Establishing Antibiotic Stewardship Programs in Rural Hospitals to Decrease Fluoroquinolone Prescribing: The Vermont Experience

Lindsay M. Smitha,*, John W. Ahernb

a Division of Infectious Diseases, University of Vermont Medical Center, USA
b Department of Pharmacy, University of Vermont Medical Center, USA

SUMMARY

Critical access and rural community hospitals struggle to develop effective antimicrobial stewardship programs (ASPs). We assisted six Vermont hospitals in developing their antimicrobial stewardship programs to meet the Centers for Disease Control and Prevention’s core elements of antibiotic stewardship. We show that rural hospitals in Vermont can (1) extract antimicrobial use data from their electronic medical record; (2) develop interventions to decrease high use antimicrobial agents, such as fluoroquinolones; and (3) successfully develop sustained ASPs meeting the CDC core elements in less than 2 years.

* Corresponding author. Address: Lindsay M. Smith, 111 Colchester Ave, Mailstop 115 SM2, Burlington, VT 05401 1-802-847-6058, USA. E-mail address: Lindsay.Smith@uvmhealth.org (L.M. Smith).
7. Education: Educating clinicians about resistance and optimal prescribing.

Critical access and rural community hospitals have struggled with developing effective ASPs [3]. Critical access hospitals, typically not affiliated with medical schools, have < 25 inpatient beds, are located > 35 miles from another hospital, have an average length of stay < 96 hours, and provide 24 hour emergency care services—features intended to improve healthcare access in rural communities. Between 2014 – 2015, only 7% of Vermont hospitals had ASPs that met all 7 core elements [4]. Vermont is the second-least populous state in the US, with approximately 625,000 residents, and the highest proportion of residents living in rural areas [5,6]. There are 15 hospitals in Vermont, which include eight critical access hospitals, five community hospitals, one Veterans Affairs hospital, and one academic medical centre. Five hospitals have infectious diseases physicians (12 at the academic medical centre and one at two of the community hospitals and one at the Veterans Affairs hospital) and the academic medical centre has one Infectious diseases trained pharmacist.

In 2017 the Joint Commission and in 2019 the Centre for Medicare and Medicaid Services required all hospitals, regardless of size, to implement ASPs. Many ASPs seek to reduce fluoroquinolone (FQ) prescribing due to the risk of drug-drug interactions, *Clostridioides difficile* infection, and five black box warnings from the Federal Drug Administration [7]. Successful ASPs are well structured, analyse antimicrobial use (AU) data regularly, and perform interventions that fit within the culture of the hospital in order to improve antibiotic prescribing. This paper describes a pragmatic effort to establish inpatient antimicrobial stewardship programs in rural Vermont hospitals. Our goal is to share our experience so that others who practice in a similar setting may benefit.

### Methods

We, an infectious diseases physician and pharmacist who run the ASP at the University of Vermont Medical Centre (Vermont’s largest hospital), contracted with the Vermont Department of Health to assist rural Vermont hospitals in developing ASPs that comply with the CDC CEAS. Six of 15 hospitals were recruited between June and December 2017 and were chosen due to lack of Infectious Disease trained physicians and pharmacists. Four have critical access designation.

Ten meetings per hospital were arranged over the 30 month time period. All attempts were made at having in-person meetings, but some were changed to teleconferencing due to inclement weather.

During the first meeting, current stewardship activities were assessed; none of the hospitals were able to fulfill all seven CEAS. Initially, all hospitals identified a pharmacist to aid in stewardship efforts. The hospitals were tasked with recruiting all necessary ASP members, including a physician champion, infection preventionist, microbiologist, and information technology specialist and to start collecting antibiotic usage (AU) data. Each hospital obtained AU data in grams (g)/1000 (1k) patient-days (PD) from their electronic medical record (EMR), starting from January 2017. Additionally, each was asked for a letter of support for antimicrobial stewardship from the hospital administration.

During the second meeting, AU data were reviewed and all hospitals identified FQ as frequently prescribed antimicrobials. Ciprofloxacin and levofloxacin are the only FQs on formulary at each hospital with one hospital only having levofloxacin. Next, ASPs were charged with performing a medication utilization evaluation (MUE) to determine how FQs were being prescribed. The MUE data were reviewed and appropriate criteria for FQ utilization were defined for each hospital. These criteria were subsequently disseminated to their clinical staff.

Subsequent meeting agendas included reviewing past accomplishments, local AU data, and hospital-to-hospital AU data comparisons. Next, hospitals were tasked with creating an antibiogram. This information was then used to create syndrome-specific empirical antibiotic use guides. Hospitals were also tasked with designing an antibiotic time out that could be easily incorporated into their workflow, fulfilling the action core element.

Meetings in the second year of the contract were used to perform repeat MUEs of FQs to ensure proper adherence to the newly developed use guidelines, new MUEs for piperacillin-tazobactam and vancomycin, and updated order sets to reflect new clinical practice guidelines, particularly for community acquired pneumonia. The final meetings were used to discuss the updated CDC CEAS of 2019 and how the individual ASPs can become self-sustaining.

