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Restriction-free antimicrobial stewardship initiative targeting fluoroquinolone reduction across a regional health-system

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SUMMARY

Background: Fluoroquinolone (FQ) antibiotics have become a target of many antimicrobial stewardship programmes. Multiple post-marketing warnings from the Food and Drug Administration caution against use of this drug class for certain infections due to risk of harmful adverse effects outweighing benefit. Commonly employed strategies to affect antibiotic prescribing can be restrictive and without improvement in overall antibiotic appropriateness or decrease in collateral damage.
Aim: To develop a strategy for sustainable optimization of FQ antibiotics.
Setting: Multi-state health-system of 14 hospitals and medical centers.
Methods: The health-system antimicrobial stewardship program identified the opportunity to improve FQ utilization. In collaboration with our data and analytics team, specific targets of FQ use in pneumonia and chronic obstructive pulmonary disease were established. Face-to-face provider education and prospective audit and feedback were the mainstays of the campaign. Enhancements to the electronic medical record to support the initiative were also implemented.
Findings: There was an overall decrease in FQ utilization by 56.9%. For pneumonia use of FQs decreased from 16.4% to 8.1% and in COPD changed from 29.6% to 9.7% over the same time period.
Conclusions: A non-restrictive FQ optimization initiative based on education and feedback decreased both FQ consumption and total antibiotic use across a large multi-hospital health-system.

Introduction

The Infectious Diseases Society of America (IDSA) has recommended that hospitals adopt an antimicrobial stewardship program (ASP) as a means of overseeing antibiotic use within hospitals. [1].

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With the goal of improving antibiotic use, fluoroquinolones (FQ) have become a target of interest for many institutions. Safety risks of the fluoroquinolone drug class are a growing concern. Dating back to 2008, multiple warnings and statements from the Food and Drug Administration have been released. They highlight safety and risks of adverse effects ranging from tendon rupture, peripheral neuropathy, central nervous system effects, hypoglycemia, and aortic dissection. [2–4] Because of these safety concerns along with waning susceptibilities across the health-system, FQ reduction was identified as a target for the ASP at Novant Health.

IDSA guidelines on implementation of an ASP identify two core approaches to improve prescribing practices: prior authorization (PA) and prospective audit and feedback (PAF). Published studies reporting on FQ restrictions have shown them to be effective in stabilizing or improving rates of bacterial resistance and *Clostridioides difficile* infection (CDI). [5–9] Restriction alone may be insufficient if not implemented in conjunction with robust stewardship interventions, including education. [6–10] This article presents the results of a multi-state health-system initiative to reduce FQs by using a comprehensive education-based strategy without the use of restriction.

Methods

Novant Health is a multi-state, integrated health-system of physician practices, hospitals, and outpatient centers. It includes 14 hospitals and medical centers ranging in size from 36 to 950 beds. In 2016 the Pharmacy Infectious Diseases (ID) service line was expanded to include antimicrobial stewardship coverage for all facilities with 6 FTE for infectious diseases-trained pharmacists and one FTE for an antimicrobial stewardship clinical manager. The health-system ASP consists of ID pharmacists, a clinical pharmacy manager, and a physician chair.

The opportunity to improve FQ utilization was determined by the system-wide ASP. The early stages of the initiative started by fostering strategic executive medical staff sponsorship. Formal planning began with the ID Pharmacy team in autumn 2016 (Figure 1). In collaboration with our data and analytics team it was determined that pneumonia (PNA) and chronic obstructive pulmonary disease (COPD) were feasible disease states to track via measurement of diagnosis related groups (DRGs).

The ASP established a FQ use goal in PNA based on a manual chart review. Of the patients reviewed, only 14.3% of FQ use was considered appropriate based on allergy profile, culture data, and/or detection of *Legionella* species. A separate evaluation of PNA DRG patients showed that 17.7% of patients were treated with a FQ. Applying the 14.3% appropriateness finding, it was determined that 2.5% of FQ represents the lowest possible FQ utilization within the DRG at our health-system. A conservative goal of <5% was set. Baseline FQ use in COPD (%COPD) was nearly 30% of all antibiotics ordered. Due to the inherent limitations using DRG-derived data, which do not distinguish between COPD with or without major complications, a goal of <10% was set. Total FQ consumption was tracked, however a goal for overall reduction was not established at baseline. The initiative was presented to ASP members in November 2016 for endorsement, followed by the Pharmacy and Therapeutics Committee in January 2017.

