Inappropriate Fluoroquinolone Use in Academic and Non-academic Primary Care Clinics

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J Gen Intern Med 34(11):2342–44
DOI: 10.1007/s11606-019-05157-6
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INTRODUCTION

Within the USA, it is estimated that 30% of outpatient antibiotic prescriptions may be inappropriate.¹ In 2016, the Centers for Disease Control and Prevention released the *Core Elements of Outpatient Antibiotic Stewardship*, which recommended clinicians and facilities perform tracking and reporting of antibiotic prescribing as an initiative to develop outpatient antibiotic stewardship programs (ASPs) and reduce inappropriate antibiotic use.² Fluoroquinolones are a class of broad-spectrum antibiotics that are over-utilized in the outpatient setting with several recent Food and Drug Administration warnings for serious adverse drug reactions (ADRs).^{3, 4} An estimated 5.1% and 19.9% of fluoroquinolone prescriptions are for indications not requiring antibiotics or have indications with alternative first-line antibiotics, respectively.⁵ One study demonstrated 84.0% of outpatient fluoroquinolone prescriptions were inappropriate based on guideline recommendations.⁶ The purpose of this study was to evaluate the appropriateness of fluoroquinolone prescribing in both academic and non-academic primary care clinics.

MATERIALS AND METHODS

This was a retrospective study conducted within Grady Health System (GHS) at nine primary care clinics and was granted exemption by the institutional review board. Four academic primary care clinics consist of attending physicians and medical residents. Five non-academic, off-site primary care clinics are served by GHS employed attending physicians or advanced practice providers (APPs). Patients were included if they received an outpatient prescription identified by the electronic medical record for oral ciprofloxacin or levofloxacin between November 1, 2016, and April 30, 2017. Patients were excluded if they were a vulnerable population and had

multiple infections, greater than two antibiotic allergies, history of ADRs related to fluoroquinolones, or indication without institutional or national guidelines. Data collected included patient demographics, prescription information, indication, microbiology, return visit within 30 days for ADR, provider status, and clinic site.

The primary composite outcome measure was the percentage of inappropriate fluoroquinolone prescriptions. Appropriateness was based on the institution's outpatient antibiotic guidelines, or national guidelines when institutional guidelines did not exist. Secondary outcomes included the individual components of the primary outcome, inappropriate prescribing between clinicians and clinics, and return visits for ADR within 30 days. Analysis was performed using IBM SPSS Statistics, Version 24.0 (2016; Armonk, New York).

RESULTS

Initially, 309 patients were identified based on fluoroquinolone prescriptions, 216 were included for analysis. Baseline patient characteristics are shown in Table 1. Of the total 216 prescriptions, fluoroquinolones were prescribed more frequently at the non-academic clinics than at the academic clinics (74.1% vs. 25.9%). The average duration of therapy was 7.1 days. Among all clinic sites, attending physicians prescribed 65.3% of the fluoroquinolone prescriptions. The most common indication for a fluoroquinolone was cystitis/pyelonephritis, which occurred in 73.6% of all prescriptions. For the primary composite outcome, 89.4% of fluoroquinolone prescriptions were determined inappropriate, as shown in Table 2. Ninety-five percent of fluoroquinolone prescriptions at the non-academic clinics were inappropriate compared with 73.2% from the academic clinics. Resident physicians prescribed fewer inappropriate fluoroquinolone prescriptions than attending physicians or APPs (78.6% vs. 92.2% vs. 90.9%).

DISCUSSION

Our study demonstrated higher inappropriate fluoroquinolone use in off-site, non-academic clinics compared with academic

Prior Presentations An earlier version of this manuscript was presented as a poster at the American Society of Health-System Pharmacists Midyear Meeting in Orlando, FL, in 2017.

Published online July 16, 2019

Table 1 Baseline Patient Characteristics Associated with Fluoroquinolone Prescribing

