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Concise Communication

Appropriateness of ambulatory antibiotic prescribing in South Carolina, 2012–2017

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Abstract

This population-based cohort study examines the appropriateness of antibiotic prescribing in South Carolina via aggregated pharmacy claims data matched with diagnosis codes from medical claims. Inappropriate antibiotic prescribing decreased from 30.2% in 2012 to 22.6% in 2017 ($P < 0.001$) and was more common in adults >40 years old.

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Introduction

Approximately 90% of antimicrobials are prescribed in the ambulatory setting, and in 2010-2011, per 1000 US population, 353 of 506 antibiotic prescriptions were considered inappropriate.[1,2] Acute upper respiratory tract infections (ARTI) are the most common offenders: sinusitis was the single diagnosis associated with the most antibiotic prescriptions per 1000 population, followed by suppurative otitis media and pharyngitis.[2] These ARTI led to 221 antibiotic prescriptions annually per 1000 population in the United States, but only 111 per 1000 population were estimated to be appropriate for these conditions.[2]

Prior work in South Carolina has examined temporal trends in ambulatory antibiotic prescription fill rates with examination of the influence of age, gender, and location.[3] This population-based cohort study examines the appropriateness of antibiotic prescribing in South Carolina from 2012 through 2017, with particular focus on age and gender.

Methods

Through the South Carolina Revenue and Fiscals Affairs office, aggregated Medicaid and State Employee Health Plan pharmacy claims for ambulatory oral antibiotics were used to estimate community antibiotic prescription fill amounts, matched via

national provider identifier (NPI) with International Classification of Diseases (ICD) diagnosis codes, either 9th or 10th revision from medical claims within 14 days of the pharmacy claim for individuals aged ≤64 years from January 1, 2012, to December 31, 2017 [Figure 1, supplement]. The ≥ 65-year-old cohort was excluded as not captured at high frequency in this dataset; regardless, these data represent nearly 30% of the South Carolina population. Data were then filtered to the ambulatory setting and patients from whom relevant demographic and diagnosis variables could be extrapolated. Appropriateness of antibiotics was defined as "maybe indicated" or "not indicated" based on ICD codes based on classification used in prior reports.[4] All diagnoses codes from the matched visit were screened, and if diagnoses included both a "maybe indicated" and "not indicated," the prescription was coded as "maybe indicated." Chi-square or student t-tests were used as appropriate to examine overall temporal trend in appropriateness and the trends across age group and gender.

Results

Overall, 6,286,041 antibiotic prescriptions were matched through medical and pharmacy claims data and national provider identifiers (NPI) linkage (89.8% of pharmacy claims connected to medical claim). When filtering to ambulatory setting and patients for whom data extrapolation was possible, 3,383,688 prescriptions were included in the analysis.

