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Original Article

Socioeconomic differences in antibiotic use for common infections in pediatric urgent-care centers—A quasi-experimental study

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Abstract

Objective: To investigate differences in the rate of firstline antibiotic prescribing for common pediatric infections in relation to different socioeconomic statuses and the impact of an antimicrobial stewardship program (ASP) in pediatric urgent-care clinics (PUCs).

Design: Quasi-experimental.

Setting: Three PUCs within a Midwestern pediatric academic center.

Patients and participants: Patients aged >60 days and <18 years with acute otitis media, group A streptococcal pharyngitis, community-acquired pneumonia, urinary tract infection, or skin and soft-tissue infections who received systemic antibiotics between July 2017 and December 2020. We excluded patients who were transferred, admitted, or had a concomitant diagnosis requiring systemic antibiotics.

Intervention: We used national guidelines to determine the appropriateness of antibiotic choice in 2 periods: prior to (July 2017–July 2018) and following ASP implementation (August 2018–December 2020). We used multivariable regression analysis to determine the odds ratios of appropriate firstline agent by age, sex, race and ethnicity, language, and insurance type.

Results: The study included 34,603 encounters. Prior to ASP implementation in August 2018, female patients, Black non-Hispanic children, those >2 years of age, and those who self-paid had higher odds of receiving recommended firstline antibiotics for all diagnoses compared to male patients, children of other races and ethnicities, other ages, and other insurance types, respectively. Although improvements in prescribing occurred after implementation of our ASP, the difference within the socioeconomic subsets persisted.

Conclusions: We observed socioeconomic differences in firstline antibiotic prescribing for common pediatric infections in the PUCs setting despite implementation of an ASP. Antimicrobial stewardship leaders should consider drivers of these differences when developing improvement initiatives.

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In 2019, the American Academy of Pediatrics (AAP) acknowledged racism as a social determinant of health.[1] Although racial and ethnic inequities in health care have been described for decades,[2,3] the 2019 coronavirus (COVID-19) pandemic has brought these inequities into the spotlight over the past 3 years. In 2021, the Centers for Disease Control and Prevention (CDC) declared systemic racism a public health threat, raising awareness about the health inequity faced by people of color in the United States.[4] Multiple studies have reported differences in rates of antibiotic prescribing in relation to race and ethnicity. Black non-Hispanic and Hispanic children evaluated in emergency departments are less likely to receive antibiotics for viral acute respiratory tract infections than are White non-Hispanic children.[5] Additionally, a study of a large pediatric network found that Black children are less likely to receive diagnoses warranting antibiotics, less likely to receive antibiotic prescriptions, and more likely to receive guideline-concordant narrow-spectrum antibiotics than non-Black children.[6] Although these results appear to demonstrate that children in disadvantaged groups receive more guideline-concordant care, this may be a paradoxical consequence of unconscious bias. This pattern is documented in other common pediatric conditions in which resource overuse is a problem, such as asthma and bronchiolitis.[7–10]

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Antimicrobial stewardship programs (ASPs) have been successful in reducing antibiotic overuse while improving patient outcomes.[11] Acknowledging outpatient antibiotic overuse and the impact of ASPs, the CDC, the AAP, and the Pediatric Infectious Diseases Society have identified high-quality antibiotic prescribing practices as an important target for outpatient ASPs.[12,13] ASPs have the potential to reduce health inequities by developing guidelines that standardize care and reduce implicit bias, allowing all patients to receive appropriate care. However, previous studies have demonstrated that, unless specifically targeted, improvement efforts have a variable effect on health equity and may even result in worsening inequities.[9,14,15]

When we analyzed the impact of our outpatient ASP, which we implemented in our pediatric urgent care (PUC) clinics starting in August 2018, we detected overall improvement in the rate of choosing firstline antibiotics for common pediatric infections.[16] However, we sought to understand the rates of firstline antibiotic agents prescribed for common pediatric infections in relation to race, ethnicity, preferred language, and insurance type prior to implementation of our outpatient ASP and to determine the effects the outpatient ASP had on these differences in the PUC setting. We hypothesized that following the implementation of the outpatient ASP, differences in the rates of firstline antibiotic choice within socioeconomic subgroups would be reduced.

Methods

Setting

We performed a quasi-experimental analysis of antibiotics prescribed by clinicians at 3 freestanding PUC centers located throughout a Midwestern metropolitan area. The PUCs are part of a large academic-affiliated pediatric healthcare institution and are staffed by general pediatricians and advanced-practice registered nurses. These core clinicians work primarily in the PUC setting, and additional "moonlighting" clinicians from other pediatric subspecialties help fill in shifts when needed. The 3 PUCs care for ~90,000 patients every year.