Both PAF and face-to-face education strategies were utilized to inform providers across the health-system of this initiative. PAF was provided by ID pharmacists during 48-hour antibiotic order review by either verbal or electronic methods. Written communication was left to providers that detailed specific alternative therapy recommendations, optimal duration, and highlighted risks of FQ use. Face-to-face education was provided to internal medicine, emergency medicine, urology, and gastroenterology service lines. The internal medicine group was noted to account for approximately 87% of antibiotic orders within the PNA and COPD DRGs. Clinician education focused on institutional antibiogram trends, FDA safety warnings, and alternatives to FQs for PNA and COPD. Similar information was provided to decentralized and

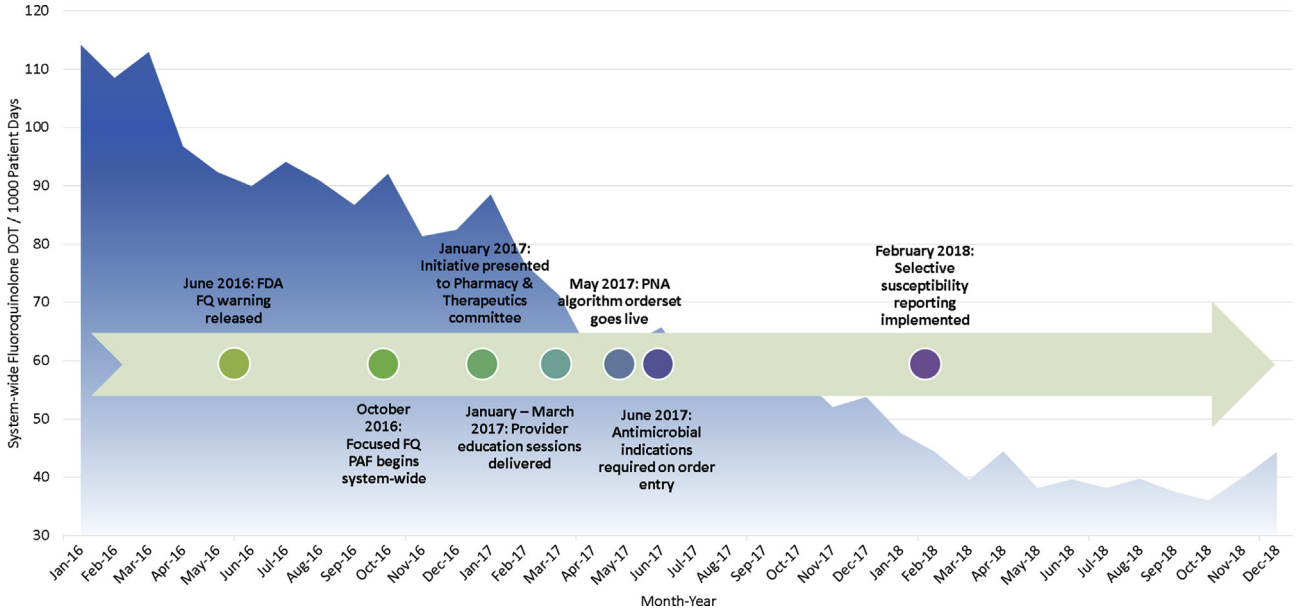

Figure 1. Timeline of individual interventions and corresponding system-wide FQ consumption.

verification pharmacists across the healthcare system to encourage reinforcement to providers at the point of order entry or on rounds. Periodic updates on facility-level progress towards goal use were reported to ASP members and key stakeholder groups at regular intervals with re-education provided as needed.

Novant Health utilizes Epic (Epic Systems Corporation, Verona, WI) electronic health record system, where modifications were made to aid ASP efforts, including requiring indications for antimicrobial orders and optimization an existing PNA order set. The PNA algorithm is integrated into the electronic medical record (EMR) and requires physician evaluation of risk factors for community-acquired pneumonia drug-resistant pathogens. Patients at low-risk receive a FQ only if they have a severe beta-lactam allergy. Selective susceptibility reporting was implemented to hide results for all-source *Enterobacteriaceae* cultures if specified antibiotic agents were susceptible. Any result of intermediate or resistant was reported.

The primary outcomes for this initiative were changes in FQ utilization in PNA and COPD DRGs. Secondary outcome was change in overall FQ use. Antibiotic utilization was measured using days of therapy (DOT) per 1000 patient-days. For DRG-specific metrics, %PNA and %COPD refer to the proportion of FQ utilization relative to all antibiotic use. These data were made available at the facility and system level. All data were collected and metrics calculated by the data and analytics team. Approval by the Institutional Review Board was not required for providing de-identified data.

Results

For pneumonia-related diagnoses, the baseline rate of FQ use was 16.4% in 2016, which decreased to 8.1% for 2017, and further declined to 6.2% for 2018 (Figure 2). This represents a change of 62.5% from baseline. There was no change in pneumonia readmission rate (-0.02%). Similarly for COPD-related diagnoses, FQ use relative to all antibiotic use was 29.6% in 2016, 14.3% for the following year, with 2018 use at 9.7% in 2018. The difference from baseline was a 67.1% decrease.

