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Prescribers' characteristics and unnecessary/inappropriate antimicrobial prescription in the emergency department: an observational study at a tertiary care center

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REVISED ABSTRACT

Objective: Antimicrobials are commonly prescribed in the emergency department (ED) and a large proportion of these drugs is potentially being misused. However, few studies have comprehensively examined the factors leading to the misuse of antimicrobials in the ED.

Methods: We performed a one-year cohort study of patients discharged from the ED at a tertiary care center with an antimicrobial prescription by retrospectively reviewing the medical records. Proportion of the misuse of discharge antimicrobial prescription, and physician-, patient- and environment-related factors predicting their misuse were evaluated.

Results: Of the 36,308 cumulative patients who visited the ED, 1,555 patients (4.3% of visit) received an oral antimicrobial prescription upon discharge. Pneumonia (17.8% [277/1,555]) was the most common indication for the antimicrobial prescription. Of the 1,555 antimicrobial prescriptions issued, 813 (52.3%) were considered misused. Except for cases of pneumonia and animal bite, antimicrobials were frequently inappropriately prescribed for a wide variety of infectious diseases. Factors significantly associated with the misuse of discharge antimicrobial prescription included the prescriber's higher postgraduate year (≥ 8 years) (adjusted odds ratio [aOR] 1.77; 95% confidence interval [CI], 1.15-2.72), the physicians in a surgical subspecialty (aOR 2.86; 95% CI, 1.94-4.22), and late-night visit (0:00-7:59) (aOR 1.55; 95% CI, 1.04-2.30).

Conclusion: More than half of discharge antimicrobial prescriptions in the ED were misused and frequently issued during late-night visits, by physicians with a higher postgraduate year, or by physicians in a surgical subspecialty, indicating that these areas need to be addressed in order to optimize discharge antimicrobial prescription in the ED.

INTRODUCTION

- Antimicrobials are commonly prescribed in the emergency department (ED).
- Redundant antimicrobial use and overuse of broad-spectrum antimicrobials are long-standing issues in the ED and may lead to the emergence of resistant pathogens.
- The purpose of the current study was to describe patterns in antimicrobial discharge prescriptions and to assess the factors associated with their misuse in the ED.

METHODS

Study design and Setting
We conducted a retrospective cohort study at Tokyo Metropolitan Tama Medical Center, a public, tertiary care center in Tokyo, from January 2016 through December 2016.

Identification of patients
We initially enrolled all patients who visited or were transferred to the ED during the study period. Among them, patients who were discharged home or to their living facilities (e.g., long-term care facility) with a discharge prescription of oral antimicrobials from the ED were selected. Patients who had already been diagnosed with an infectious disease prior to their ED visit and had received a discharge prescription of antimicrobial agents and those who were hospitalized later on the same day as their visit to the ED were also excluded.

Study flow
We initially evaluated the indications for antimicrobial therapy in cases of infectious disease diagnosed by the treating physicians based on previous literature. If discharge antimicrobial prescription in the ED was considered necessary, we next assessed its appropriateness using a list of treatment recommendations for common infectious diseases provided by international infectious disease treatment guidelines and a textbook. Two infectious disease physicians (Y.T. and H.H.) reviewed each case and assessed the use of discharge antimicrobial prescription by referring to the study flow.

METHODS (cont.)

Definition of the terminology: "unnecessary use", "inappropriate use", "suboptimal use", and "appropriate use"
- We classified the **misuse** of discharge antimicrobial prescription as unnecessary, inappropriate, or suboptimal.
- **Unnecessary use** was defined as antimicrobial use for non-infectious syndromes, nonbacterial infections, or self-limiting bacterial infections or antimicrobial use despite uncertain diagnosis.
- **Inappropriate use** was defined as the choice of an antimicrobial agent not conforming to current treatment or antimicrobial use against a pathogen resistant to the agent.
- **Suboptimal use** was defined as antimicrobial use that could have been improved in one of the following categories: drug delivery route, dosage interval, or dosage.
- **Appropriate use** was defined as discharge antimicrobial prescriptions not meeting the classification of misuse.

Data collection and variables of interest
The primary outcome was the proportion of overall misuse of discharge antimicrobial prescription and misuse for each type of infectious disease at the ED. We collected the demographic characteristics, clinical data, physician's diagnosis at ED, antimicrobial prescription data of the eligible patients, and the prescribers' information including primary service, sex, and postgraduate year (PGY) level.

Statistical analysis
We performed multivariate logistic regression to predict the misuse of discharge antimicrobial prescription in the ED. The factors associated with antimicrobial misuse in the outpatient setting in previous studies and factors with P<.10 in univariate analysis were included in the final model. We assessed multicollinearity by examining the variance inflation factor to ensure the independence of the explanatory variables. Variables were retained in the final model if P<.05. All analyses were performed using Stata version 15.2 (Stata Corp, College Station, Texas).