Our outpatient ASP team includes pediatric infectious diseases physicians, pharmacists, and a biostatistician. We have developed strong collaborations with frontline clinicians from the PUCs since its inception in 2018. The implemented outpatient ASP initiatives align with the CDC's core elements[13] and include the following: intermittent feedback and education to frontline clinicians; electronic health record (EHR) changes; clinical resources such as an outpatient antibiotic handbook that gives recommendations on firstline antibiotics, dosing, duration, and alternatives for specific common pediatric infections;[17] integration of evidence-based practice with development of clinical practice guidelines; and multiple quality improvement (QI) projects. We described the timeline of our interventions and the impact of our efforts on antibiotic prescribing in a recent manuscript.[16]

Data collection

We used *International Classification of Diseases, 10th Revision* (ICD-10) codes to develop an EHR report that identified all PUC encounters of patients >60 days to 18 years of age with the following discharge diagnoses: acute otitis media (AOM), community-acquired pneumonia (CAP), group A streptococcal (GAS) pharyngitis, urinary tract infection (UTI), and certain skin and soft-tissue infections (SSTIs) (nonfacial cellulitis, abscess, and animal bites).[16] We included only patients who were prescribed systemic antibiotics. We excluded patients who were transferred or admitted, and those with a concomitant diagnosis who may have required systemic antibiotics thus possibly biasing the antibiotic prescribed for the condition of interest.[18] Our baseline period extended from July 2017 through July 2018, and the post-implementation period extended from August 2018 through December 2020. For each patient, we collected demographic information (ie, age, sex, race, ethnicity, language, insurance) and clinical information (ie, all primary and secondary diagnoses and any oral antibiotics prescribed).

In our institution, demographic information is collected by self-identification through an electronic form filled by the family prior to the appointment.

Table 1. Demographics of the Study Population

Characteristic	Pre-Period (N=12.757), No. (%)	Post-Period (N=21.846), No. (%)
Patient age, y		
<2	3,261 (25.6)	5,825 (26.7)
2–12	8,638 (67.7)	14,560 (66.6)
13+	858 (6.7)	1,461 (6.7)
Sex		
Female	6,439 (50.5)	11,193 (51.2)
Male	6,318 (49.5)	10,651 (48.8)
Race and ethnicity		
American Indian or Alaska Native	29 (0.2)	36 (0.2)
Asian	235 (1.8)	498 (2.3)
Black or African American	1,346 (10.6)	2,176 (10.0)
Hispanic/Latino	1,672 (13.1)	3,007 (13.8)
Multiracial	613 (4.8)	1,043 (4.8)
Native Hawaiian or Pacific Islander	55 (0.4)	87 (0.4)
White	8,416 (66.0)	14,396 (65.9)
Unspecified	206 (1.6)	352 (1.6)
Unknown/refused	185 (1.5)	251 (1.1)
Language		
English	12,288 (96.3)	21,028 (96.3)
Spanish	304 (2.4)	503 (2.3)
Other/Unknown[a]	165 (1.3)	315 (1.4)
Insurance		
Commercial	6,467 (50.7)	11,146 (51.0)
Medicaid	5,377 (42.1)	8,361 (38.3)
Self-pay	550 (4.3)	1,410 (6.5)
Other/Unknown[b]	363 (2.8)	929 (4.3)

[a]Includes 43 unique languages.
[b]Includes commercial multiple peril (CMP), other/government, and unknown.

Data Analysis

We used established national guidelines[19–21] and our local antibiogram[22] to determine appropriateness of antibiotic choice for each diagnosis. We considered penicillin G benzathine,

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Table 2. Proportion of Patients of Each Socioeconomic Group That Received Firstline Antibiotics by Diagnosis

