

THE INTERSECTION OF

Antibiotic Resistance (AR), Antibiotic Use (AU), and COVID-19

for the Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria

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CDC AR Investments Support U.S. through Pandemic

- 500+ experts in infection prevention and control, HAI, AR, laboratorians responding domestically
- AR Lab Network in 50 states, several cities, territories to provide COVID-19 testing and identify AR outbreaks
- Data collection systems, like the National Healthcare Safety Network, gather COVID-19 and AR/AU data
- CDC antibiotic stewardship tools for frontline workers
- Infection control experts responding globally to COVID-19
- Building on foundational innovations for AR sewage surveillance to detect COVID-19 in wastewater
- Leverage antibiotic stockpile for continuity of TB treatment due to drug shortages



CDC
Funding
2016-2020:

\$558+ million

across all 50 state and several local health departments for detection/prevention

CDC has invested

\$160+ million

in 100+ institutions to investigate AR innovations across One Health

Key Takeaways: AR Infections

- **Healthcare infection control is critical to fight AR and COVID-19.**
 - No clear evidence that patients with COVID-19 are more susceptible to bacterial/fungal infections—similar frequency as patients with influenza-like illness (ILI). **However, sporadic outbreaks of AR infections in COVID-19 units & higher rates of hospital-onset infections are being reported.**
 - COVID-19 can create a perfect storm for AR infections **in healthcare settings**: increased length of stay, increased number of patients, staffing shortages, sick patients, antibiotic use, challenges implementing infection prevention and control.
- Some preliminary analyses have identified **increases in hospital-onset resistant infections** (e.g., MRSA) and potential changes for community-onset infections.
 - Given the significant changes in **healthcare utilizations and, possibly, lab testing** (due to supply issues) during the pandemic, additional analyses are needed to assess the net impacts on AR threat pathogens.
- Findings highlight **continued importance of healthcare infection control** as one of the foremost tools needed to address emerging infectious diseases.

AR Pathogen Outbreaks and COVID-19

- CDC and public health partners responded to 20 outbreaks of AR pathogens in COVID-19 treatment and observation units since April 2020
- 2 MMWRs about outbreaks from Urgent Threats in hospitals during COVID-19 surges



New Jersey: 34 cases of carbapenem-resistant *Acinetobacter baumannii* attributed to changes in infection prevention and control practices¹



Florida: 39 cases of *Candida auris* attributed to unconventional PPE practices and environmental contamination²

- Outbreaks resolve after surge but long-term impact on spread of AR pathogens in a region is uncertain

¹Perez S, Innes GK, Walters MS, et al. Increase in Hospital-Acquired Carbapenem-Resistant *Acinetobacter baumannii* Infection and Colonization in an Acute Care Hospital During a Surge in COVID-19 Admissions – New Jersey, February–July 2020. MMWR Morb Mortal Wkly Rep 2020;69:1827–1831.

²Prestel C, Anderson E, Forsberg K, et al. *Candida auris* Outbreak in a COVID-19 Specialty Care Unit – Florida, July–August 2020. MMWR Morb Mortal Wkly Rep 2020; 70:56–57.

Key Takeaways: Antibiotic Use



- **Hospitals: Lots of variability.**
 - Overall increases in some agents (azithromycin/ceftriaxone). No national increases in broad spectrum agents; some facilities have seen shifting.
 - Decreases in overall prescribing vary; facilities with more COVID-19 cases had higher rates of prescribing on average for azithromycin/ ceftriaxone.
- **Outpatient: Significant drop in antibiotic prescribing.**
 - Drop appears related to decrease in healthcare utilization; however, antibiotic use has remained lower than pre-pandemic levels even as healthcare utilization has risen.
- **Nursing Homes: Spikes in use.**
 - Spikes were greatest early in the pandemic and subsequent increases were lower.

About Data Shown Today



Preliminary data provide the largest snapshot to date about relative burden of AR infections and antibiotic use in U.S. patients with COVID-19.