RESULTS

- Of the 36,308 cumulative patients who visited to the ED during the study period, 1,674 patients (4.6% of visit) received discharge oral antimicrobial prescriptions. Among these, 119 (0.3%) were excluded and a total of 1,555 (4.3%) patients for analysis.
- In this cohort, penicillins (42.9% [667/1,555]) were the most frequently prescribed single antimicrobial agent, followed by cephalosporins (23.4% [364/1,555]) and fluoroquinolones (13.6% [211/1,555]).
- Common diagnoses made by treating physicians were pneumonia (17.8%, 7.6 per 1,000 visits), skin and soft tissue infection (15.9%, 6.4 per 1,000 visits), and urinary tract infection (13.7%, 5.9 per 1,000 visits).
- Overall, 813 (52.3%) antimicrobial prescriptions were considered as cases of misuse; unnecessary, inappropriate, and suboptimal discharge antimicrobial prescription accounted for 428 (27.5%), 337 (21.7%), and 48 (3.1%) cases, respectively.

CONCLUSIONS

- This study included all patients who received discharge antimicrobial prescription for various infectious diseases in the ED throughout a one-year period. We also successfully explored the details and appropriateness of discharge antimicrobial prescriptions.
- More than half of discharge antimicrobial prescriptions in the ED were considered to be cases of misuse, while one-third were considered unnecessary.
- Misuse frequently occurred during late-night visits, and older physicians and physicians in a surgical subspecialty were detected. These factors highlight the influence of social norms, attitudes, and beliefs on antimicrobial prescribing behavior. The implementation of effective antimicrobial stewardship focusing on physician- and environment-related factors is urgently needed.

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Table 1. Appropriateness of discharge antimicrobial prescription in the emergency department (n=1,555)

Diagnosis	Appropriate	Unnecessary	Inappropriate	Suboptimal
Pneumonia and COPD exacerbation	257/284 (90.5)	0	23/284 (8.1)	4/284 (1.4)
Skin and soft tissue infection	103/233 (44.2)	0	100/233 (42.9)	30/233 (12.9)
Urinary tract infections	127/213 (60.1)	0	79/213 (39.4)	1/213 (0.5)
Prophylaxis for traumatic injury	19/162 (11.7)	132/162 (81.5)	10/162 (6.2)	1/162 (0.6)
Intraabdominal infection	56/118 (47.5)	0	61/118 (52.7)	1/118 (0.8)
Pharyngitis	55/103 (53.4)	41/103 (39.8)	6/103 (5.8)	1/103 (1.0)
Just in case use despite low likelihood of bacterial infection*	0	92/92 (100)	0	0
Animal bite	80/90 (88.9)	3/90 (3.3)	3/90 (3.3)	4/90 (4.4)
Gastroenteritis	5/38 (13.2)	29/38 (76.3)	4/38 (10.5)	0
Composite upper respiratory tract infections**	20/139 (14.4)	109/139 (78.4)	8/139 (5.8)	2/139 (1.4)
Others***	23/83 (27.7)	19/83 (22.9)	37/83 (44.6)	4/83 (4.8)

NOTE. * Discharge antimicrobial prescription in the absence of a certain diagnosis by the treating physician was considered to be a just in case of antimicrobial use. ** Composite upper respiratory tract infections included acute tonsillitis, acute otitis media, otitis externa, sinusitis, bronchitis, asthma attack, and other upper respiratory tract infections. *** Others include sexually transmitted disease, other genitourinary infections, odontogenic infection, miscellaneous bacterial infections, sialadenitis, febrile neutropenia, lymphangitis, bursitis, and septic arthritis.

Table 2. Predictors for the misuse of discharge antimicrobial prescriptions in the emergency department

Variables	Adjusted OR (95% CI)
Physician-related factors	
Prescriber's Post Graduate Year level ≤ 3 years	Reference
Prescriber's Post Graduate Year level 4-7 years	1.17 (0.86-1.61)
Prescriber's Post Graduate Year level ≥ 8 years	1.77 (1.15-2.72)
Physician in emergency department	Reference
Physician in medicine subspecialties	1.66 (0.99-2.77)
Physicians in surgical subspecialties	2.86 (1.94-4.22)
Environment-related factors	
Daytime visit (8:00-16:59)	Reference
Nighttime visit (17:00-23:59)	1.13 (0.83-1.53)
Late-night visit (0:00-7:59)	1.55 (1.04-2.30)
Physician's diagnosis	
Pneumonia	Reference
Intra-abdominal infections	4.58 (2.41-8.69)
Urinary tract infection	6.12 (3.45-10.86)
Pharyngitis	6.59 (3.41-12.77)
Skin and soft tissue infection	10.64 (6.13-18.48)
Gastroenteritis	48.56 (16.75-140.80)
Composite upper respiratory tract infections*	50.03 (24.17-103.54)
Prophylaxis for traumatic injury	59.51 (28.21-125.53)
Others**	12.32 (6.13-24.78)

NOTE. The outcome variable was the misuse of antimicrobial prescriptions in the emergency department.
*Composite upper respiratory tract infections included acute tonsillitis, acute otitis media, otitis externa, sinusitis, bronchitis, asthma attack, and other upper respiratory tract infections. ** Others include sexually transmitted disease, other genitourinary infections, odontogenic infection, miscellaneous bacterial infections, sialadenitis, febrile neutropenia, lymphangitis, bursitis, septic arthritis, and tonsillar abscess. Variables considered but not retained in the final model were patient age, patient gender, allergy for antimicrobial agents, history of asthma, chronic lung disease, chronic liver diseases, active solid organ malignancies, hypertension, chemotherapeutic agent use in the last 28 days, symptoms meeting SIRS criteria, duration of symptom, days of visiting ED, spring-summer, and patient's request for antimicrobial agents.