	No./Total (%)				
Demographic	AOM	Cellulitis	CAP	GAS pharyngitis	UTI
Patient age, y					
<2	6,105/8,297 (73.6)	158/204 (77.5)	290/344 (84.3)	132/149 (88.6)	74/92 (80.4)
2–12	8,206/10,367 (79.2)	1,208/1,608 (75.1)	1,524/2,118 (72.0)	6,858/7,923 (86.6)	1,017/1,182 (86.0)
13+	404/523 (77.2)	322/482 (66.8)	163/285 (57.2)	636/742 (85.7)	230/287 (80.1)
Sex					
Female	7,181/9,236 (77.8)	803/1,068 (75.2)	964/1,346 (71.6)	3,925/4,493 (87.4)	1,265/1,489 (85.0)
Male	7,533/9,949 (75.7)	885/1,226 (72.2)	1,013/1,401 (72.3)	3,701/4,321 (85.7)	56/72 (77.8)
Race and ethnicity					
American Indian or Alaska Native	21/27 (77.8)	1/3 (33.3)	3/6 (50.0)	15/20 (75.0)	8/9 (88.9)
Asian	332/407 (81.6)	22/30 (73.3)	58/84 (69.0)	162/179 (90.5)	24/33 (72.7)
Black or African American	1,645/1,994 (82.5)	165/208 (79.3)	206/255 (80.8)	819/904 (90.6)	139/161 (86.3)
Hispanic/Latino	2,249/2,779 (80.9)	218/285 (76.5)	241/331 (72.8)	926/1,062 (87.2)	202/222 (91.0)
Multiracial	760/976 (77.9)	74/102 (72.5)	102/126 (81.0)	339/390 (86.9)	52/62 (83.9)
Native Hawaiian or Pacific Islander	84/91 (92.3)	2/2 (100.0)	18/20 (90.0)	23/26 (88.5)	2/3 (66.7)
White	9,181/12,358 (74.3)	1,166/1,605 (72.6)	1,295/1,854 (69.8)	5,099/5,962 (85.5)	860/1,033 (83.3)
Unspecified	243/292 (83.2)	24/29 (82.8)	30/42 (71.4)	156/170 (91.8)	21/25 (84.0)
Unknown/refused	200/263 (76.0)	16/30 (53.3)	24/29 (82.8)	87/101 (86.1)	13/13 (100.0)
Language					
English	14,104/18,465 (76.4)	1,633/2,226 (73.4)	1,907/2,646 (72.1)	7,327/8,474 (86.5)	1,268/1,505 (84.3)
Spanish	382/456 (83.8)	45/55 (81.8)	37/59 (62.7)	171/194 (88.1)	42/43 (97.7)
Other[a]	229/266 (86.1)	10/13 (76.9)	33/42 (78.6)	128/146 (87.7)	11/13 (84.6)
Insurance					
Commercial	6995/9510 (73.6)	828/1134 (73.0)	1157/1603 (72.2)	3879/4533 (85.6)	690/833 (82.8)
Medicaid	6142/7761 (79.1)	714/965 (74.0)	636/908 (70.0)	3073/3517 (87.4)	509/587 (86.7)
Self-pay	988/1155 (85.5)	78/109 (71.6)	103/128 (80.5)	442/488 (90.6)	70/80 (87.5)
Other[b]	590/761 (77.5)	68/86 (79.1)	81/108 (75.0)	232/276 (84.1)	52/61 (85.2)

[a]Includes 43 unique languages and unknown.
[b]Includes commercial multiple peril (CMP), other/government, and unknown.
Note. AOM, acute otitis media; CAP, community-acquired pneumonia; GAS, group A streptococcal; UTI, urinary tract infection.

penicillin V potassium, and amoxicillin firstline agents for GAS pharyngitis. For AOM and CAP, we considered amoxicillin the firstline agent. Based on the local susceptibilities, we considered cephalexin the firstline agent for UTI and nonfacial cellulitis; clindamycin, or trimethoprim–sulfamethoxazole for abscess; and amoxicillin-clavulanate for animal bites.

We compared the frequency distributions of demographic factors in each period to demonstrate similarity in patient cohorts. We also compared the proportion of patients receiving firstline antibiotic therapy between demographic factors, within each period. We identified trends in rates of firstline antibiotic use over time by race category and diagnosis group trends within race category. We performed unadjusted and multivariable logistic regression models to calculate the odds ratios (ORs) of appropriate antibiotic agent by age, sex, race and ethnicity, language, and insurance type as documented in the EHR. Difference-in-difference effect estimates for each period were derived using interaction terms in the regression models (eg, age group by before and after the ASP was implemented). All analyses were completed using R software (R Core Team, Vienna, Austria).

This study was given exempt status by our institutional review board.

Results

The study included 12,757 encounters during the baseline period (July 2017–July 2018) and 21,846 encounters after the implementation of our ASP (August 2018–December 2020). Socioeconomic variables were, in general, similar between the baseline and study periods (Table 1). Overall, AOM accounted for 55.4% of diagnoses for which antibiotics were prescribed during this time-period. When stratifying the data by diagnosis for the entire study period (July 2017–December 2020), we detected differences in the rates of prescribing firstline antibiotics for all socioeconomic variables for all included diagnoses (Table 2).

Evaluation of demographic variables demonstrated a higher proportion of patients receiving firstline antibiotic for the diagnoses evaluated throughout both periods for children aged 2–12 years, those whose preferred language was not English, and those on Medicaid or who self-paid. The proportion of firstline

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Table 3. Proportion of Patients Receiving Firstline Antibiotics