Overall, 26.8% of antibiotic prescriptions filled during the 6-year period were "not indicated" [Table 1]. This decreased from 2012 to 2017 from 30.2% to 22.6%, ($P < 0.001$). Each individual year also showed improved trend (Table 1).
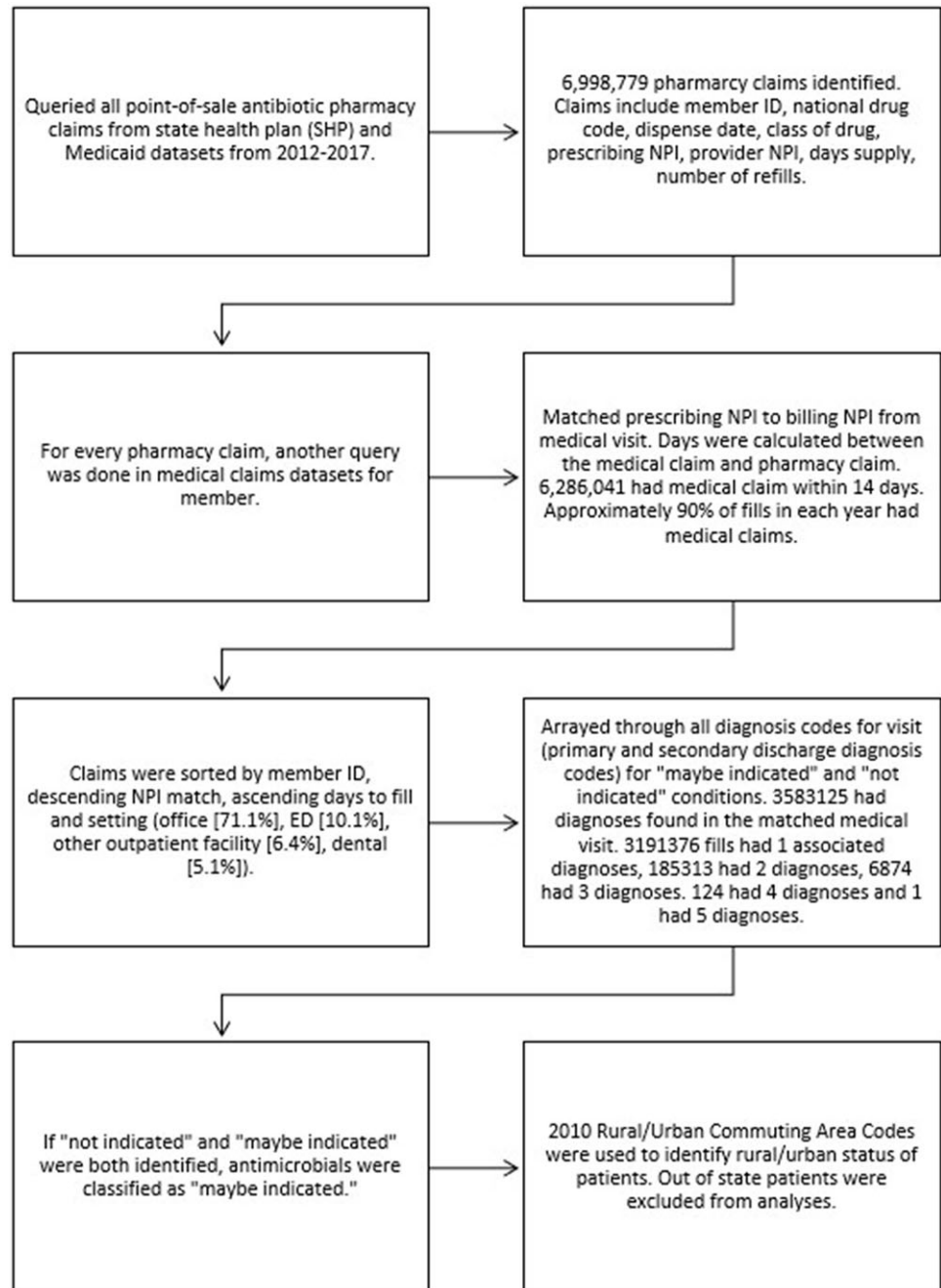
Figure 1. Methodology for creating dataset.

The most common "maybe indicated" conditions were suppurative otitis media (n = 899663, 35.3%), sinusitis (n = 745585, 29.2%), and acute bacterial tonsillitis (n = 318798, 12.5%). The most common "not indicated" conditions were viral upper respiratory infections (n = 365483, 35.4%), bronchitis (n = 249810, 24.2%), and serous otitis media (n = 122145, 11.8%).

While females filled more antibiotic prescriptions (1,990,559 vs 1,393,129, $P < 0.0001$), they were slightly more likely than males to have a "not indicated" condition (27.1% vs 26.5%, $P < 0.0001$) (Table 1). Prescribing for "not indicated" conditions was significantly ($P < 0.001$) more likely in adults aged 40–64 (36.8%) than those aged 18–39 (23.8%), and <18 (23.8%) (Table 1).

Discussion

The observed decline in inappropriate ambulatory antibiotic prescribing from 2012 to 2017 is welcome, though further stewardship efforts are needed particularly in males and adults ≥40 years old. The most common diagnoses for both "not indicated" and "maybe indicated" antibiotic prescriptions were ARTI.