From January 2017 – December 2019, monthly AU data were collected in for each hospital. To assess the impact of ASP interventions, ciprofloxacin and levofloxacin AU data were analysed using Stata version 16.1 software (SataCorp, College

### Table I

Core elements of antibiotic stewardship successfully implemented in six Vermont hospitals

| CDC core elements                  | Critical access hospital 1 | Critical access hospital 2 | Rural community hospital 3 | Critical access hospital 4 | Rural community hospital 5 | Critical access hospital 6 |
|------------------------------------|----------------------------|---------------------------|---------------------------|----------------------------|---------------------------|----------------------------|
| Leadership                         |                           |                           |                          |                            |                           |                            |
| Accountability                     | ✔                         | ✔                         | ✔                         |                            |                           |                            |
| Drug expertise                     | ✔                         | ✔                         | ✔                         |                            |                           |                            |
| Action (time-out)                  | ✔                         | ✔                         | ✔                         |                            |                           |                            |
| Tracking                           | ✔                         | ✔                         | ✔                         |                            |                           |                            |
| Reporting                          | ✔                         | ✔                         | ✔                         |                            |                           |                            |
| Education                          | ✔                         | ✔                         | ✔                         |                            |                           |                            |

*: Compliance.

**: previously compliant, now not reliable.
Results

By the end of the 30 month contract period, three of the six hospitals created and sustained ASPs that met all of the CEAS (Table I). All hospitals initially had senior leadership support for antimicrobial stewardship and received letters of support. Three hospitals were unable to have sustained physician and pharmacist leaders and two were not able to track AU data on a consistent basis. All hospitals were able to fulfill the education element, primarily by utilizing the authors as speakers for Grand Rounds or developing online learning modules about antimicrobial stewardship. Five of the six hospitals were able to implement an antibiotic time out as an action item. Time outs were led by pharmacists or infection preventionists at least three times per week and were incorporated into multidisciplinary rounds. Five hospitals fulfilled the reporting element with ASP updates at medical staff meetings or with an email newsletter. One hospital was featured on a local television news channel for their ASP successes.

Each hospital had unique interventions to decrease FQ prescribing, including order set changes and pharmacist intervention. For example, several hospitals removed levofloxacin from community acquired pneumonia admission EMR order sets. Others empowered pharmacists to ask clinicians to choose other antimicrobials if FQs were prescribed for indications that were not previously agreed upon. All hospitals successfully decreased FQ prescribing. Prior to implementing ASPs, there was a combined FQ rate of 69g/1K PD. After 24 months of ASP interventions, combined FQ prescribing decreased to 25g/1K PD (Figure 1, R² = 0.8794, p<0.001). This trend was also significant for each individual FQ: ciprofloxacin (R² = 0.41, p<0.05) and levofloxacin (R² = 0.93, p<0.01).

Discussion

ASP's can be successfully implemented in rural critical access and small community hospitals that deliver sustainable impacts on antibiotic prescribing. The systematic approach of assessing needs, assessing AU data, developing hospital-specific interventions, and ongoing assessment of AU data is successful in decreasing FQ use. This approach can be used to influence prescribing of all antimicrobials and would likely transition well to non-hospital based settings, such as long term care facilities and outpatient clinics.

Even though all hospitals were not able to consistently meet the CEAS, they were all able to consistently and sustainably decrease FQ prescribing. In a two year period the amount of fluoroquinolones prescribed in six of Vermont hospitals decreased by 64%. The largest impact was the reduction of levofloxacin prescribing, as it was more often prescribed at baseline than ciprofloxacin. Additionally, we found it easier to change the prescribing practice of levofloxacin for community acquired pneumonia, the main use of levofloxacin prior to ASP interventions. We suspect that with additional time, a focus on urinary tract and intra-abdominal infections, which result in a greater decrease in ciprofloxacin prescribing. During the study period we did notice an increase in ceftriaxone prescribing with a shift away from FQ prescribing.

A major limitation of the initial development of ASPs in rural hospitals was that none of the hospitals at the start were able to extract AU data. It took each hospital nearly six months to work with their IT departments to build programs to extract and aggregate AU data. While we would have preferred to collect AU data in defined daily doses, this additional calculation would have placed an additional burden on an already stressed IT team. Therefore, in order to have comparable AU data between hospitals, we collected AU data in g/1k PD.

We found that rural community and critical access hospitals have advantages and challenges when developing ASPs, unique from those of large academic medical centres. Advantages include: 1) smaller institutional bureaucracies that allow for more rapid implementation of initiatives; 2) fewer providers so that education can be focused and tailored; 3) hospital staff familiarity so that teamwork is facilitated. Disadvantages include: 1) lack of protected antimicrobial stewardship time for physicians and pharmacists; 2) Local EMRs limitations that can make AU data extraction difficult; 3) hospital financial challenges that contribute to high physician and pharmacist turnover which leads to lack of antimicrobial stewardship prioritization; 4) Frequent use of locum tenens physicians that necessitates increased education around hospital-specific ASP policies; 5) use of off-site microbiology laboratories contributes to delayed culture reporting; and 6) work flows and

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Figure 1. Fluoroquinolone Administration in 6 Vermont Hospitals After Implementing Antibiotic Stewardship Programs.
philosophies that are not conducive to prior authorization for antibiotic prescribing.

The most successful ASPs had full support of senior hospital leadership and committed physicians and pharmacists. They frequently had an Emergency Medicine physician and Chief Medical Officer present for ASP meetings. Hospitals that struggled to meet the CEAS had leadership that did not view antimicrobial stewardship as an institutional priority and had financial instability leading to high turnover of physicians and pharmacists. We feel that the key to developing a successful ASP at rural locations is to have full support from the senior hospital leadership, as this is necessary to promote an institutional culture that is conducive to antimicrobial stewardship.

Author credit statement

Lindsay Smith and John Ahern contributed equally in the development and implementation of this project and in the writing of the manuscript.

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Conflict of interest statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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