Characteristic	Pre-ASP Period (N=12,757) Total Patients,	Pre-ASP Period (N=12,757) Firstline, No. (%)	Post-ASP Period (N=21,846) Total Patients	Post-ASP Period (N=21,846) Firstline, No. (%)
Patient age, y				
<2	3,261	2,382 (73.0)	5,825	4,377 (75.1)
2–12	8,638	6,967 (80.7)	14,560	11,846 (81.4)
13+	858	656 (76.5)	1,461	1,099 (75.2)
Sex				
Female	6,439	5,130 (79.7)	11,193	9,008 (80.5)
Male	6,318	4,875 (77.2)	10,651	8,313 (78.0)
Race and ethnicity				
American Indian or Alaska Native	29	22 (75.9)	36	26 (72.2)
Asian	235	195 (83.0)	498	403 (80.9)
Black or African American	1,346	1,137 (84.5)	2,176	1,837 (84.4)
Hispanic/Latino	1,672	1,358 (81.2)	3,007	2,478 (82.4)
Multiracial	613	472 (77.0)	1,043	855 (82.0)
Native Hawaiian or Pacific Islander	55	51 (92.7)	87	78 (89.7)
White	8,416	6,453 (76.7)	14,396	11,148 (77.4)
Unspecified	206	173 (84.0)	352	301 (85.5)
Unknown/refused	185	144 (77.8)	251	196 (78.1)
Language				
English	12,288	9,611 (78.2)	21,028	16,628 (79.1)
Spanish	304	253 (83.2)	503	424 (84.3)
Other[a]	165	141 (85.5)	315	270 (85.7)
Insurance				
Commercial	6,467	4,939 (76.4)	11,146	8,610 (77.2)
Medicaid	5,377	4,346 (80.8)	8,361	6,728 (80.5)
Self-pay	550	448 (81.5)	1,410	1,233 (87.4)
Other[b]	363	272 (74.9)	929	751 (80.8)

[a]Includes 43 unique languages.
[b]Includes commercial multiple peril (CMP), other/government, and unknown.

antibiotics was higher for patients who were Asian, Black, Hispanic/Latino, or Native Hawaiian/Pacific Islander compared to children who were White non-Hispanic (Table 3).

Our logistic regression model showed that prior to implementation of our ASP, Asian, Black non-Hispanic, Hispanic, Native Hawaiian or Pacific Islander, and patients with unknown or unspecified race and ethnicity were more likely to receive firstline antibiotics for the infections evaluated compared to White non-Hispanic patients with the following ORs: 1.48 for Asian; 1.65 for Black non-Hispanic; 1.32 for Hispanic; 3.88 for Native Hawaiian or Pacific Islander; and 1.3 for unspecified or unknown. Following implementation of the ASP, these differences persisted for all races except Asian and American Indian patients, but we also detected an increase in the OR of multiracial patients to receive firstline antibiotics compared to White non-Hispanic patients (Table 4).

Similarly, compared to patients with English reported as a preferred language, patients with Spanish as a preferred language and those with another preferred language were more likely to receive a firstline antibiotic prior to ASP implementation (OR, 1.38; 95% CI, 1.03–1.89; $P = .037$ and OR, 1.64; 95% CI, 1.08–2.59; $P = .026$), respectively. This difference persisted following implementation of the ASP (OR, 1.42; 95% CI, 1.12–1.82; $P = .005$; and OR, 1.59; 95% CI, 1.17–2.21; $P = .004$) for Spanish and other languages, respectively (Table 4).

Regarding insurance type, patients with government insurance were more likely than those with commercial insurance to receive a firstline antibiotic prior to ASP implementation (OR, 1.30; 95% CI, 1.19–1.43; $P < .001$). This difference persisted following implementation of our outpatient ASP (OR, 1.21; 95% CI, 1.13–1.3; $P < .001$). Similarly, patients who self-paid were more likely to receive a firstline antibiotic compared to those with commercial insurance (OR, 1.36; 95% CI, 1.09–1.71, $P = .007$). Following implementation of our outpatient ASP, the difference between commercial insurance and self-pay increased (OR, 2.05; 95% CI, 1.75–2.42; $P < .001$) (Table 4).

Patients <2 years of age had lower odds of receiving firstline antibiotics compared to those 2–12 years of age before and following our ASP interventions (OR, 0.65; 95% CI, 0.59–0.71;

Table 4. Logistic Regression Model Results: Unadjusted Odds of Receiving FirstLine Antibiotic

