Improvement of Antibiotics Susceptibility of
Escherichia coli in a Tertiary Hospital in Japan

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Authors’ contributions

This work was carried out in collaboration between both authors. Author YW designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author MS managed the analyses of the study and the literature searches. Both authors read and approved the final manuscript.

ABSTRACT

Antimicrobial stewardship team (AST) and Infection Control Team (ICT) have recently been linked Infectious diseases (ID) physicians, and implemented in clinical settings in Japan. The microbiological effects of an AST and ICT, in addition to Diagnostic stewardship team (DST) supported by ID physicians in our tertiary hospital were shown in significant reduction of antibiotic resistance of Escherichia coli (E coli) including extended spectrum beta-lactamases (ESBL)-producing E.coli.

Keywords: Antimicrobial stewardship team (AST); diagnostic stewardship team (DST); infection control team (ICT); infectious diseases (ID) physicians; Escherichia coli; extended spectrum beta-lactamases (ESBL).
1. INTRODUCTION

Antimicrobial stewardship (AS) has been defined as an activity that includes appropriate selection, dosing, route, and duration of antimicrobial therapy [1,2]. The benefits of AS are improved patient outcomes, reduced-frequency adverse events, improved rates of antibiotic susceptibility to targeted antibiotics, and optimization of resource utilization across the continuum of care. The Infectious Diseases Society of America (IDSA), the Society for Healthcare Epidemiology of America (SHEA), and the Pediatric Infectious Diseases Society (PIDS) have strongly suggested that AS program (ASP) are best led by infectious disease physicians with additional stewardship training [1,2].

In addition to Infection Control Teams (ICT), interdisciplinary AS teams (AST), comprising infectious disease physicians, pharmacists, nurses, and microbiological technicians who recently contributed diagnostic stewardship (DS), have begun to be organized at university and/or tertiary hospitals in Japan, and the efficacy of the resulting interventions in preventing inappropriate antibiotic use have been reported for Japanese AST and its related staffs [3-6].

2. SHORT COMMUNICATIONS

In our hospital, a 650-bed tertiary-care university hospital in the city of Sendai in Japan, all adult patients who were (a) hospitalized at our facility from 2015 to 2018, (b) received antibiotic therapy, and (c) for whom an intervention was recommended by our ICT/AST in addition to diagnostic stewardship team (DST) and Infectious diseases (ID) physicians, were eligible for enrollment in this analysis. The microbiological data analysis are approved as the study; ID 2019-2-011, 012, and 020 by the ethics committee in our hospital.

The roles of the infection staffs and clinical microbiological laboratory included microbial diagnosis and a review of antimicrobial orders with respect to the usage, dose, isolated pathogens, and sites of infection for all inpatients receiving parenteral antibiotics, and consultation with physicians before the prescription of antibiotics. Cases receiving carbapenems, anti-pseudomonad penicillins, fluoroquinolones, 4th-generation cefem, and anti-Methillin resistant Staphylococcus aureus (MRSA) agents were specifically reviewed. When an inappropriate use of antibiotics was found, infection members made immediate contact with the prescriber over the telephone, via report papers, and/or via electronic messaging on the computer order system. Usually, total 50-100 patients were monitored, and finally a half of them were intervened in each month by our infection staffs and reported to clinical microbiological laboratory.

As the results, antibiotic susceptibility of Escherichia coli were significantly improved, especially, resistant E. coli for penicillin including ampicillin/sulbactam, cefazolin, and levofloxacin were significantly decreased (Fig. 1). Furthermore, the rates of extended spectrum beta-lactamases (ESBL)-producing E. coli among all isolated E. coli were also reduced (Fig. 2).

The occurrences of drug-resistant strains including ESBL- producing E. coli and related infectious diseases were big issues in Japan [7]. The nationwide surveillance showed that susceptibility rates of E. coli were decreased to 38% for ampicillin/sulbactam, and 82% for cefazolin although they were 92% for PIPC/TAZ, 96% for cefoxitin, and 100% for ertapenem. Ampicillin/sulbactam are not acceptable especially for intra-abdominal infection (IAI) and urinary tract infection (UTI), sometimes in pneumonia and blood stream infections (BSI) treatments, and cefoxitin should be used for these infections with caution empirically because we have to consider E. coli as one of the important pathogens of these infectious diseases. Therefore, antimicrobial and diagnostic stewardship interventions should work synergistically to decrease ordering of bacterial cultures without clear indication and prevent excessive antimicrobial administration in patients without clearly defined these infectious diseases.

To solve these issues, the infection staffs and clinical microbiological laboratory intervention for pneumonia has been recently reported to yield a significant decrease (from a median of 10 to 7 days) in the duration of antibiotic therapy, and also result in more frequently narrowing of antibiotic spectrum or modification on the basis of susceptibility results [8]. Maeda et al. showed that an AST intervention approach decreases the use of inappropriate therapy and may improve clinical outcomes in blood stream infection (BSI) patients, and previous other studies have reported that clinical intervention by infectious disease specialists also reduces mortality, length of stay (LOS), and medical costs [4,9,10]. These results indicate that the infection staffs and clinical microbiological laboratory interventions can...
Fig. 1. Antibiotics resistant rates of *Escherichia coli* were decreased year by year from 2008-2018.

Fig. 2. The rates of extended spectrum beta-lactamases (ESBL)-producing type among all isolated *Escherichia coli* were decreased year by year from 2008-2018.
decrease inappropriate therapy and also potentially improve clinical and economic outcomes in severe infectious disease, including IAI, UTI, pneumonia, and BSI by \textit{E coli}.

Therefore, a multidisciplinary infection staffs, including microbiologists, is very important for successful interventions and improving drug susceptibility of the pathogenic bacteria, including \textit{Pseudomonas aeruginosa} as we previously reported \cite{4,11,12}. Our team could decrease significant resistant rates of \textit{E coli} in our hospital by the synergistically collaborations.

3. CONCLUSIONS

Recommendations regarding appropriate therapies require a broad knowledge of infectious diseases. Interdisciplinary teams that are able to facilitate discussion among specialists from various relevant occupational fields may lead to successful implementation and decrease of resistance bacteria, including \textit{E coli}, by the infection staffs and the clinical microbiological laboratory.

ETHICAL APPROVAL

The study; ID 2019-2-011, 012, and 020 was approve by the ethics committee of the hospital.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES


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