A 2015 meta-analysis showed that women in the 16–54 age group receive significantly higher number of prescriptions of cephalosporins and macrolides in primary care than men do, presumed by the authors to be related to the higher prescriptions in respiratory tract infections as the fluoroquinolones prescribed for

Table 1. Demographic data and results

		Maybe Indicated [n, %]	Not Indicated [n, %]
By Year	2012	402955 (69.8)	174005 (30.2)
	2013	391559 (70.0)	168224 (30.0)
	2014	383717 (71.2)	155584 (28.8)
	2015	400299 (73.2)	146293 (26.8)
	2016	447522 (77.1)	133138 (22.9)
	2017	449198 (77.4)	131194 (22.6)
	total	2475250 (73.2)	908438 (26.8)
By Gender	Female	1451140 (72.9)	539419 (27.1)
	Male	1024110 (73.5)	369019 (26.5)
By Age Group	0–17yo	1694860 (76.2)	529942 (23.8)
	18–39yo	406163 (71.7)	160571 (28.3)
	40–64yo	374227 (63.2)	217925 (36.8)
By Geography	Rural	527408 (70.4)	221453 (29.6)
	Urban	1947842 (73.9)	686985 (26.1)

All p values <0.0001

primarily urinary tract infections remained balanced between the genders.[5] Women have more acute visits for respiratory infection than men, despite men having more risk factors for chronic respiratory conditions related to social behaviors (e.g. smokers, illicit drug user, regular and heavy alcohol use) which put them at risk for acute infections.[6,7] While women received more antibiotic prescriptions in our data (3:2 ratio), there was more appropriate antibiotic prescribing for diagnoses in males; this should be further researched with considerations for the differences in health-seeking behaviors and comorbid conditions.

In the 2010 US Census data, 33.7% of the population of South Carolina resided in a rural area.[8] Rural areas may be a particularly difficult area for antimicrobial stewardship. Rural visits, particularly in the southern United States, are a significant contributor to inappropriate antimicrobial prescriptions.[3] In a 2019 survey, 10% of providers in rural areas had not heard of antimicrobial stewardship but were generally (84.3%) interested in learning more and acknowledged that antibiotics are overprescribed and inappropriate use leads to resistance.[9] Providers who saw ≥50 patients a week felt more pressured to prescribe antibiotics, as well as if the visit were ≤20 minutes. Only 42.9% of prescribers selected that 90-98% rhinosinusitis are viral, with only 5.7% recommending supportive care without antibiotics; viral sinusitis was one of the most common "not indicated" diagnoses in this analysis.[9]

Behavioral and unmeasured factors, such as patient, prescriber, health care system, health care payer, and local/state policies, may impact prescribing rates. Additional factors such as the setting (e.g., urgent care or emergency department) or patient/provider relationship also likely play a significant role in prescribing patterns.[10] In an analysis of patient, physician, and practice characteristics, it was noted that family medicine providers, female gender, and self-report race/ethnicity of white or Hispanic were significantly associated with inappropriate antibiotic prescribing around ARTI.[6] They also noted that a group with low prescribers was likely to have overall low prescribers, whereas groups with high prescribers were 1.3 times more likely to have a second high prescriber.[6] In a study where patient characteristics were similar, it is the providers who had significant variability in prescribing.[11]

Patients who saw high prescribers received 3.0 more fills per 100 people or 14.6% more fills over the subsequent year, compared with those seen by low prescribers.[11] The patients with prior fills were also more likely to have repeat upper respiratory tract visits in the subsequent year, with a relative increase in prescribing across quartiles at these subsequent visits at 2.8%.[11] Diagnoses were also different in high prescribers compared to low prescribers; the high prescribers tended to use diagnoses where antibiotics may be indicated compared to low prescribers using more viral conditions where antibiotics are not indicated.[11,12]

This study has several limitations. Extrapolating from coding and claims data is limited in assessing accuracy of the data, and the provider may have coded the diagnoses inaccurately.[12] Additionally, prescribers may have intentionally coded inaccurately to avoid scrutiny of inappropriate prescribing. There may be limited ability to generalize these data to other states or geographic regions. The ≥ 65-year-old cohort was excluded from analysis due to inability to capture them in this data set (only 1.0% initial data), which limits generalizability into that population. There was also ongoing national and international work to increase awareness of antimicrobial stewardship during the period of this study, which may confound results. Ecologic fallacy is also a concern in using administrative data such as this.

While the reduction in inappropriate antibiotic prescribing is encouraging, there is still significant work to achieve the goals of antimicrobial stewardship in the ambulatory setting.

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