	Odds Ratio	*P* Value	95% CI	Odds Ratio	*P* Value	95% CI	Odds Ratio	*P* Value	95% CI	Difference in Difference
Patient age, y										0.855
<2	0.65	<.001	0.59–0.71	0.69	<.001	0.64–0.74	1.07	.295	0.95–1.20	
2–12[a]	Ref	. . .	. . .	Ref	. . .	. . .	1.05	.185	0.98–1.12	
13+	0.78	.003	0.66–0.92	0.70	<.001	0.61–0.79	0.89	.288	0.72–1.10	
Sex										0.993
Female[a]	Ref	. . .	. . .	Ref	. . .	. . .	1.05	.195	0.97–1.14	
Male	0.86	.001	0.79–0.94	0.86	<.001	0.81–0.92	1.00	.993	0.90–1.11	
Race and ethnicity										0.724
American Indian or Alaska Native	0.96	.918	0.43–2.42	0.76	.456	0.38–1.65	0.79	.684	0.25–2.42	
Asian	1.48	.025	1.06–2.12	1.24	.067	0.99–1.56	0.83	.386	0.55–1.25	
Black or African American	1.65	<.001	1.42–1.94	1.58	<.001	1.40–1.79	0.95	.641	0.78–1.16	
Hispanic/ Latino	1.32	<.001	1.15–1.50	1.36	<.001	1.23–1.51	1.04	.667	0.88–1.23	
Multiracial	1.02	.855	0.84–1.24	1.33	.001	1.13–1.56	1.30	.042	1.01–1.68	
Native Hawaiian or Pacific Islander	3.88	.009	1.58–12.84	2.53	.009	1.34–5.41	0.65	.494	0.17–2.12	
White[a]	Ref	. . .	. . .	Ref	. . .	. . .	1.04	.185	0.98–1.11	
Unspecified/ Unknown	1.30	.044	1.01–1.70	1.37	.004	1.11–1.70	1.05	.782	0.75–1.46	
Language										0.883
English[a]	Ref	. . .	. . .	Ref	—	—	1.05	.064	1.00–1.11	
Spanish	1.38	.037	1.03–1.89	1.42	.005	1.12–1.82	1.03	.890	0.69–1.51	
Other[b]/Unknown	1.64	.026	1.08–2.59	1.59	.004	1.17–2.21	0.97	.912	0.56–1.65	
Insurance										0.236
Commercial[a]	Ref	. . .	. . .	Ref	. . .	. . .	1.05	.184	0.98–1.13	
Medicaid	1.30	<.001	1.19–1.43	1.21	<.001	1.13–1.30	0.93	.212	0.83–1.04	
Self-pay	1.36	.007	1.09–1.71	2.05	<.001	1.75–2.42	1.51	.003	1.14–1.99	
Other[c]/Unknown	0.92	.530	0.73–1.19	1.24	.012	1.05–1.48	1.34	.051	1.00–1.81	

[a]Largest category within each demographic subset was chosen as reference group.
[b]Includes 43 unique languages.
[c]Includes commercial multiple peril (CMP), and other/government.

P < .001; OR, 0.69; 95% CI, 0.64–0.74; *P* < .001, respectively). Similarly, patients ≥13 years of age were less likely to receive firstline antibiotics prior to the ASP (OR, 0.78; 95% CI, 0.66–0.92; *P* = .003) and after the implementation of the ASP (OR, 0.7; 95% CI, 0.61–0.79; *P* < .001). Patients identified as male in the EHR had lower odds of receiving firstline agents compared to female patients (OR, 0.86 before and after ASP implementation) (Table 4).

Trends in firstline antibiotic use improved over time for all diagnoses, but the slopes differed by race and ethnic categories (Fig. 1). Supplemental Figure 1 shows the firstline antibiotic use trend by diagnosis group and race and ethnic categories. We evaluated the difference-in-difference after versus before the change across race and ethnicity, language, and insurance groups. We did not see an overall significant change in the odds of receiving a firstline antibiotic following implementation of our outpatient ASP (Table 4).

Discussion

We identified differences in the rate of prescribing firstline antibiotics for common pediatric conditions relating to race and ethnicity, language, insurance type, age, and sex in the PUC setting. Although overall antibiotic prescribing practices improved for many common pediatric infections following initiation of our outpatient ASP in August 2018, the differences based on socioeconomic status persisted, and in some instances (eg, insurance type) increased. These findings are consistent with previous studies suggesting that quality improvement interventions may not influence differences within socioeconomic subsets unless a conscious effort is made to identify specific drivers of health equity and to consider the impact that interventions will have on different socioeconomic subsets.[9,14,15,23,24]

White non-Hispanic children, children with commercial insurance, and children with English as their preferred language were less likely to receive firstline antibiotics compared to their socioeconomic counterparts. Rather than receive the recommended narrow-spectrum antibiotics, these groups appear to receive unnecessary broad-spectrum antibiotics more frequently. Although we did not evaluate the rate of penicillin or amoxicillin allergy in our study, this allergy is more commonly reported in White non-Hispanic children,[25,26] which may contribute to this group not receiving amoxicillin as the firstline antibiotic for

