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## Major Article

## Implementing an antibiotic stewardship program at a long-term acute care hospital in Detroit, Michigan

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**Key Words:**  
 Antibiotic stewardship  
 Long-term acute care  
 Sustainability  
 Daptomycin  
 Tigecycline

**Background:** The objective of the study was to assess health care providers' (HCPs) knowledge and attitude toward antimicrobial resistance (AMR) and implement an antimicrobial stewardship program (ASP) in a long-term acute care hospital (LTACH).

**Methods:** A questionnaire on antibiotic use and resistance was administered to HCP in an LTACH in Detroit, Michigan, between August 2011 and October 2011. Concurrently, a retrospective review of common antibiotic prescription practices and costs was conducted. Then, a tailored ASP was launched at the LTACH followed by 2-phase postimplementation assessment aiming at evaluating the impact of the ASP on antibiotic expenditure.

**Results:** Of all respondents (N = 26), 65% viewed AMR as a national problem, but only 38% perceived AMR as a problem at their facility. Most respondents were familiar with infections caused by resistant organisms such as methicillin-resistant *Staphylococcus aureus*, vancomycin-resistant enterococci, and extended-spectrum  $\beta$ -lactamase; however, only 35% expressed confidence in treating infected patients. In the preimplementation phase, 15% of antimicrobial doses were inappropriate and 10 of 13 de-escalation opportunities were missed, resulting in additional \$23,524.00 expenditure. In the first postimplementation phase, there was a 42% and 58% decrease in the use of daptomycin and tigecycline, respectively, resulting in \$55,000 savings. In the second postintervention phase, total antimicrobial cost for treating a cohort of 28 patients in 2016 and 2017 was \$26,837.85 and \$22,397.15, respectively.

**Conclusions:** Introduction of an ASP in an LTACH improves antimicrobial prescribing practices, reduces cost, and is sustainable.

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## BACKGROUND

Based on the overwhelming evidence that implementation of antimicrobial stewardship programs (ASPs) in health care settings limits antimicrobial resistance (AMR), improves treatment efficacy, and reduces treatment-related costs, the Joint Commission (JC) developed antimicrobial stewardship standards that became effective on January 1, 2017.<sup>1</sup> Compliance with the standards requires hospitals to establish an evidence-proven ASP as an organizational priority.<sup>1</sup>

Long-term acute care hospitals (LTACHs) have emerged as important postacute care facilities that care for critically ill patients with complex medical needs such as intravenous medications.<sup>2</sup> Most LTACH patients are older, with multiple comorbidities, recent history of acute or intensive care hospitalizations, and prolonged exposure to antimicrobials and indwelling devices.<sup>2</sup> Because LTACHs are becoming an essential component of the continuum of health care, they play a critical role in the spread of multidrug-resistant organisms (MDROs) across interconnected health care facilities.<sup>3</sup> Despite this, few LTACHs have established ASPs.<sup>4</sup> The aim of this study was to survey the knowledge and attitude of health care personnel (HCP) toward AMR, audit the antimicrobial prescribing practices, and based on the JC's newly mandated standards, describe our experience of successful and sustainable implementation of an ASP at an LTACH in Detroit, Michigan.

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Conflicts of interest: None to report.

## METHODS

The study was conducted at a 76-bed LTACH in metropolitan Detroit, Michigan, and was approved by the ethics committee.

### HCP survey

A 71-item closed-ended paper-based questionnaire was administered to all clinical HCP at the LTACH between August and October 2011 to assess knowledge and attitude of HCP toward AMR. Survey questionnaire included basic demographic information and was comprised of 4 other parts: general knowledge of AMR, prescribing practices, familiarity with MDROs, and interventions that can decrease AMR from the perspective of HCP. The respondents had to use a 5-point Likert scale ranging from strongly agree to strongly disagree, very confident to unsure of what it is, definitely effective to definitely ineffective, or very important to very unimportant, as applicable. For the fourth part of the questionnaire, interventions to decrease AMR were listed, and the respondents selected one that they thought was the most important in decreasing AMR. Survey data were anonymous and could only be accessed by the ASP team.