In 2016 the total system-wide FQ utilization was 94.9 DOT per 1000 patient-days. In 2017, utilization was 63.5 DOT per 1000 patient-days. The health-system continued to see a decrease in total FQ use to 40.9 DOT per 1000 patient-days in 2018, reflecting a change of 56.9% from baseline (Figure 3).

During 2016 the health-system consumed a total of 822.4 DOT per 1000 patient-days for all antimicrobials. There was nominal change in 2017 to 828.6 DOT per 1000 patient-days. However in 2018 total consumption decreased by 13.4% to 717.4 DOT per 1000 patient-days.

Discussion

Over a 2-year period, our ASP led an initiative that reduced FQ consumption across a 14-hospital health-system. Other FQ optimizing studies have focused on restrictive policies. [10] Here we describe a restriction-free multifaceted approach to FQ reduction based on sustained education. Both PA and PAF are supported by the Centers for Disease Control and Prevention and have been shown to reduce antibiotic consumption and antimicrobial resistance without negative effects on patient outcomes. [11,12] We preferred to utilize PAF over PA due to our belief that provider education is paramount to the longevity of successful stewardship initiatives. PAF facilitates provision of education while maintaining provider autonomy, as well as discussion of patient-specific considerations that may not be apparent in the EMR. This approach allows for continual education with limited disruption to the provider.

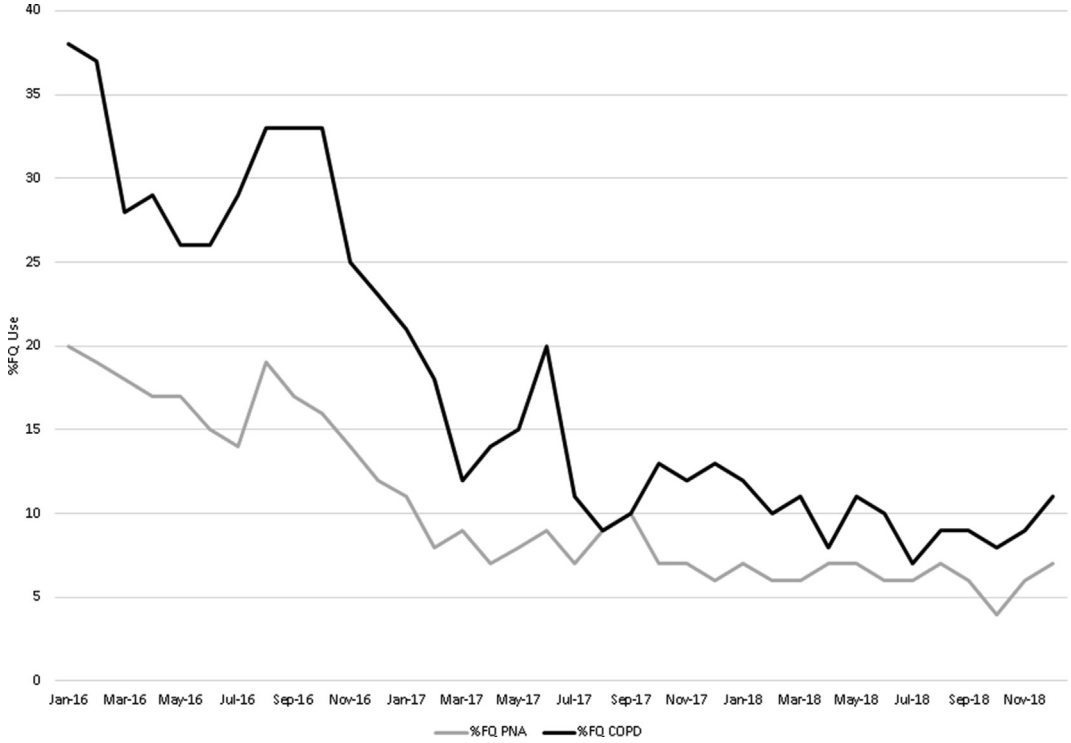

Figure 2. FQ utilization within pneumonia and COPD diagnosis-related groups.