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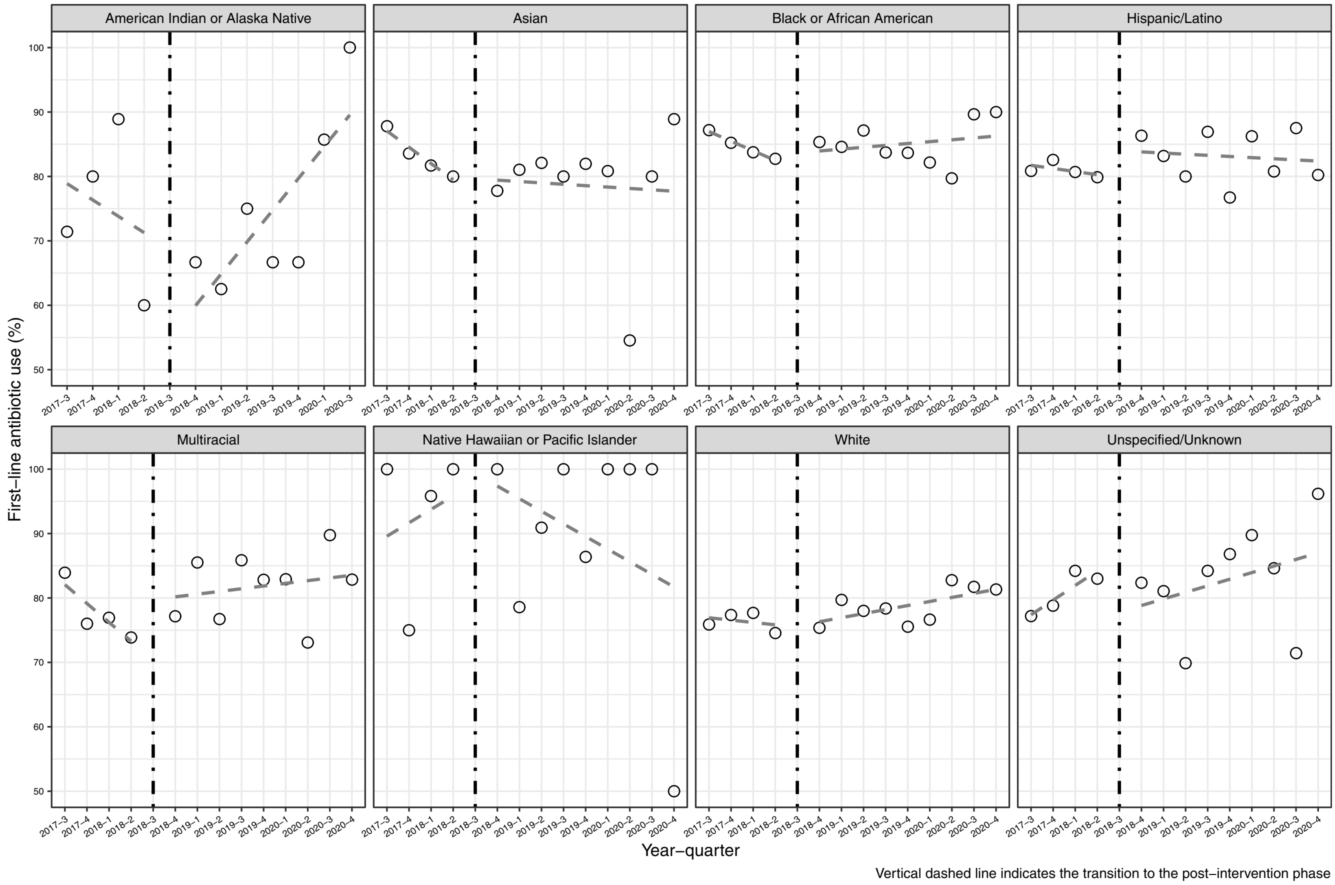

Figure 1. Trends in firstline antibiotic use over time for all diagnoses combined, by race category.

respiratory diagnoses. However, data show that >95% of children labeled as "amoxicillin-allergic" do not in fact have an IgE-mediated reaction after cutaneous or systemic exposure to amoxicillin.[27,28]

Language in antibiotic prescribing has not yet been well studied. Families with English as their preferred language may feel more comfortable suggesting alternatives to recommended firstline treatments. Although our data suggest that families with English as their preferred language were less likely to receive guideline-concordant care, many patient-facing quality improvement interventions target families whose preferred language is English. More research into the influence preferred language has on prescribing behaviors is needed.

In our study, children identified as male were less likely to receive firstline antibiotics compared to those identified as female for all diagnoses except CAP. More studies are needed to understand differences in prescribing based on sex. However, studies on inequity in pediatric pain assessment reported that male patients are perceived to experience more discomfort compared to female patients exhibiting similar behaviors and clinical presentations; thus, receiving better pain control.[29,30]

Our data suggest that children aged <2 years were less likely to receive firstline antibiotics. However, this finding may be due to diagnostic distribution, with AOM accounting for >50% of all diagnoses. In this age group, the increased frequency of respiratory illnesses may result in re-evaluations for perceived treatment failures.

Barriers that contribute to differences in antibiotic prescribing behaviors between socioeconomic subsets, and countermeasures that promote antibiotic stewardship while reducing these differences, are not well studied. Implicit bias may have a higher impact when clinicians experience time pressure, high cognitive demand, and fatigue,[23] all of which are commonly experienced in PUC settings. Developing interventions that reduce implicit bias, such as EHR decision tools, has been shown to reduce health inequity in recognition of sepsis.[31] Our ASP interventions included EHR changes but did not appear to affect the socioeconomic differences noted. Additional EHR decision support tools may need to be included. Mangione-Smith *et al*[32] noted that parental beliefs and clinicians' perception of parental expectation regarding antibiotics differed based on race and ethnicity and were primary drivers of unnecessary antibiotics in the primary care setting. Future studies should evaluate the influence of implicit bias on antibiotic prescribing and what interventions encourage high-quality, equitable antibiotic prescribing in the PUC setting.

