital, Chengdu 610072, China*
[d] *Third Affiliated Hospital, Sun Yat-sun University, Guangzhou 510630, China*
[e] *First Teaching Hospital, Xinjiang Medical University, Urumqi 830054, China*
[f] *Ruijin Hospital, Shanghai Jiaotong University, Shanghai 200025, China*
[g] *Tianjin Medical University General Hospital, Tianjin 300052, China*
[h] *First Hospital, China Medical University, Shenyang 110001, China*

Received 24 July 2014; accepted 12 February 2015
Available online ■ ■ ■

Abstract

The purpose of this study was to survey antibacterial resistance in outpatients of Chinese county hospitals. A total of 31 county hospitals were selected and samples continuously collected from August 2010 to August 2011. Drug sensitivity testing was conducted in a central laboratory. A total of 2946 unique isolates were collected, including 634 strains of *Escherichia coli*, 606 *Klebsiella pneumoniae*, 476 *Staphylococcus aureus*, 308 *Streptococcus pneumoniae*, and 160 *Haemophilus influenzae*. Extended-spectrum β-lactamases were detected in *E. coli* (42.3% strains), *K. pneumoniae* (31.7%), and *Proteus mirabilis* (39.0%). Ciprofloxacin-resistance was detected in 51.0% of *E. coli* strains. *Salmonella* spp. and *Shigella* spp. were sensitive to most antibacterial agents. Less than 8.0% of *Pseudomonas aeruginosa* isolates were resistant to carbapenem. For *S. aureus* strains, 15.3% were resistant to methicillin, and some strains of *S. pneumoniae* showed resistance to penicillin (1.6%), ceftriaxone (13.0%), and erythromycin (96.4%). β-lactamase was produced by 96.5% of *Moraxella catarrhalis* strains, and 36.2% of *H. influenzae* isolates were resistant to ampicillin. Azithromycin-resistant *H. influenza*e, imipenem-resistant but meropenem-sensitive *Proteus*, and ceftriaxone- and carbapenem non-sensitive *M. catarrhalis* were recorded. In conclusion, cephalosporin- and quinolone-resistant strains of *E. coli* and *Klebsiella pneumonia* and macrolide-resistant Gram-positive cocci were relatively prominent in county hospitals. The antibacterial resistance profiles of isolates from different geographical locations varied significantly, with proportions in county hospitals lower than those in their tertiary counterparts in the central cities, although the difference is diminishing.

Keywords: Antimicrobial resistance; Surveillance; Outpatients; County hospitals; China

* Corresponding authors.
E-mail addresses: xiao-yonghong@163.com (Y. Xiao), ljli@zju.edu.cn (L. Li).

http://dx.doi.org/10.1016/j.micinf.2015.02.001

1. Introduction

Antibacterial resistance is a serious public health problem, and the prevalence of multidrug- and pandrug-resistant organisms in tertiary medical institutions has compounded concerns for patients. In recent years, the proportion of antibacterial resistance has been increasing annually in community-acquired infections such as methicillin-resistant *Staphylococcus aureus* (MRSA), extended-spectrum β-lactamase (ESBL)-producing *Escherichia coli* and *Klebsiella*, vancomycin-resistant enterococci, and penicillin-resistant *Streptococcus pneumoniae* [1–3]. The containment of microbial drug resistance has become a global priority, and in 2011 the World Health Organization (WHO) highlighted concern with their Combat Drug Resistance: No Action Today, No Cure Tomorrow policy. The WHO recommended more extensive surveillance of drug resistance, catching up with dynamic development of drug resistance, and improved management strategies [4].

