CONCISE REPORT

Usefulness of an antibiotic prescription-based healthcare-associated infection surveillance program in an ICU setting

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ABSTRACT

We evaluated the accuracy of the use of an antibiotic prescription-based (APB) case-finding program to identify healthcare-associated infections (HAIs) by carrying out a retrospective review of all patient records in the adult ICU in a tertiary care Finnish teaching hospital in one year. The concordance between the program and our retrospective review was 91.7%. Of all prescribed antibiotics, 12.4% were for HAIs. The case-finding program produces large amounts of data, only a small fraction of which is useful for estimating the incidence of HAIs. Case-finding needs automatic data processing using multiple sources of information.

KEYWORDS

Surveillance; healthcare-associated infection; antimicrobial; case-finding; ICU; intensive care

INTRODUCTION

Surveillance is an essential element in preventing healthcare-associated infections (HAIs) [1]. However, surveillance of HAIs using conventional (symptom-based and lab result-based) methods leads to under-reporting [2]. Therefore, electronic surveillance systems using multiple sources of information have been developed [3]. Hospitals using automated surveillance have been effective in implementing evidence-based practices to prevent HAIs [4].

The search for HAI cases was performed by the Hospital Antibiotic and Infection Monitoring System (SAI) (Neotide, Finland), an antibiotic prescription-based (APB) case-finding program. At the beginning of antibiotic treatment, the program requires that the physician indicate whether the antibiotic was started for an ICU-related HAI (ICU-HAI), for a HAI from healthcare treatment received outside the ICU (H-HAI), for a community-acquired infection (CAI), or for prophylaxis (PR). HAI cases were then reviewed by an infection control nurse (ICN) and the cases were recorded into the SAI system, which was linked to electronic patient databases.

The aim of this study was to assess the accuracy of the electronic HAI case-finding system in the ICU of a tertiary-care Finnish teaching hospital. The study was approved by the Ethics Committee of the University of Turku.

METHODS

In this study, the accuracy of the APB program was retrospectively evaluated by an infection control researcher who reviewed electronic records of patients admitted to the ICU in 2015. The incidence of HAIs was defined by the number of initiated antibiotics for HAIs per 1,000 patient days. The number of HAIs was expressed in absolute numbers; the proportion of HAIs per all discharged patients and patient days; and the number of central line-associated bloodstream infections (CLABSI), catheter-associated urinary tract infections (CAUTI), and ICU-acquired pneumonia per 1,000 device days. The agreement between cases (ICU-HAI, H-HAI, CAI, and PR), APB cases, and cases after the researcher's retrospective inspection were examined by percentage and Cohen's kappa. All statistical tests were performed using JMP® Pro 13.1.0.

RESULTS

This study was conducted in a mixed adult ICU with 25 beds, 1,736 admitted patients, and 5,707 patient days in 2015.

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Ethics approval: The study was approved by the Ethics Committee of the University of Turku.

Antibiotics were started 1,425 times. ICU-HAIs represented 10% of antibiotics, H-HAIs represented 2.5%, CAIs represented 27.2%, and PR represented 60.4%. The incidence of ICU-HAIs was 24.9 per 1,000 patient days.

After retrospective review of electronic patient files, antibiotics were found to be started 1,444 times. Here, 12.4% of antibiotic treatments were started for ICU-HAIs, 5.5% for H-HAIs, 26.6% for CAIs, and 56.8% for PR. The incidence of ICU-HAIs was 31.4 per 1,000 patient days.

The agreement between registered cases and cases after retrospective inspection by the researcher was 91.7% (1,266/1,380). The Cohen's kappa statistic was 0.86, with a 95% confidence interval (0.82-0.87). The most common CAI was pneumonia. Antibiotic treatments for PR were started in 10.4% of cases. The most common ICU-HAI was pneumonia in 49 cases.

DISCUSSION

The accuracy of the application of the APB program to ICU-HAIs in our ICU was good. In 15% of cases, physicians did not record the reason for initiating antibiotics. Sometimes it may be challenging for a physician to decide the cause of infection at the beginning of ICU care. Furthermore, physicians do not usually return to answer questions they initially skipped.

The agreed incidence of ICU-HAIs was lower than those reported in previous publications [5]. Pneumonia was the most common HAI; ICU-acquired pneumonia was higher than European HAI surveillance of ICUs (8.6 vs 6 per 1,000 patient days) [6]. Otherwise, incidences of BSIs and CAUTIs were considerably lower (0.7 vs. 1.7 and 0.2 vs 1.1 per 1,000 patient days) than previously reported.

The antibiotic-initiated case identification program also reveals antibiotic consumption not related to any infection (PR).

FIGURE 1: Antibiotic prescription and APB case-finding surveillance by indication and HAI type (CAI, H-HAI, ICU-HAI, and PR).