Although specific drivers to reduce differences in antibiotic prescribing in relation to socioeconomic status have not been identified, the CDC developed the CORE Commitment to Health Equity, a strategy for integrating health equity into quality improvement and research initiatives.[33] Additionally, the Institute for Healthcare Improvement defined strategies to eliminate racism and address social determinants of health that may help narrow the gap in health equity for antibiotic prescribing. These strategies include understanding how structural racism and bias influence the relationship between the clinician and family, acknowledging the impact racism and implicit bias have on health equity through culture change and transparent communication, screening for social determinants of health regarding access to care and

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medications, and developing resources that all families can use and understand.[34] We believe that all ASPs should interrogate their antimicrobial prescribing data relative to socioeconomic status and design interventions with a health-equity perspective.

Our study had several limitations. It had a retrospective design, and we relied on the accuracy of the EHR in determining socioeconomic variables for each encounter. During registration, patients self-reported their race and ethnicity and preferred language. However, the options available to classify each person into a social construct were limited and may have failed to accurately capture the self-identity of each individual. Additionally, we did not evaluate differences in gender identity or immigration status, both of which are important variables to include but are difficult to measure. We did not evaluate documented penicillin allergy, the use of delayed antibiotics, or no antibiotics prescribed for eligible encounters based on socioeconomic variables. Additionally, the recommended treatment options are derived from guidelines. In some instances, guidelines may not be followed, such as in cases of severe illness, antibiotic allergy, or treatment failure. However, outside the reported penicillin allergy differences, we would not expect to see a difference in prevalence of these exceptions between socioeconomic subsets. Finally, the generalizability of these findings may be limited because we evaluated only 3 practices in a Midwestern academic-affiliated PUC setting.

In conclusion, differences in firstline antibiotic prescribing in relation to socioeconomic variables did not improve following implementation of an outpatient ASP, despite overall improvement in firstline, guideline-concordant antibiotics for common pediatric infections. Future studies are needed to identify additional drivers, to develop countermeasures, and to evaluate their impact on health equity in antibiotic prescribing. The findings of this study will contribute to future projects seeking to identify barriers of health equity in antibiotic prescribing behaviors and to develop interventions that promote equitable care to all children.

Supplementary material. To view supplementary material for this article, please visit https://doi.org/10.1017/ice.2023.107