### Preimplementation phase

A retrospective cohort study was conducted on 88 patients admitted between August 1, 2011, and October 31, 2011. Pharmacy database and patient medical charts were queried to collect information about the empirical antimicrobial therapy started either at an outside facility or at the LTACH, missed opportunities for de-escalation, and duration of therapy. Empirical therapy was defined as the initial antimicrobial treatment anticipated to cover most of the possible pathogens associated with a specific infectious disease syndrome. Missed opportunity for de-escalation was defined as a failed attempt to narrow the antibiotic spectrum after susceptibility data became available. Unnecessary antimicrobial therapy was defined as (1) treatment longer than typical length of therapy and (2) administration of antibiotics for a likely noninfectious disease process. The Infectious Diseases Society of America guidelines, when available, were used as the criteria for the stated variables.<sup>5</sup>

### Intervention: Introduction of the ASP

A biweekly education session was organized for all LTACH staff, particularly targeting the prescribers.<sup>5</sup> During the session we explained the goal of our ASP intervention and provided information on optimal antibiotic prescription practice based on the Infectious Diseases Society of America and Centers for Disease Control and Prevention guidelines. Each educational session lasted 60 minutes and included a video presentation on a relevant topic by a member of the ASP team. Thereafter, interactive educational sessions were conducted monthly to help translate policies into practice and ensure dissemination of data.

On November 1, 2011, an infection control and antimicrobial stewardship team, including an infectious diseases physician, an infection control practitioner, a microbiologist, and a clinical pharmacist, who were all either full-time or part-time LTACH staff, implemented an ASP. The stewardship was a 7-step pyramid approach derived from the Centers for Disease Control and Prevention's 12 Steps to Prevent Antimicrobial Resistance Among Hospitalized Adults.<sup>6</sup> A postprescription approach was used for prospective review and feedback to clinicians by the ASP team. Every week the ASP team reviewed patients receiving antibiotics including indication, duration, adverse events, renal function, and drug allergies. Based on the clinical response, microbiology, and other supporting diagnostic data, a recommendation to either continue, discontinue, or de-escalate

to pathogen-directed therapy was made. The decision was communicated to the primary team by phone and a notation in a patient's medical chart. Changes in dosage and route of administration were also recommended whenever needed. The decision to follow the recommendations rested with the primary team, but overall, >90% of the recommendations were followed and implemented within 24 hours of notification.

### Postimplementation phase

#### Phase 1

The primary outcome was to evaluate the impact of the ASP intervention on antimicrobial usage. A postimplementation assessment was performed from December 2011 to February 2012 for the 2 most commonly used antimicrobials. The difference in usage and costs between the pre- and postintervention phases was calculated.

#### Phase 2

The secondary outcome was demonstration of sustainability of the program. Based on the Centers for Disease Control and Prevention's 12 Steps to Prevent Antimicrobial Resistance Among Hospitalized Adults, antimicrobial costs is one of the outcomes measured in the ASP.<sup>6</sup> Cost analysis of all antibiotics was done for years 2016 and 2017. Twenty-eight patients in a period of 3 months from January-March were randomly selected from each of the 2 years, as was done in the preintervention period.

### Statistical analysis

Descriptive analyses were conducted using IBM SPSS Statistics 22 (SPSS, Chicago, IL). Percentages were reported only when the denominator was >100. Cost of drugs was obtained from the drug formulary at the LTACH and calculated based on the unit acquisition price multiplied by the number of doses.

## RESULTS

### HCP survey

Twenty-six HCP, including physicians, physician assistants, nurses, nurse practitioners, pharmacists, and infection control practitioners, participated in the survey. Seventeen HCP strongly agreed that AMR was a national problem, 16 strongly agreed that it was a problem in long-term care facilities, and 10 strongly agreed that it was a problem at their facility.

Twenty-one respondents were familiar with infections caused by methicillin-resistant *Staphylococcus aureus* and vancomycin-resistant enterococci. Twenty-two and 21 were familiar with infections caused by extended-spectrum  $\beta$ -lactamase and *Klebsiella pneumoniae* carbapenemase producers, respectively. Only 9 respondents expressed their confidence in caring for patients with methicillin-resistant *S aureus*, vancomycin-resistant enterococci, and extended-spectrum  $\beta$ -lactamase organisms, and 7 were confident in caring for patients infected with *K pneumoniae* carbapenemase organisms.

Nineteen respondents described overprescribing of antibiotics as a very important cause of AMR. The top 2 avenues reported by HCP to decrease AMR were improving providers' knowledge of antibiotic use and receiving routine advice from a pharmacist or an infectious diseases specialist.

### Antimicrobial prescribing in the preimplementation phase

Of 88 patients admitted in the preimplementation phase, 28 were randomly selected. The cohort received a total of 54 courses of

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