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Concise Communication

Changes in outpatient antibiotic utilization, 2000–2016: More people are receiving fewer antibiotics

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Abstract

We examined annual outpatient antibiotic dispensings within a health insurance plan covering ~970,000 members per year during 2000–2016. The proportion of members with antibiotic dispensings decreased from 33.3% in 2000 to 25.9% in 2016. This trend was consistent in all stratifications of age, race/ethnicity, sex, and comorbidities.

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High rates of inappropriate antibiotic prescribing in the outpatient setting have raised concern, and many initiatives are in place to try to decrease inappropriate prescribing. The effectiveness of such efforts has been described at the individual clinician and practice levels, but few data on the impact of stewardship efforts at the population level are available, particularly in the United States. Recent reports are conflicting and most examine relatively short periods.[1–4] The Centers for Disease Control and Prevention, for example, reported that outpatient antibiotic use declined by 5% from 2011 to 2014.[1] Another group found no change in annual national outpatient antibiotic prescription dispensings in 2013–2015.[2] In both cases, it is unclear whether different trends would have been observed if the study had encompassed a longer duration of surveillance. A third study reported a decline in outpatient antibiotic use from 1999 to 2014, but the study was limited to children 19 years and younger.[4] Our objective was to examine trends in outpatient antibiotic utilization among members of a multistate insurance plan from 2000 through 2016, including whether and how utilization varies in different demographic and chronic disease subgroups.

Methods

We utilized claims data from a commercial health insurance plan in New England that covers ~1 million people annually. We identified all members with ≥1 day of enrollment per year from 2000 through 2016. All ages were included, with age calculated on the last day of each year. We assessed evidence of comorbidities using the Charlson comorbidity index.[5] Members were flagged as having comorbidities if they had ≥1 *International Classification of Disease, Ninth Revision* (ICD-9) or ICD-10 diagnosis code of interest in the 365 days prior to the antibiotic dispensing date, or prior to January 1 of the year of interest for those not receiving antibiotics.

Outpatient antibiotic prescription dispensings were identified in claims via National Drug Codes (primarily penicillins, cephalosporins, β lactams, macrolides, lincosamides, quinolones, trimethoprim-sulfamethoxazole, urinary antibacterials, and tetracyclines). If a person was dispensed 2 antibiotics on the same day, both were counted if they were for different generic names; 2 codes on the same day were counted as 1 antibiotic dispensing if they had the same generic name.

We calculated the proportion of members with antibiotic prescription dispensings per year, stratified by age, sex, race, Hispanic ethnicity, and selected comorbidities. We conducted a sensitivity analysis among the subset of patients that were continuously enrolled throughout the entire study period, censoring only the date of death. We applied a linear regression model to examine the time trend in those receiving an antibiotic. We used SAS version 9.4 software (SAS Institute, Cary, NC) for our analysis.

The Harvard Pilgrim Health Care Institutional Review Board approved this study.

Results

On average, 968,904 members were included in the analysis per year. We observed an overall decrease in the proportion of members receiving antibiotics per year, from 33.3% in 2000 to 25.9% in 2016 ($P < .0001$) (Fig. 1). The effect was consistent when stratified by age, sex, race, Hispanic ethnicity, and comorbidities (Table 1). We did not observe substantial changes in the population demographics over time (ie, by age, sex, race/ethnicity, or comorbidity; data not shown). In addition, members with ≥2 antibiotic prescriptions dispensed also decreased per year, from 15.4% in 2000 to 10.9% in 2016.