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References

1. Trent M, Dooley DG, Douge J, *et al.* The impact of racism on child and adolescent health. *Pediatrics* 2019;144.
2. Williams DR, Rucker TD. Understanding and addressing racial disparities in health care. *Health Care Financ Rev* 2000;21:75–90.
3. Flores G, Committee On Pediatric R. Technical report—racial and ethnic disparities in the health and health care of children. *Pediatrics* 2010;125: e979–e1020.
4. Media statement from CDC Director Rochelle P. Walensky, MD, MPH, on racism and health. Center for Disease Control and Prevention website. https://www.cdc.gov/media/releases/2021/s0408-racism-health.html. Published 2021. Accessed September 6, 2022.
5. Goyal MK, Johnson TJ, Chamberlain JM, *et al.* Racial and ethnic differences in antibiotic use for viral illness in emergency departments. *Pediatrics* 2017;140.
6. Gerber JS, Prasad PA, Localio AR, *et al.* Racial differences in antibiotic prescribing by primary care pediatricians. *Pediatrics* 2013;131:677–684.
7. Tackett AP, Farrow M, Kopel SJ, Coutinho MT, Koinis-Mitchell D, McQuaid EL. Racial/ethnic differences in pediatric asthma management: the importance of asthma knowledge, symptom assessment, and family-provider collaboration. *J Asthma* 2021;58:1395–1406.
8. Honcoop AC, Poitevien P, Kerns E, Alverson B, McCulloh RJ. Racial and ethnic disparities in bronchiolitis management in freestanding children's hospitals. *Acad Emerg Med* 2021;28:1043–1050.
9. Schechter SB, Pantell MS, Parikh K, *et al.* Impact of a national quality collaborative on pediatric asthma care quality by insurance status. *Acad Pediatr* 2021;21:1018–1024.
10. Hester G, Nickel AJ, Watson D, Bergmann KR. Factors associated with bronchiolitis guideline nonadherence at US children's hospitals. *Hosp Pediatr* 2021;11:1102–1112.
11. Nathwani D, Varghese D, Stephens J, Ansari W, Martin S, Charbonneau C. Value of hospital antimicrobial stewardship programs (ASPs): a systematic review. *Antimicrob Resist Infect Control* 2019;8:35.
12. Gerber JS, Jackson MA, Tamma PD, *et al.* Policy statement: antibiotic stewardship in pediatrics. *J Pediatric Infect Dis Soc* 2021;10:641–649.
13. Sanchez GV, Fleming-Dutra KE, Roberts RM, Hicks LA. Core elements of outpatient antibiotic stewardship. *MMWR Recomm Rep* 2016; 65:1–12.
14. Corl K, Levy M, Phillips G, Terry K, Friedrich M, Trivedi AN. Racial and ethnic disparities in care following the New York State sepsis initiative. *Health Aff (Millwood)* 2019;38:1119–1126.
15. Trivedi AN, Grebla RC, Wright SM, Washington DL. Despite improved quality of care in the Veterans' Affairs health system, racial disparity persists for important clinical outcomes. *Health Aff (Millwood)* 2011; 30:707–715.
16. Nedved A, Lee BR, Hamner M, Wirtz A, Burns A, El Feghaly RE. Impact of an antibiotic stewardship program on antibiotic choice, dosing, and duration in pediatric urgent cares. *Am J Infect Control* 2023;51:520–526.
17. Outpatient antibiotic handbook. Children's Mercy Kansas City website. https://www.childrensmercy.org/siteassets/media-documents-for-depts-section/documents-for-health-care-providers/evidence-based-practice/clinical-practice-guidelines–care-process-models/outpatient-antibiotic-handbook.pdf. Published 2022. Accessed December 6, 2022.
18. El Feghaly RE, Burns A, Goldman JL, Myers A, Purandare AV, Lee BR. Novel outpatient antibiotic prescribing report of respiratory infections in a pediatric health system's emergency departments and urgent care clinics. *Am J Infect Control* 2021;49:398–400.
19. Reaffirmation of AAP Clinical Practice Guideline: the diagnosis and management of the initial urinary tract infection in febrile infants and young children 2–24 months of age. *Pediatrics* 2016;138.
20. Shulman ST, Bisno AL, Clegg HW, *et al.* Clinical practice guideline for the diagnosis and management of group A streptococcal pharyngitis: 2012 update by the Infectious Diseases Society of America. *Clin Infect Dis* 2012;55:1279–1282.
21. Stevens DL, Bisno AL, Chambers HF, *et al.* Practice guidelines for the diagnosis and management of skin and soft-tissue infections: 2014 update by the Infectious Diseases Society of America. *Clin Infect Dis* 2014;59:e10–e52.
22. Provider resources for antimicrobial stewardship. Children's Mercy Kansas City website. https://www.childrensmercy.org/health-care-providers/pediatrician-guides/antimicrobial-stewardship/provider-resources-for-antimicrobial-stewardship/. Published 2021. Accessed November 30, 2021.
23. Penner LA, Blair IV, Albrecht TL, Dovidio JF. Reducing racial healthcare disparities: a social psychological analysis. *Policy Insights Behav Brain Sci* 2014;1:204–212.

24. National Healthcare Quality & Disparities Reports. *2019 National Healthcare Quality and Disparities Report*. Rockville, MD: Agency for Healthcare Research and Quality; 2020.
25. Taylor MG, Joerger T, Li Y, *et al*. Factors associated with penicillin allergy labels in electronic health records of children in 2 large US pediatric primary care networks. *JAMA Netw Open* 2022;5:e222117.
26. Hersh AL, Shapiro DJ, Zhang M, Madaras-Kelly K. Contribution of penicillin allergy labels to second-line broad-spectrum antibiotic prescribing for pediatric respiratory tract infections. *Infect Dis Ther* 2020;9:677–681.
27. Norton AE, Konvinse K, Phillips EJ, Broyles AD. Antibiotic allergy in pediatrics. *Pediatrics* 2018;141.
28. Vyles D, Adams J, Chiu A, Simpson P, Nimmer M, Brousseau DC. Allergy testing in children with low-risk penicillin allergy symptoms. *Pediatrics* 2017;140.
29. Earp BD, Monrad JT, LaFrance M, Bargh JA, Cohen LL, Richeson JA. Featured article: gender bias in pediatric pain assessment. *J Pediatr Psychol* 2019;44:403–414.
30. Cohen L, Cobb J, Martin S. Gender biases in adult ratings of pediatric pain. *Child Health Care* 2014;43:87–95.
31. Raman J, Johnson TJ, Hayes K, Balamuth F. Racial differences in sepsis recognition in the emergency department. *Pediatrics* 2019;144.
32. Mangione-Smith R, Elliott MN, Stivers T, McDonald L, Heritage J, McGlynn EA. Racial/ethnic variation in parent expectations for antibiotics: implications for public health campaigns. *Pediatrics* 2004;113:e385–e394.
33. CDC CORE health equity science and intervention strategy. Center for Disease Control and Prevention website. https://www.cdc.gov/healthequity/core/index.html. Published 2022. Accessed September 22, 2022.
34. Improving health equity: eliminate racism and other forms of oppression, guidance for health care organizations. Institute for Healthcare Improvement website. https://www.chausa.org/docs/default-source/health-equity/4_ihi_improvinghealthequity_eliminateracismoppressionguide.pdf. Published 2019. Accessed September 6, 2022.