Hospital data reflect:

- Infection data from 150+ hospitals and 14,000 hospital discharges
- Antibiotic use data from 1,400+ hospitals & 4+ million hospital discharges
- 2 data systems: CDC's National Healthcare Safety Network and Premier Healthcare Database



Outpatient data reflect:

- National estimates extrapolated from 92% of retail prescriptions (IQVIA data)

Nursing home data reflect:

- Pharmacy info based on PharMerica data from 1,900 U.S. nursing homes

AR Pathogens & SARS-CoV-2 in Hospitalized Patients



Patient Discharge Data: Flu & COVID-19

	Patients with Influenza-Like Illness (Jan-March 2019)	Patients with COVID-19 (Jan-October 2020)
Median length of stay	5.88 days	8.20 days
Discharges with bacterial/fungal culture	55.8%	56.7%
Discharges with an AR-positive culture with a susceptibility result	12.4%	9.1%

Source: Premier Healthcare Database

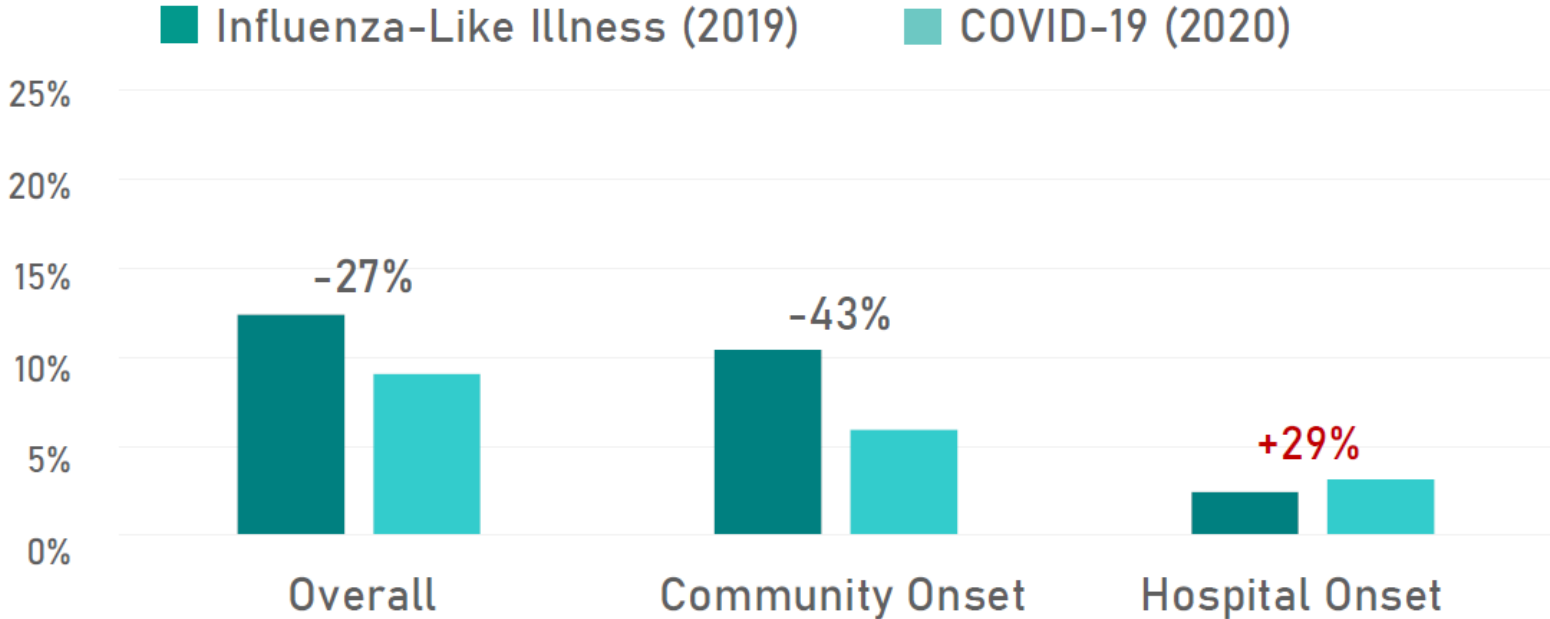
Influenza-Like Illness Definition: A hospitalization with a discharge during January 1, 2019–March 30, 2019, and any of the following ICD-10-CM codes: B97.89, H66.9, H66.90, H66.91, H66.92, H66.93, J00, J01.9, J01.90, J06.9, J09.X, J10.X, J11.X, J12.89, J12.9, J18, J18.1, J18.8, J18.9, J20.9, J40, R05, R50.9

