COVID-19 and Antibiotic Prescribing in the United States: A County-level Analysis

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Background

Declines in outpatient antibiotic prescribing were reported during the beginning of the COVID-19 pandemic in the United States; however, the overall impact of cases on antibiotic prescribing remains unclear. There are two main reasons that cases may have altered prescribing:

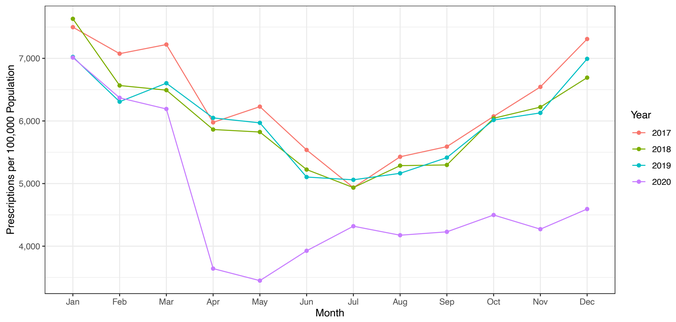
1. Inappropriate treatment for viral infections: Bacterial co-infection in COVID-19 patients is rare[1], and studies have identified inappropriate prescribing[2]. An estimated 30% of outpatient antibiotic prescriptions were inappropriate pre-pandemic[3].

2. Reduced transmission of other URIs (e.g., the cold and influenza) due to non-pharmaceutical interventions (NPIs): The winter of 2020 saw unseasonably low rates of these URIs[4], peaks in which are typically associated with increased prescribing[5].

Objective

To assess the association between COVID-19 cases and pandemic-related NPIs on antibiotic prescribing in the United States.

Figure 1
A. Prescriptions per 100,000 Population from 2017-2020 by Month



B. Map of Percent Change in Antibiotic Prescriptions Dispensed per 100,000 Population by State

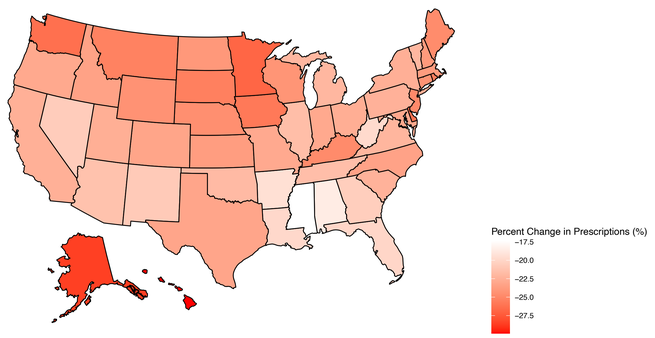


Figure 1A. Prescribing followed previous years' trends from January-March 2020, dropping drastically in April. Prescriptions rose May-July but remained below previous years prescribing through December. Total antibiotic prescriptions fell 26.7% during the period March-December compared to this period in previous years. Figure 1B. Larger declines were observed in the Southeast region of the US with lower declines in the Western and Northern regions. This is consistent with overall prescribing rates, which are generally higher in the Southeast region compared to the rest of the country.

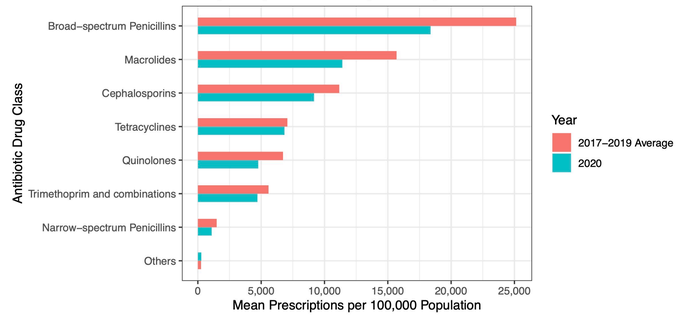
Methods

Random effects panel regression (February-December 2020) of monthly reported COVID-19 case data in each US county and corresponding monthly outpatient antibiotic prescription data from IQVIA.

IQVIA Exponent Database

Systemic antibiotic prescriptions (J01) collected from retail pharmacies disaggregated by month, zip code, age, and gender. Topical agents that are not systemically absorbed and medications not recommended to treat respiratory infections were excluded.