Patient characteristics	Academic clinic N = 56	Non-academic clinic N = 160
Age (years), mean (SD)	55.9 (14.0)	53.8 (15.3)
Male, n (%)	9 (16.1)	15 (9.4)
Race, n (%)		
African American	41 (73.2)	100 (62.5)
Hispanic	4 (7.1)	33 (20.6)
Caucasian	8 (14.3)	18 (11.3)
Other	3 (5.4)	9 (5.6)
Temperature, n (%)		
≥ 100.4 (°F)	2 (3.6)	1 (0.6)
White blood cell count (K/mL), n (%)		
>10.7	1 (1.8)	3 (1.9)
Glomerular filtration rate (mL/min), n (%)		
≥ 60	44 (78.6)	140 (87.5)
15–59	11 (19.6)	20 (12.5)
< 15 and/or hemodialysis	1 (1.8)	0 (0.0)
Failed previous antibiotic therapy, n (%)	9 (16.1)	18 (11.3)
Fluoroquinolone prescribed, n (%)		
Ciprofloxacin	36 (64.3)	136 (85.0)
Levofloxacin	20 (35.7)	24 (15.0)
Duration of therapy (days), mean (SD)	8.8 (12.0)	6.5 (5.0)
Provider, n (%)		
Attending physician	14 (25.0)	127 (79.4)
Resident physician	40 (71.4)	2 (1.3)
Advanced practice provider	2 (3.6)	31 (19.4)
Indication, inappropriate/total prescriptions (% inappropriate)		
Cystitis/pyelonephritis	26/31 (83.9)	125/128 (97.7)
Upper respiratory tract infection (bronchitis, sinusitis)	3/3 (100)	12/12 (100)
Intra-abdominal infection/diverticulitis	3/3 (100)	5/8 (62.5)
Skin and soft tissue infection	1/2 (50.0)	7/9 (77.8)
Pneumonia	6/9 (66.7)	1/1 (100)
Osteomyelitis	0/5 (0.0)	0/0 (0.0)
Otitis externa	0/0 (0.0)	2/2 (100)
Chronic obstructive pulmonary disease exacerbation	2/2 (100)	0/0 (0.0)
Prevention of spontaneous bacterial peritonitis	0/1 (0.0)	0/0 (0.0)

clinics, which to our knowledge has not been evaluated in recent literature. This was primarily driven by inappropriate indication, unnecessary prescription, excessive durations, and inappropriate dose. Most ASPs are hospital based which may position off-site and non-academic clinics at a disadvantage for visibility with the ASP for intervention and/or education. ASP representation in all clinics is critical for implementation of outpatient antibiotic stewardship. ASPs have the opportunity to promote evidence-based guidelines, which will require innovative interventions. Clinicians that practice within their respective clinics should be incentivized to collaborate with hospital-based ASPs as outpatient prescribing may pay forward antibiotic resistance managed in the acute care setting. Utilization of the electronic medical record for clinical decision support may provide an avenue to implement a broad intervention across a health system at the time of antibiotic prescribing. This study highlighted the educational disparities that may exist between providers in academic and off-site, non-academic clinics. Future studies should place an emphasis on interventions directed in academic, non-academic, and off-site clinic settings.

Table 2 Fluoroquinolone Prescribing Based on Academic Versus Non-academic Clinic

Outcome	Academic clinic N = 56	Non-academic clinic N = 160	P value*
Composite outcome for inappropriate prescription [†] , n (%)	41 (73.2)	152 (95.0)	< 0.001
By provider, n/n (%)			
Resident physician	31/40 (77.5)	2/2 (100)	–
Advanced practice provider	1/2 (50.0)	29/31 (93.5)	0.209 [‡]
Attending physician	9/14 (64.3)	121/127 (95.3)	0.013 [§]
Inappropriate indication, n (%)	36 (64.3)	138 (86.3)	< 0.001
Unnecessary prescription, n (%)	6 (10.7)	54 (33.8)	0.001
Excessive duration, n (%)	27 (48.2)	104 (65.0)	0.027
Insufficient duration, n (%)	1 (1.8)	2 (1.3)	1.00
Inappropriate dose, n (%)	19 (33.9)	85 (53.1)	0.013
Bug-drug mismatch, n (%)	2 (3.6)	12 (7.5)	1.000
Adverse drug reaction within 30 days [‡] , n (%)	1 (1.8)	5 (3.1)	1.000

**p* < 0.05 is considered statistically significant

[†]The primary composite outcome was the percentage of inappropriate fluoroquinolone prescriptions classified by at least one of the following: inappropriate indication, unnecessary prescription, inappropriate duration, inappropriate dose, or bug-drug mismatch. Inappropriate indication = prescriptions for diagnoses in which fluoroquinolones are not recommended; unnecessary prescription = diagnoses with no indication for antibiotics; bug-drug mismatch = treatment of a bacterial pathogen identified on culture with intermediate or resistant susceptibility to fluoroquinolones

[‡]Comparison between residents and advanced practice providers

[§]Comparison between resident and attending

[‡]Yeast infection (n = 2), gastrointestinal upset (n = 2), seizure (n = 1), and arthralgia (n = 1)

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Data Availability: The datasets during and/or analyzed during the current study available from the corresponding author on reasonable request.

Compliance with Ethical Standards:

This study was granted exemption by the Emory University IRB and for this type of study formal consent is not required.

Conflict of Interest: The authors declare that they do not have a conflict of interest.

Prior Presentations: An earlier version of this manuscript was presented as a poster at the American Society of Health-System Pharmacists Midyear Meeting in Orlando, FL, in 2017.

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