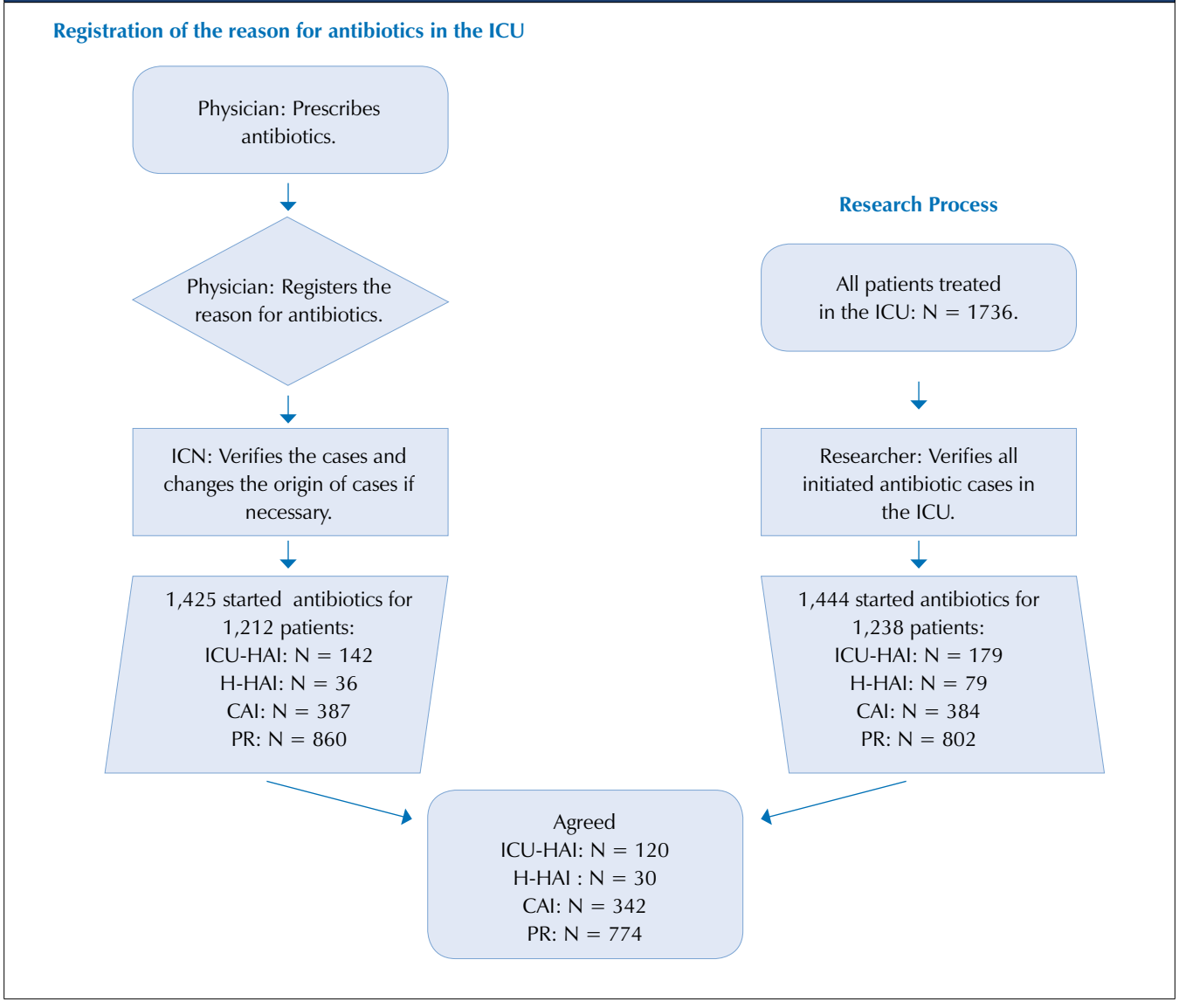

TABLE 1: Reason for antibiotic initiation in the ICU and the agreement between APB case-finding cases and cases after retrospective inspection.

Characteristics of antibiotic treatment initiation	Surgical patients: 41.4% Medical patients: 58.6% BSI: 3.6% (63/1,736) Pneumonia: 11.4% (198/1,736)			
Characteristics of antibiotic treatments initiated for ICU-HAIs	Surgical patients: 54.4% Medical patients: 45.6% 21 antibiotics/1,000 patient days 0.8 CLABSI/1,000 CVC days 15.2 ICU-acquired pneumonia/1,000 ventilator days 1.4 CDI/1,000 patient days 0.2 CAUTI/1,000 urinary catheter days			
Agreement between APB cases and cases after retrospective inspection		Percentage	Cohen's kappa	95% confidence interval
	ICU-HAI	79%	0.82	0.77-0.87
	H-HAI	52%	0.66	0.54-0.77
	CAI	90%	0.87	0.83-0.90
	PR	98%	0.88	0.86-0.91

LEGEND
Bloodstream infection (BSI)
Catheter-associated urinary tract infection (CAUTI)
Central line-associated bloodstream infection (CLABSI)
Central venous catheter (CVC)
Clostridium difficile infection (CDI)
Community-acquired infection (CAI)
Healthcare-associated infections from healthcare treatment received outside the ICU (H-HAI)
ICU-related infections (ICU-HAI)
Prophylaxis (PR)

If that much of all antibiotic consumption (10%) is clinically relevant and ecologically sustainable, it should be discussed by intensive care specialists, surgeons, and infection control specialists.

There were some limitations in our study. Only 5% of the data were analyzed by three evaluators; the rest was analyzed by one. The evaluators were all infection control professionals but there is nonetheless the possibility of subjectivity.

The antibiotic-initiated case-finding program helps evaluate the use of antibiotics in the ICU. However, it also produces a huge amount of data, of which only a small fraction helped accurately record the incidence of HAIs. Moreover, as has been reported [7], verifying the accuracy of our HAI surveillance program is time-consuming. There is a need for more automatic case-finding data processing using multiple sources of information. Automated text mining would help minimize that workload.

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