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Major Article

Dramatic effects of a new antimicrobial stewardship program in a rural community hospital

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Background: New Joint Commission antimicrobial stewardship requirements took effect on January 1, 2017, promoted as a central strategy for coping with the emerging problems of antimicrobial resistance and *Clostridium difficile* infection. Our objective was to measure the effects of a new antimicrobial stewardship program (ASP) in a rural community hospital with no prior ASP, in the context of having a new infectious disease specialist on staff.

Methods: An ASP team was formed to implement a prospective audit with health care provider feedback and targeting 12 antimicrobial agents in a rural hospital in Georgia. An educational grand rounds lecture series was provided before implementation of the ASP to all prescribers. After implementation, algorithms to aid the selection of empirical antibiotics for specific infectious disease syndromes based on local antibiograms were provided to prescribers to improve this selection. Rates of *C difficile* infections, total targeted antimicrobial costs, and drug utilization rates were calculated for 1 year pre-ASP implementation (2013) and 1 year post-ASP implementation (October 2014-December 2015).

Results: The patient safety metric of *C difficile* infections decreased from 3.35 cases per 1,000 occupied bed days (OBDs) in 2013 to 1.35 cases per 1,000 OBDs in 2015. Total targeted antimicrobial costs decreased 50% from $16.93 per patient day in 2013 to $8.44 per patient day in 2015. Overall antimicrobial use decreased 10% from before the ASP initiative to 1 year after it. Annualized savings were $280,000 in 1 year, based on drug savings only.

Conclusions: Judicious use of antimicrobials and resources can improve a patient safety metric and decrease costs dramatically in rural institutions where the average hospital census is <100 patients per day. The savings would allow the institutions to spend better while improving the use of antimicrobials.

New Joint Commission antimicrobial stewardship requirements took effect on January 1, 2017.[1] The requirements apply to community hospitals and critical access hospitals and stem from the anticipated final rule by the Centers for Medicare and Medicaid Services (CMS), which will require antimicrobial stewardship programs (ASPs) as a condition of CMS participation in 2017.[2] This government mandate is promoted as a central strategy for coping with the emerging problems of antimicrobial resistance and *Clostridium difficile* infection (CDI). The approach on how to implement an ASP depends on many factors, including need for an infectious disease (ID) consultant, an ID-trained pharmacist, or a person with a doctor of pharmacy degree, or a combination of these; institution size; composition of the providers; and resources provided by the institutional leadership. Little data exist from community hospitals with low daily patient census about the outcomes of ASPs. Our objective was to measure the effects of a new ASP in a rural community hospital with an average occupied bed census of <100.

METHODS

In 2013, our institution assumed operations of a rural health system in Georgia. Its average daily census typically was <100 patients. An ID physician, who joined the staff in the beginning of the second quarter of 2014, championed the implementation of a new ASP to reduce the occurrence of antibiotic resistance and unnecessary

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adverse effects, such as CDI. A work group was created that included infection prevention nurses, a microbiology supervisor, and 2 lead pharmacists (neither with specialty training in IDs). The ID physician led clinical topics of discussion at biweekly meetings and fostered the ASP implementation to various hospital committees, whose approval was required before implementation at the rural hospital, including its medical executive governing bodies.

The constituency and content of the ASP was adopted from the Infectious Diseases Society of America and the Society for Healthcare Epidemiology of America guidelines issued in 2007.[3] Revision of the guidelines was published in 2016.[4] The ASP focused on a core strategy of a postprescriptive audit with intervention and feedback. A targeted list of antimicrobial agents was developed from use and cost criteria plus local antibiograms from 2012 and 2013. In total, 12 antimicrobials were selected to be prospectively audited on indications for use. The agents were collectively referred to as targeted antimicrobial agents and were amikacin, aztreonam, cefepime, ceftaroline, daptomycin, doripenem, ertapenem, fosfomycin, imipenem, linezolid, meropenem, and tigecycline. No formulary restriction and preauthorization were used for the targeted antimicrobial agents. ASP intervention included a pre-ASP implementation education lecture series and the dissemination of clinical guidelines and algorithms on advised antibiotic use for specific ID syndromes. The intervention did not include strategies to limit antibiotic therapy to the shortest effective duration.

The 12 targeted antimicrobials were reviewed when the provider's indication for use of the given antimicrobial was not delineated in the prescription order or was deemed not appropriate after review by a clinical pharmacist and the ID physician. A provider was able to order an initial 72-hour course of antimicrobial therapy while awaiting microbiologic data to aid in pathogen-targeted antimicrobial selection and therapy de-escalation. At the time of computerized order entry, a message alerted the prescriber that the medication was targeted to be monitored and required an indication for use. Daily, the clinical pharmacist reviewed, with the ID specialist's supervision, the active list generated by the medical information system (Meditech version 5.65; Medical Information Technology, Westwood, MA) for appropriate empirical antibiotic selection. The clinical pharmacist contacted the ordering provider as soon as possible after the order was generated if the indication was deemed inappropriate after discussion with the ID physician.