We compared utilization in different subgroups in 2016, the last full year for which data were available. Utilization (defined here as ≥1 antibiotic dispensed in 2016) was highest among children aged 0–4 years (31.8%) and among adults aged 60–64 years (31.6%). Females had a higher antibiotic utilization rate than males

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Table 1. Percentage of Members with ≥1 Antibiotic Dispensing per Year by Demographic Characteristic and Select Comorbidity (Total per Category)

Variable	2000	2004	2008	2012	2016
Total, % (no.)	33.3% (1,227,065)	31.5% (936,069)	31.5% (910,277)	28.8% (949,413)	25.9% (1,089,185)
Sex, % (no.)					
Female	37.0 (643,492)	35.4 (485,290)	35.2 (470,495)	32.3 (488,750)	29.3 (559,390)
Male	29.1 (583,573)	27.4 (450,779)	27.6 (439,782)	25.2 (460,663)	22.3 (529,795)
Age, % (no.)					
0–4 y	45.3 (79,462)	39.5 (60,524)	37.4 (53,761)	33.7 (51,336)	31.8 (48,691)
5–19 y	33.9 (258,883)	30.4 (196,686)	30.4 (188,444)	28.4 (192,827)	26.3 (180,718)
20–49 y	30.8 (596,633)	29.2 (439,898)	29.0 (430,293)	26.7 (416,366)	24.5 (471,200)
≥50 y	34.5 (292,061)	34.8 (238,948)	34.8 (237,768)	31.3 (288,879)	26.6 (388,574)
Race, % (no.)					
Black	32.8 (8,763)	32.4 (11,877)	28.1 (17,971)	25.7 (16,591)	23.2 (14,208)
White	39.7 (93,193)	37.6 (128,024)	37.1 (200,026)	32.8 (202,137)	30.5 (176,343)
Asian	29.2 (3,200)	26.3 (5,500)	22.9 (11,080)	20.6 (10,671)	19.4 (9,060)
Amer. Indian/ Alaskan Native	45.8 (225)	36.9 (293)	39.7 (532)	35.7 (616)	32.1 (617)
Native Hawaiian/ Pac. Islander	34.1 (82)	35.2 (105)	33.0 (185)	31.0 (200)	32.2 (202)
Unknown	32.8 (1,121,602)	30.6 (790,270)	30.1 (680,483)	27.9 (719,198)	25.1 (888,755)
Hispanic	37.3 (3,527)	35.5 (5,693)	32.2 (9,658)	30.0 (9,885)	26.5 (8,295)
Not Hispanic	38.8 (105,260)	36.7 (145,581)	35.7 (229,531)	31.8 (230,358)	29.5 (199,039)
Comorbidity, % (no.)					
No comorbidity	NA[a]	28.1 (799,066)	28.1 (777,288)	25.8 (799,553)	23.2 (907,210)
Severe/moderate liver disease	NA[a]	60.3 (471)	62.9 (542)	61.7 (708)	53.2 (955)
Chronic pulmonary disease	NA[a]	56.4 (72,631)	56.4 70,161)	49.9 (75,249)	45.0 (82,907)
Diabetes	NA[a]	48.5 (41,469)	47.9 (42,373)	42.6 (50,993)	35.7 (66,585)
Cancer[b]	NA[a]	53.3 (26,115)	52.5 (3,904)	46.6 (29,474)	37.8 (37,793)
Renal disease[c]	NA[a]	58.7 (3,835)	58.2 (4,873)	48.1 (8,449)	35.6 (15,102)

[a]1 year of enrollment history was used to assess the presence of diagnosis codes for the comorbidities; 2000 was the first year of data accessed.
[b]Includes malignancy (except skin) and metastatic solid tumor.
[c]The increase in the number of members with evidence of renal disease is substantial and has been observed and commented on by others[10] using other data sources due to changes in clinical classifications.

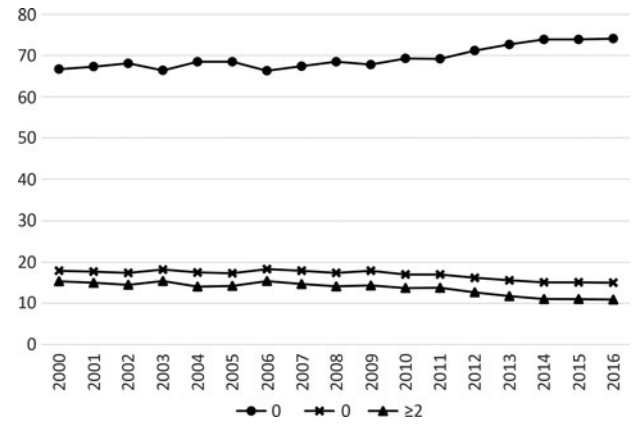

Fig. 1. Percentage of members with and without outpatient antibiotic dispensings per year, by number of dispensings (2000–2016).