COVID-19 Definition: An ICD-10-CM code of U07.1 (confirmed) with a discharge date April–October 2020 or ICD-10-CM code of B97.29 (suspected) with a discharge date March–April 2020, and admission dates February–April 2020

Data collected January 10, 2021

Frequency of Positive Cultures from Patients with COVID-19 and ILI

Proportion of discharges with a positive culture



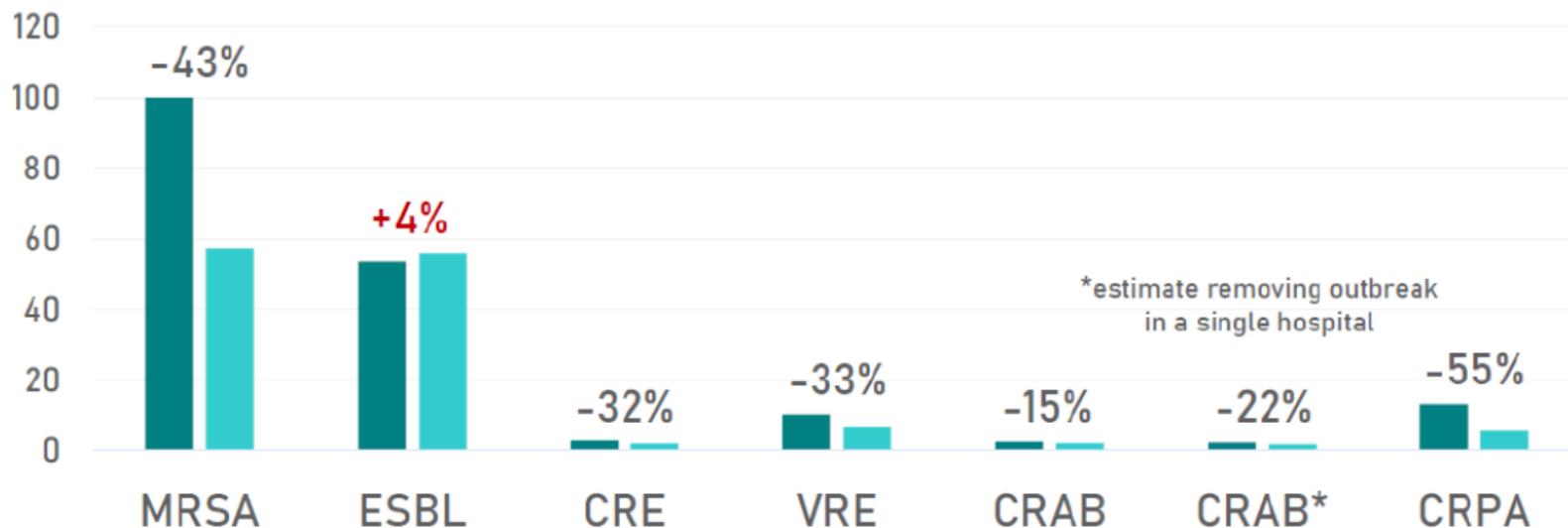
Source: Premier Healthcare Database

Preliminary unpublished analysis, please do not reproduce without permission

AR Pathogens in Hospitalized Patients: Community-Onset Infections Only

Rate of community-onset resistant organisms per 10,000 discharges

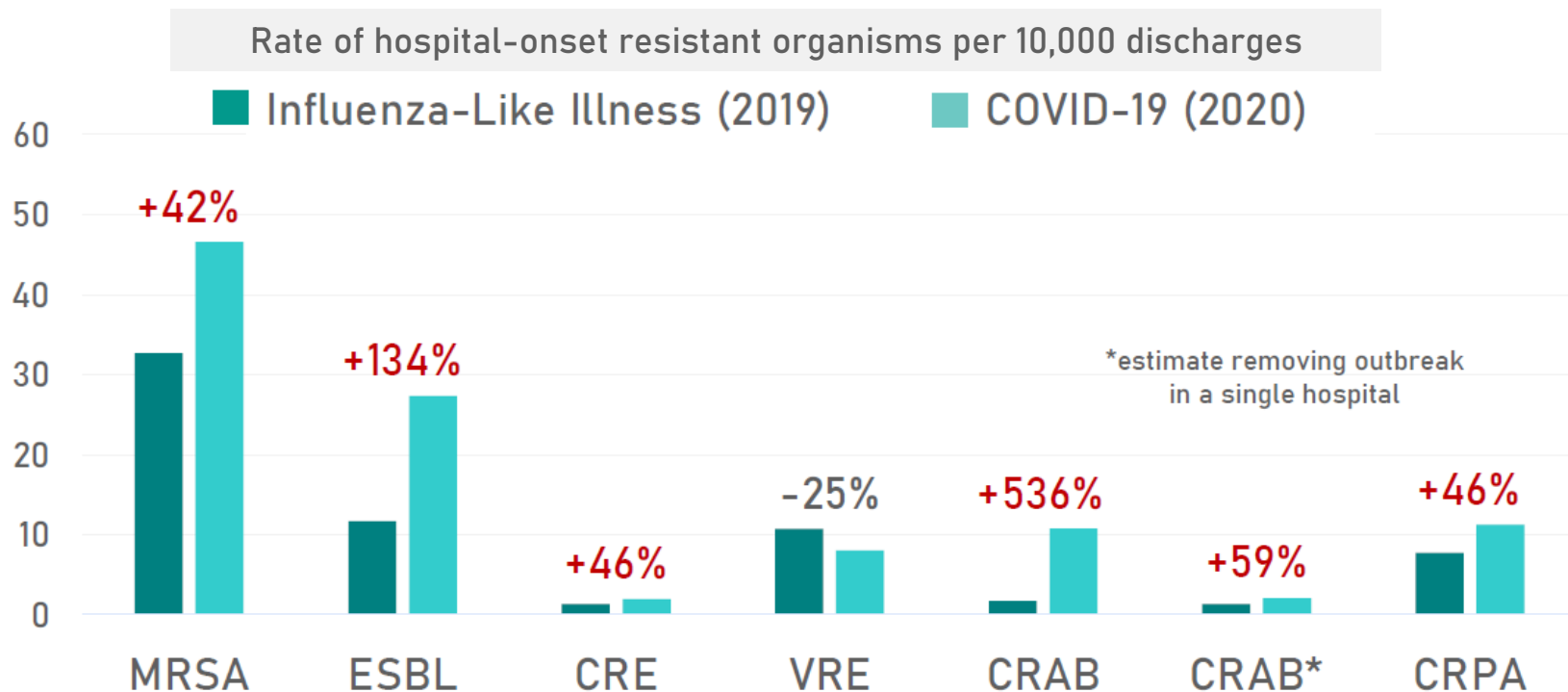
Influenza-Like Illness (2019) COVID-19 (2020)