The Chinese Ministry of Health (MOH) National Antibacterial Resistance Investigation Net (Mohnarin) was established in 2005, and consists of approximately 100 tertiary medical institutions based in the central cities. The results of their surveillance revealed relatively high levels of drug resistance in the hospitals. For example, the proportions of MRSA, ESBL-producing *E. coli*, quinolone-resistant *E. coli* and macrolide-resistant Gram-positive cocci were greater than 50%. Carbapenem-resistant *Klebsiella pneumoniae* and non-fermenters also showed a rapidly increasing rate of resistance. This survey focused on hospitalized patients, recovered few isolates from outpatients, and did not include the county medical institutions [5]. County medical institutions provide basic medical services for most Chinese people. The focal point created by this service warrants the need for a survey of antibacterial resistance to establish the epidemiological characteristics and provide reference data to promote the rational use of antibiotics and resistance control in these institutions. For this purpose, bacterial pathogens were isolated from the outpatients of 31 county medical institutions. Antibacterial resistance among isolates from primary medical institutions, the geographical significance, and the differences with hospitals in the central cities were investigated. This surveillance was named Monitoring for Antimicrobial Resistance in County Hospitals (MARCH).

2. Materials and methods

2.1. Location of hospitals

Thirty-one county medical institutions from 12 provinces were selected. Samples were collected from outpatients who had a respiratory tract infection (RTI), urinary tract infection (UTI), skin soft tissue infection (SSTI), or other conditions during the period August 2010 to August 2011. Pathogens were isolated by standard microbiological methods and transferred to the central laboratory (State Key Laboratory for Diagnosis and Treatment Infection Disease, The First Affiliated Hospital, School of Medicine, Zhejiang University) for antibiotic sensitivity tests (Fig. 1).

2.2. Selection of patients and collection of isolates

The inclusion criteria were: (i) patients from outpatient clinics, emergency departments, or those who had been hospitalized for less than 48 h; (ii) those with a suspected diagnosis of bacterial infection; and (iii) individuals who had not been hospitalized during the 90 day period before visiting a doctor. The exclusion criteria were: (i) patients who had received antibacterial treatment for over 3 days; and/or (ii) those with chronic diseases requiring frequent visits to the doctor (more than once per week), including patients on outpatient peritoneal dialysis and those with prolonged urethral catheter retention or a diabetic foot infection.

Sputum, urine, stool, pus, blood and other infective specimens were collected from infected patients in each hospital. Bacteria were isolated and then identified by the Vitek II and API bacterial identification systems or by traditional manual methods. Most of the result of organism identification and susceptibility testing in county hospital correlated well with central results, if the results were not coincidence, the results in central laboratory were taken as final conclusion. All strains were transferred to the central laboratory, and their identities verified. Strains were stored in Microscan freeze tubes (Thermo Fisher Scientific Inc, Waltham, MA, USA) at −80 °C.

This study did not require institutional review board approval, and had no impact on patient management. All patients were informed of the study before taking samples.

2.3. Antibacterial sensitivity

2.3.1. Culture medium, antibacterial agents, and standard strains

Muller–Hinton agar (MHA) and *Haemophilus* Test medium (HTM) were used (OXOID, Basingstoke, UK) to culture strains. Reference standards of antibacterial agents were purchased from the National Institute for Food and Drug Control (Beijing, China).

The bacterial reference strains used were: *E. coli* (ATCC25922), *Pseudomonas aeruginosa* (ATCC27853), *S. aureus* (ATCC29213), *Enterococcus faecalis* (ATCC29212), *S. pneumoniae* (ATCC49619), and *Haemophilus influenzae* (ATCC49247).

2.3.2. Antimicrobial susceptibility testing

Antimicrobial susceptibility was determined using the agar dilution method and the breakpoint of drug sensitivity assessed according to the Clinical and Laboratory Standards Institute (CLSI) M100-21S. The Sakuma MIP-60P type multipoint inoculation equipment (Sakuma, Japan) was used according to the manufacturer's recommendations. Antibiotic susceptibility of *H. influenzae* was determined using the broth microdilution method. The breakpoint for the antibiotic sensitivity of *Moraxella catarrhalis* was determined according to CLSI M45-A

Please cite this article in press as: Xiao Y, et al., Bacterial-resistance among outpatients of county hospitals in China: significant geographic distinctions and minor differences between central cities, Microbes and Infection (2015), http://dx.doi.org/10.1016/j.micinf.2015.02.001