(29.3% vs 22.3%). Antibiotics were more commonly dispensed to patients with comorbidities (31.0%–53.2%) versus those without (23.2%). The proportion with ≥1 antibiotic dispensed in 2016 varied by comorbidity; for example, at the high end of the range, 53.2% of patients with severe or moderate liver disease received at least 1 antibiotic and 46.4% of those with hemiplegia or paraplegia received at least 1 antibiotic. At the low end of the range, 35.7% of those with diabetes received at least 1 antibiotic and 31.0% with dementia received at least 1 antibiotic. The most frequently dispensed antibiotics in 2016 were penicillins (34.3%), followed by macrolides (19.7%) and cephalosporins (12.2%).

In the sensitivity analysis, which was restricted to members continuously enrolled from 2000 to 2016, we detected a similar decrease in antibiotic utilization. With an average of 62,486 members enrolled each year, the percentage of members receiving antibiotics decreased from 43.9% in 2000 to 33.8% in 2016. The trend was again consistent in all strata of age, sex, race, and Hispanic ethnicity.

Discussion

This descriptive analysis reveals a meaningful and sustained decrease in the annual fraction of patients receiving antibiotics over a 17-year period. These findings were consistent across all strata of age, sex, race/ethnicity, and comorbidities. Furthermore, a sensitivity analysis restricted to people continuously enrolled for the entire study period showed similar decreases in antibiotic prescriptions. The proportion of continuously

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enrolled members who received antibiotics was higher than the proportion of those in the main analysis during the study, but their utilization also decreased.

The recent literature on antibiotic utilization in the United States varies by study period and age of the study population. One group examined outpatient pharmacy dispensing data in 2013–2015 and found no significant changes in individual or overall rates of antibiotics dispensed during that time.[2] In our study, the proportion of members who received no antibiotics from 2013 to 2015 was also modest (73% to 74%), suggesting the importance of looking at longer periods to detect more subtle trends. Likewise, the CDC reported a decline in rates of outpatient antibiotics dispensed among children 19 and younger from 2011 to 2015 (908 to 788 per 1,000, respectively), but the report also revealed a constant rate of antibiotic use among those 20 and older.[6] An earlier study reported a decline in outpatient antibiotic prescribing from 2006 to 2010 (892 prescriptions per 1,000 to 867 prescriptions per 1,000, respectively) in IMS Health data.[7] From 2002 to 2010, the number of dispensed antibiotics captured in large prescription databases decreased by 14% among children 17 and younger.[8] Among children 3 months to 18 years of age in 3 health plans, rates of outpatient antibiotic dispensings were lower in 2009–2010 than in 2000–2001.[9]

The major strength of our analysis is the long duration of the study period. The study, based within a single commercial health plan in New England, also has several other strengths and limitations. Although our results may not be generalizable to other geographic areas or other patient populations, the relative homogeneity of the population, especially in the continuously enrolled cohort in the sensitivity analysis, provides estimates that may be less affected by demographic and/or other sources of variation. An important limitation of the study is that inpatient (hospital) antibiotic use was not included. In addition, we did not examine appropriateness of use. Finally, the way we assessed comorbidities was more sensitive than specific; we included all patients with ≥1 pertinent diagnosis code and therefore may have overestimated those with comorbidities. On the other hand, we did not require members to have at least 1 year of enrollment history for comorbidity assessment, so we may have underestimated the prevalence of some comorbidities.

In conclusion, over a 17-year study period in a single commercial health plan based in New England, we observed a decrease in the proportion of members receiving antibiotics across age, sex, race/ethnicity, and comorbidities.

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

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