Education was an integral component of the ASP. The ID specialist joined the hospital staff on April 1, 2014. Since an ASP did not exist at the hospital before October 1, 2014, a grand rounds series on antimicrobials was given by the ID specialist before the ASP initiation from July 1-September 31, 2014. The ID clinical guidelines and algorithms of empirical antimicrobial recommendations for specific ID syndromes were disseminated to all prescribers who attended the lectures. After ASP implementation, prescribers received direct, personalized communication about how they could improve antimicrobial prescribing after review of indications and health records of the patients by the pharmacist, under the supervision of the ID specialist. This intervention occurred immediately after the prescription was generated in the electronic health record, except during late evening hours. Those late orders would be reviewed at the beginning of the next day. The pharmacist discussed the recommendations with the ID specialist before communicating with the prescriber. If needed, the ID specialist was available for further discussion of the case. As microbiologic data were reported, or at a 72-hour point after starting empirical antimicrobial therapy (whichever occurred first), a second review to de-escalate the antimicrobial effect was done by the ID specialist. Antimicrobial dose optimization was the responsibility of the clinical pharmacists during each shift, which was an established clinical practice before ASP implementation.

The outcome of the interaction between pharmacist and ordering provider was documented in a software application (TheraDoc; Premier, Charlotte, NC). However, compliance with recommendations was not the end point in the ASP initiative, but rather the patient safety metric, utilization rates, and cost. De-escalation and streamlining of antimicrobial use was done by the ID provider (ie, not the pharmacist or doctor of pharmacy) after review of microbiologic data and the clinical record, as previously described. If an intervention was indicated, the ID physician spoke with the provider caring for that patient about the data, rendering guidance in antimicrobial selection and de-escalation.

No additional training was provided to the clinical pharmacist other than ongoing daily education during case discussion between the clinical pharmacist and the ID physician. The institution granted a 0.25 full-time equivalent position for the ID physician, who was a hospital employee. No additional clinical pharmacists were hired to participate in the program.

Data from January 1, 2013-September 30, 2014, on usage of these 12 targeted antimicrobial agents were used for comparison with the post-ASP initiation time of October 1, 2014-December 31, 2015. A technical unit of measurement was created to compare antibiotic consumption, called defined daily dose (DDD). The data of DDDs per 1,000 patient days (PDs) were analyzed. The DDD defined the assumed average maintenance daily dose for a day, used for its main indication in adults and assigned by the World Health Organization Collaborating Centre using established principles. Similarly, cost comparisons were conducted for the 12 agents before and after ASP implementation. Because of limited resources to calculate costs, cost data were compared quarterly, not monthly. The chosen quality safety metric was CDI reduction.

RESULTS

Nosocomial CDI rate declined from 3.35 cases per 1,000 occupied bed days (OBDs) at the end of the fourth quarter in 2013 to 1.35 cases per 1,000 OBDs at the end of the fourth quarter in 2015 (difference between rates, 2.0 cases per 1,000 OBDs; 95% confidence interval [CI], 0.62-3.39 cases; $P < .001$). Figure 1 shows the actual quarterly number of inpatient CDIs for 2 years. A 6-month rolling average of inpatient CDIs and a regression line show the trend

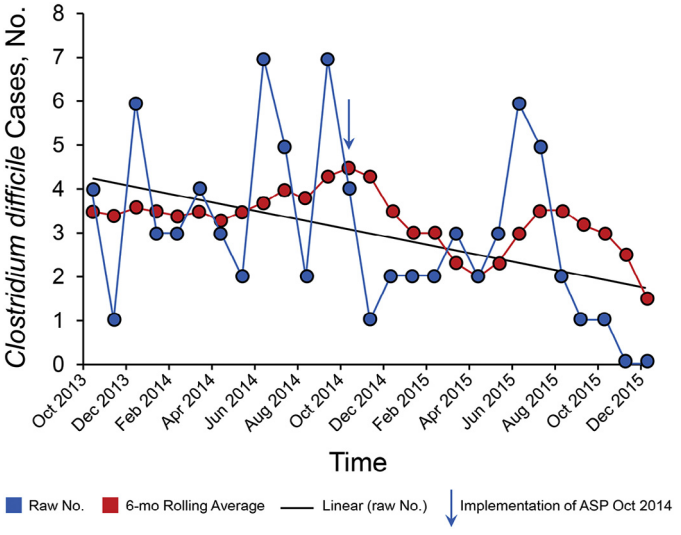

Fig 1. Inpatient *Clostridium difficile* infection rate for a 6-month rolling average and linear regression. *ASP*, antimicrobial stewardship program.