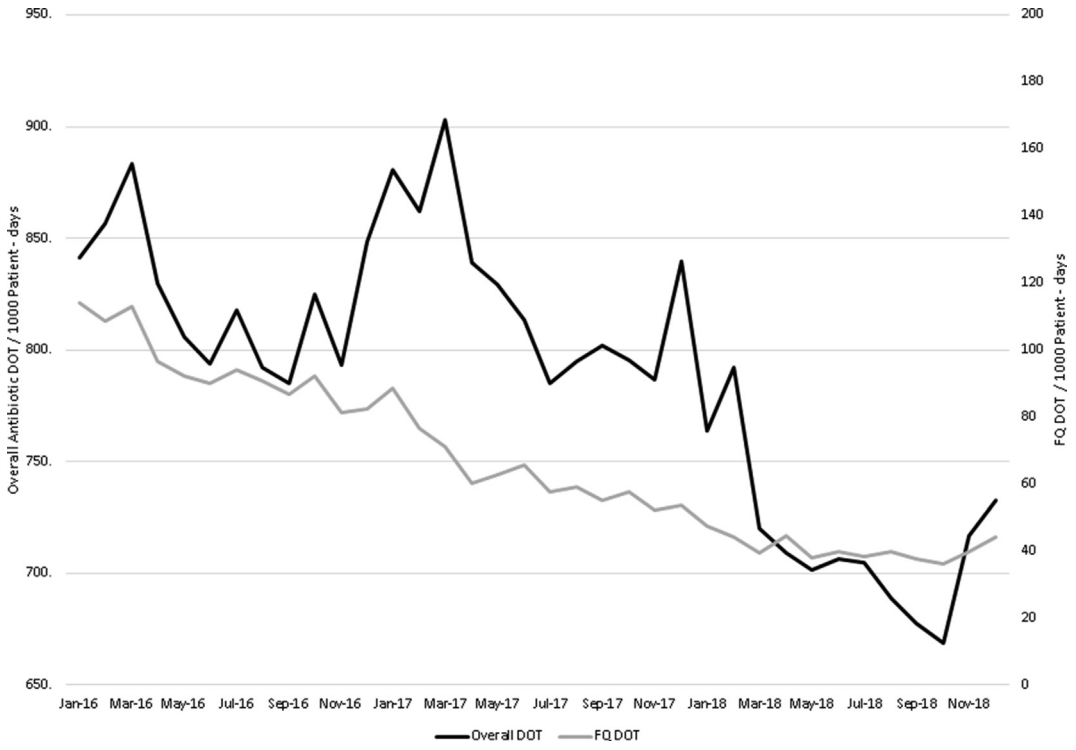

Figure 3. Overall antibiotic and FQ consumption before and during the initiative period. Of note, additional facilities were added in June 2016 which contributed to approximately 6% of the health-system days of therapy.

Utilization of non-ASP team members to extend stewardship efforts has been described elsewhere and associated with similar efficacy and safety outcomes as other ASP methods. [13,14] We provided education to our decentralized and verification pharmacists. There was no requirement for intervention on their part, but by providing usable education on the rationale behind this work, we empowered our team members to join us in our stewardship efforts. We found many pharmacists and pharmacy residents were eager to add this element to their clinical patient care skills.

Health-system administration and medical staff leadership support is a critical component of successful antimicrobial stewardship programs. [1,11,12] It is imperative to gain buy-in and sponsorship around key stewardship initiatives that broadly impact the medical staff. While this was not the only benefit of pursuing the FQ optimization initiative, the work aligned closely with existing organizational priorities, such as decreasing CDI rates.

Creation of educational materials that incorporated relevant data and evidence was key to creating a unified message across a large health-system. These educational tools were often used for both additional distribution and as talking points by leadership. This served as an important introduction to our ASP and to the role of the antimicrobial stewardship pharmacist.

Modifying the EMR to support ASP priorities was important for sustained prescribing changes. Documentation of antibiotic indication has been shown to be accurate and support appropriate antimicrobial use when using a pre-selected, evidence-based indication list rather than free text. [15,16] IDSA ASP guidelines recommend selective or cascade reporting of antimicrobial susceptibility. [12] A single-center study analyzed the impact on ciprofloxacin use when selective reporting limited release of FQ susceptibility. [17] Not only did they observe a decrease in use of ciprofloxacin but also noted improvement in *E. coli* susceptibility at 12 and 24 months post-intervention based on historical rates of decline. Increased use of oral beta-lactams for treatment of bloodstream infections, which is associated with higher rates of treatment failure, has been identified as an unintended consequence of FQ suppression. [18] In October 2018 we modified the suppression to exclude blood cultures.

As expected, interventions of this scale are not without limitations. The entire process occurred over a 3-year period. The ASP team expanded membership from two to 10 FTE, and all members contributed to the development, optimization, and support of this initiative; this may not be scalable to smaller or nascent programs. Additionally, we were unable to isolate the impact of any single method on FQ reduction due to the overlap of multiple interventions.

Conclusions

We describe here a successful, non-restriction-based FQ reduction initiative across a regional health-system. This collaborative approach supported development of relationships with system and facility leadership, providers, and pharmacy team members. Several interventions were implemented within the EMR. The combination of system-wide ASP partnership, multimodal education, and EMR enhancements may yield sustained changes in FQ prescribing.

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Conflict of interest statement

All authors report no conflicts of interest relevant to this article.

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