Figure 2
A. Number of Antibiotic Prescriptions Dispensed per 100,000 Population in 2020 vs 2017-2019 Average by Antibiotic Class



B. Number of Antibiotic Prescriptions Dispensed per 100,000 Population in 2020 vs 2017-2019 Average by Age Group

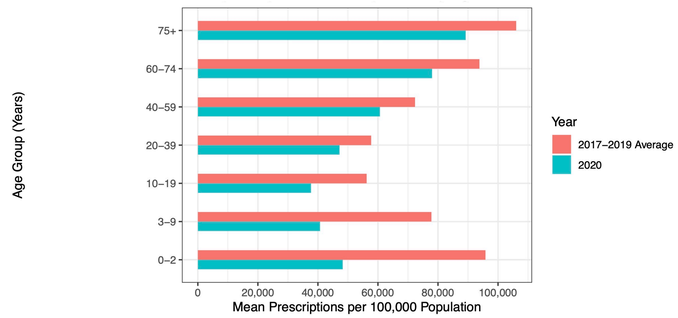


Figure 2A. Prescribing of Quinolones dropped the most (28.9%) and tetracyclines dropped the least (3.13%), while other classes showed negligible changes. Figure 2B. The largest change by age group was observed among children 0-2 years old, dropping 49.6%, while prescribing to adults aged 75+ dropped only 15.8%.

Data	Source
Number of Prescriptions (TRX) Defined Daily Doses (DDD)	IQVIA WHO ATC/DDD Index
COVID-19 Cases	New York Times
COVID-19 Tests	Johns Hopkins Coronavirus Resource Center
Number of physicians' offices Percent of the population living in poverty Percent of the population of people of color	US Census Bureau
Urbanization level	National Center for Health Statistics
Internal movement restrictions Facial coverings	Oxford COVID-19 Government Response Tracker
School status by county	MCH Strategic Data
School status by state	EducationWeek

Results

- For each 1% increase in monthly COVID-19 cases per 100,000, there was an associated 0.009% increase in prescriptions per 100,000.
- Prior years' prescribing trends and physicians' offices per 100,000 had the strongest associations with prescriptions per 100,000.
- Closing schools, internal movement restrictions, and requiring facemasks did not have a significant relationship with prescribing among all ages but did have a significant negative relationship in the sub-analysis using prescriptions among children.

Table 1
Effect of COVID-19 Cases on County-level Number of Prescriptions Dispensed (TRX), United States, February – December 2020

	Log of Monthly TRX per 100,000 Total Population	Log of Monthly TRX per 100,000 Children 0-9 Years Old
	Coefficient (95% CI)	Coefficient (95% CI)
Log of Monthly COVID-19 Cases per 100,000 Population	0.009*** (0.007 – 0.011)	-0.012*** (-0.017 – -0.008)
Log of Monthly COVID-19 Tests per 100,000 Population	-0.011** (-0.021 – -0.000)	-0.039*** (-0.058 – -0.019)
Log of 2017-2019 Monthly TRX per 100,000 Population	0.647*** (0.634 – 0.661)	0.556*** (0.541 – 0.570)
Log of Physician Offices per 100,000 Population	0.095*** (0.086 – 0.103)	0.102*** (0.092 – 0.112)
Percent of Population in Poverty	0.008*** (0.005 – 0.011)	0.011*** (0.007 – 0.015)
Percent of Population of People of Color	-0.002*** (-0.003 – -0.001)	-0.003*** (-0.005 – -0.002)
School Status (Reference = Closed)		
Hybrid/Other/Unknown	0.006 (-0.003 – 0.015)	0.030*** (0.013 – 0.046)
Open	0.005 (-0.006 – 0.016)	0.044*** (0.024 – 0.065)
Internal Movement Restrictions (Reference = No restrictions/Recommended)		
Restrictions in place	-0.003 (-0.011 – 0.006)	-0.030*** (-0.047 – -0.013)
Facial Coverings (Reference = No policy/Recommended/Required in some places)		
Required in all places outside the home	-0.007 (-0.020 – 0.007)	-0.029** (-0.054 – -0.004)
Urbanization Level (Reference = Large Central Metro)		
Large Fringe Metro	-0.127*** (-0.208 – -0.045)	-0.164*** (-0.264 – -0.063)
Medium Metro	-0.101** (-0.184 – -0.019)	-0.094* (-0.196 – 0.008)
Small Metro	-0.056 (-0.140 – 0.027)	-0.072 (-0.176 – 0.031)
Micropolitan	-0.069* (-0.151 – 0.013)	-0.027 (-0.128 – 0.074)
Noncore	-0.088** (-0.171 – -0.006)	-0.078 (-0.180 – 0.023)

*** p<0.01, ** p<0.05, * p<0.1

Conclusions

- Increases in prescribing likely occurred primarily among adults.
- A fraction of these prescriptions may have been inappropriate.
- Facemasks and school closures may have prevented other upper respiratory infections among children.
- Behavioral norms appear to be an important driver of prescribing.

Main Limitations

- Ecological study design means results are correlative not causative.
- NPI data were at the state level not the county level and do not account for heterogeneity within counties.
- IQVIA data do not include diagnostic information and represent where the prescription was filled not where the patient lived.

Questions for Future Research

1. Why do clinicians continue to prescribe antibiotics for viral infections and how can this behavior be modified?
2. What constitutes "prescribing norms"? How do they drive variation in use?

References

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