Source: Premier Healthcare Database

Preliminary unpublished analysis, please do not reproduce without permission

AR Pathogens in Hospitalized Patients: Hospital-Onset Infections Only



Source: Premier Healthcare Database

Preliminary unpublished analysis, please do not reproduce without permission

Increase in Healthcare-Onset MRSA Bacteremia SIR in 2020: Quarter 2

	2019 Q2	2020 Q2	Difference in Pooled Values (2020-2019) N (%)
# Hospitals	3,039	3,039	
# Hospitals with ≥ 1 HO event	890	882	-8 (-0.9%)
HO MRSA Events	1,690	1,704	14 (0.8%)
# Predicted HO MRSA	2,064.55	1,813.43	-251.12 (-12.2%)
Patient Days	32,937,724	28,058,539	-4,879,185 (-14.8%)
> Inpatient HO MRSA Rate	5.1	6.1	0.9 (18.4%)
SIR	0.82	0.94	0.12 (14.8%)
Inpatient CO MRSA Events	4,119	3,737	-382 (-9.3%)
Admissions	7,719,330	6,368,916	-1,350,414 (-17.5%)
> Inpatient CO MRSA Rate	5.3	5.9	0.5 (10.0%)
Outpatient MRSA Events	10,615	10,463	-152 (-1.4%)
Outpatient Encounters	28,792,424	19,056,924	-9,735,500 (-33.8%)
> Outpatient MRSA Rate	3.7	5.5	1.8 (48.9%)

Source: National Healthcare Safety Network (NHSN)

Larger Increases in Healthcare-Onset MRSA Bacteremia in 2020: Quarter 3

	2019 Q3	2020 Q3	Difference in Pooled Values (2020-2019) N (%)
# Hospitals	3,157	3,157	
# Hospitals with ≥ 1 HO event	929	1,082	153 (16.5%)
HO MRSA Events	1,873	2,364	491 (26.2%)
# Predicted HO MRSA	2,339.17	2,359.80	20.63 (0.9%)
Patient Days	37,062,230	36,285,640	-776,590 (-2.1%)
> Inpatient HO MRSA Rate	5.1	6.5	1.5 (28.9%)
SIR	0.80	1.00	0.20 (25.1%)
Inpatient CO MRSA Events	4,620	4,399	-221 (-4.8%)
Admissions	8,747,884	8,157,200	-590,684 (-6.8%)
> Inpatient CO MRSA Rate	5.3	5.4	0.1 (2.1%)
Outpatient MRSA Events	12,277	12,919	642 (5.2%)
Outpatient Encounters	31,896,130	25,779,810	-6,116,320 (-19.2%)
> Outpatient MRSA Rate	3.8	5.0	1.2 (30.2%)

Source: National Healthcare Safety Network (NHSN)

