Impact of Antimicrobial Stewardship on Outcomes in Hospitalized Veterans With Pneumonia

Kari E. Kurtzhalts, PharmD[1]; John A. Sellick Jr, DO, MS[1,2]; Christine A. Ruh, PharmD, BCPS[4]; James F. Carbo, PharmD[1,3]; Michael C. Ott, PharmD, BCPS[4]; and Kari A. Mergenhagen, PharmD, BCPS AQ-ID[1]

[1]Infectious Diseases Department, Veterans Affairs Western New York Healthcare System, Buffalo, New York; [2]University at Buffalo School of Medicine, The State University of New York, Buffalo, New York; [3]Veterans Affairs Southern Nevada Healthcare System, North Las Vegas, Nevada; and [4]Pharmacy Department, Erie County Medical Center, Buffalo, New York

ABSTRACT

Purpose: The purpose of this study was to evaluate the impact of an antimicrobial stewardship program (ASP) on outcomes for inpatients with pneumonia, including length of stay, treatment duration, and 30-day readmission rates.

Methods: A retrospective chart review comparing outcomes of veterans admitted with pneumonia before (2005–2006) and after (2013–2014) implementation of an ASP was conducted; pneumonia was defined according to *International Classification of Diseases, Ninth Revision* (ICD-9) codes. Infectious diseases physicians and pharmacist in the ASP provided appropriate recommendations to the primary medicine teams. Bivariate analysis of baseline characteristics and comorbid conditions were performed between the time frames. Least squares regression was used to analyze length of stay, time of IV to PO conversions, and duration of antibiotics. Multivariate logistic regressions were used to determine odds of 30-day readmission and odds of *Clostridium difficile* infections between time periods.

Findings: There were 86 patients in the pre-ASP period and 88 patients in the ASP period. Mean length of stay decreased from 8.1 to 6.6 days ($P = 0.02$), total duration of antibiotic therapy decreased from 12 to 8.5 days ($P < 0.0001$), and time of IV to PO antibiotic conversions decreased from 5.3 to 3.9 days ($P = 0.0003$), before ASP and during ASP, respectively. The odds ratio of 30-day readmission before ASP was 2.78 and 0.36 during the ASP ($P = 0.05$). The odds ratios of *Clostridium difficile* infections before ASP was 2.08 and 0.48 during the ASP ($P = 0.37$).

Implications: The ASP interventions were associated with shorter durations of therapy, shorter lengths of stay, and lower rates of readmission and *Clostridium difficile* infections within 30 days. Limitations of this study are retrospective cohort design, small study population, limited study population diversity, and non-concurrent cohort times periods. (*Clin Ther.* 2016;38:1750–1758) Published by Elsevier HS Journals, Inc.

Key words: antimicrobial stewardship, patient-centered, pneumonia, readmission.

INTRODUCTION

Pneumonia is one of the leading causes of death in the United States, accounting for 57,000 deaths in 2013.[1,2] Worsening antibiotic resistance and multidrug resistant (MDR) organisms may be linked to death and poor treatment outcomes.[3–9] Health care exposure, inappropriate use of antibiotics at institutions, and overprescribing of antibiotics in the community are some factors associated with development of MDR organisms and antibiotic resistance.[10–14] Antibiotic resistance can result in other negative outcomes such as increased length of hospital stay (LOS), prolonged treatment duration, and development of *Clostridium difficile* infections.[15–17]

The use of antimicrobial stewardship programs (ASPs) in health care facilities has been encouraged

Accepted for publication June 1, 2016.
http://dx.doi.org/10.1016/j.clinthera.2016.06.004
0149-2918/$ - see front matter
Published by Elsevier HS Journals, Inc.

as an important tool in improving and preserving antibiotic susceptibilities, along with improving patient care and health care outcomes.[18] In 2007 the Infectious Disease Society of America (IDSA) and the Society of Healthcare Epidemiology of America published guidelines that laid foundations to aid institutions in developing ASPs.[18] The IDSA updated these guidelines in 2016 with recommendations for the implementation and measurement of the success of these ASPs.[19] These guidelines recommend that antimicrobial stewardship teams consist of collaboration between infectious disease (ID) physicians and ID-specialized clinical pharmacists.

Since then, ASPs have emerged in facilities across the country and have improved antimicrobial utilization, decreased treatment durations, and reduced treatment costs.[20–22] In 2009 the Veteran's Affairs Healthcare System in Buffalo, New York, began their ASP team with an ID-specialized clinical pharmacist and a team of ID physicians. This ASP uses a patient-centered approach. Automated protocols are not used, and the ID pharmacist performs daily chart reviews for each patient on IV antibiotics. The goal of this study was to address the impact our ASP has had on the outcomes of pneumonia treatment, including LOS, duration of antibiotic treatment, time of IV to PO antibiotic conversion, 30-day hospital readmissions, and occurrence of *C difficile* infections. Interventions of the ASP were characterized as secondary objectives.

PATIENTS AND METHODS

This single-centered retrospective cohort study took place at the Veterans Affairs Western New York Healthcare System (VAWNYHCS), which is a 150-bed level 1b facility. The institutional review board approved this study. Patient information was collected for patients who were hospitalized and received antibiotics for pneumonia during a 1-year period before the facility's ASP was initiated and during a 1-year period after the program had been well established. The pre-ASP group consisted of the period of time between June 1, 2005 and June 1, 2006, and between June 1, 2013, and June 1, 2014, for the ASP group. Patients must have had a primary diagnosis of pneumonia, based on *International Classification of Diseases, Ninth Revision* (ICD-9) codes (507, 486, 518, 381, 482, 481, 038.9) to be included in this study; both general ward and patients in the intensive care unit were included. Exclusion criteria included death on discharge after being placed on comfort care measures, <48 hours of inpatient admission or inpatient antibiotics, lung abscess, empyema, necrotizing pneumonia, having a thoracentesis, severe immunosuppression, concurrent extra-pulmonary source of infection (such as endocarditis, urinary tract infection, meningitis, etc), and if there was no documented duration of therapy (ie, lost to follow-up). The VAWNYHCS is a vertical health care system, providing both outpatient and inpatient care to patients, which allowed us to accurately follow treatment both while the patients were hospitalized and after discharge.

Definitions

Patients were considered to be immunosuppressed if they had systemic chemotherapy within 28 days of admission, HIV infection/AIDS, solid organ or bone marrow transplant, or absolute neutrophil count of <1500 cells within 28 days of admission. Morbidity was calculated using the Charlson Comorbidity Score.[23] Severity of illness was calculated by using the CURB-65 (confusion, uremia, elevated respiratory rate, low blood pressure, and age $\geq$ 65 years) score. The CURB-65 score was used to determine level of illness severity on admission for patients with community-acquired pneumonia (CAP) and for health care-associated pneumonia (HCAP).[24,25] A patient was considered to have HCAP if he or she met the following criteria on admission: either acute hospitalization for >2 days or long-term care facility residence within 90 days of admission, or any of the following within 28 days of admission: chronic hemodialysis, antibiotics, wound care, tracheotomy, ventilator, or aspiration.[26]

Antimicrobial Stewardship

The antimicrobial stewardship team consists of ID physicians and a clinical ID pharmacist with added qualifications in IDs. The ASP is patient centered, using individualized patient care by daily chart reviews. Select antibiotics were restricted, requiring approval by the ID team for use. These restrictions were in place before the ASP was established. Each morning a report is printed of all hospitalized patients on IV antibiotics, and the ASP then reviews each patient's chart to assess appropriateness of antibiotic therapy. Interventions consist of prospective audit and feedback regarding antibiotic selection, microbiology,