Preliminary unpublished analysis, please do not reproduce without permission

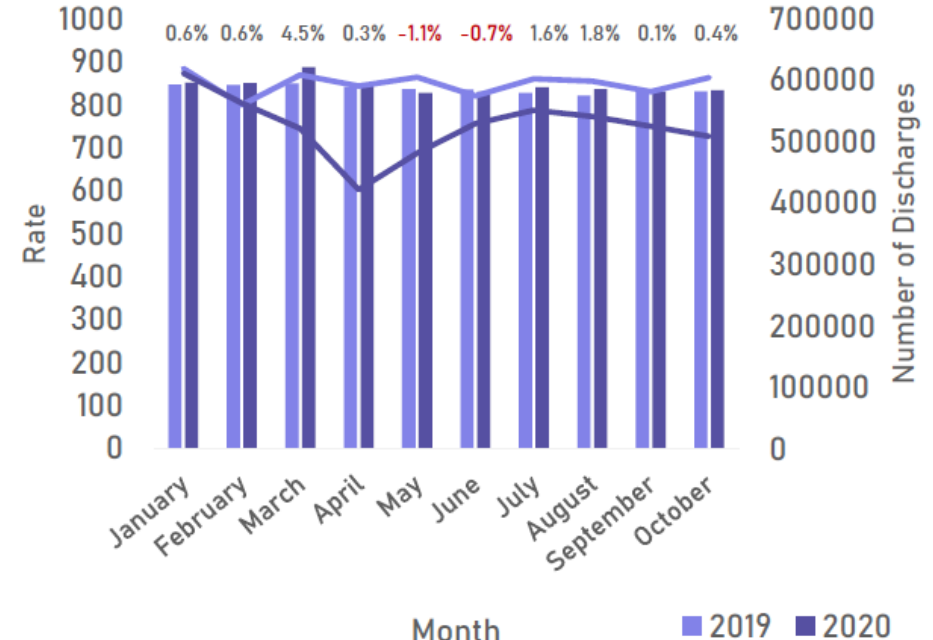
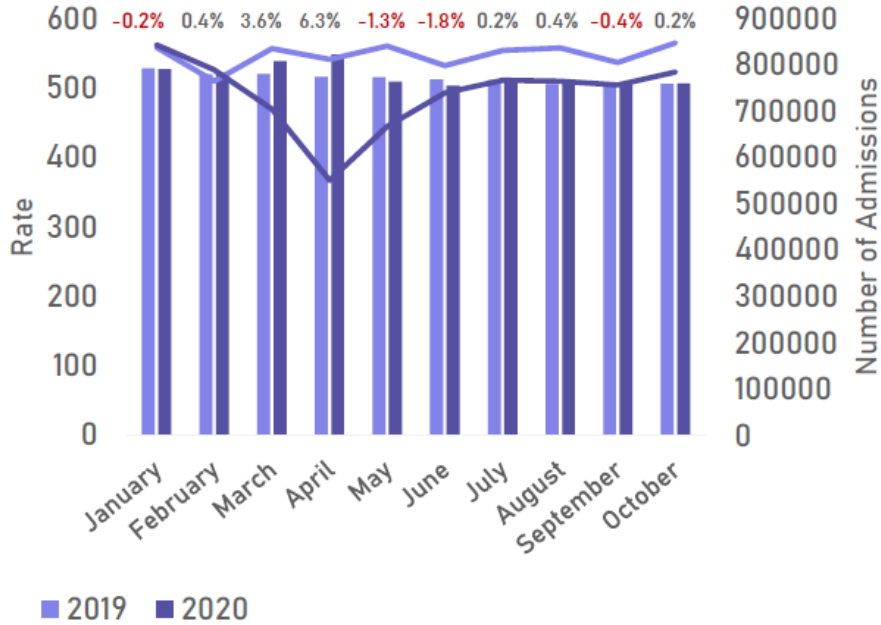
Antibiotic Use During the COVID-19 Pandemic - Hospitals



Aggregate Hospital Antibiotic Use: All Antibiotics

National Healthcare Safety Network (710 hospitals)
Days of Therapy per 1,000 Days Present – All Antibacterial Agents

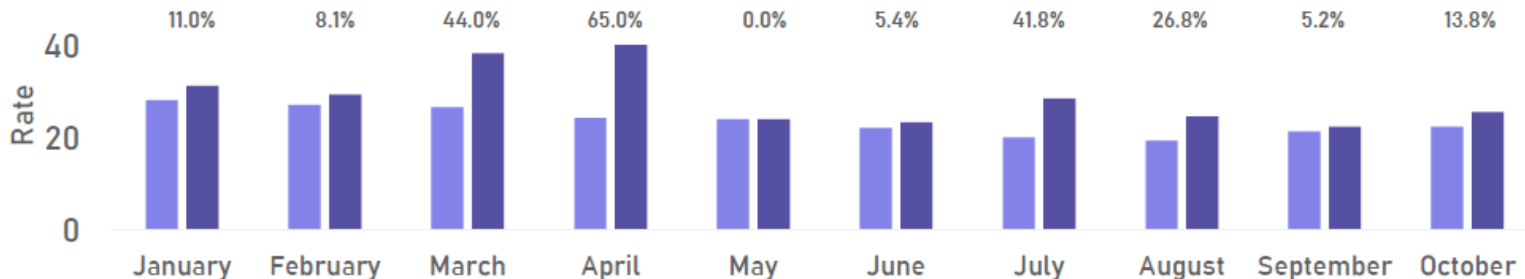
Premier Healthcare Database (716 hospitals)
Days of Therapy per 1,000 patient days – All Antibacterial Agents



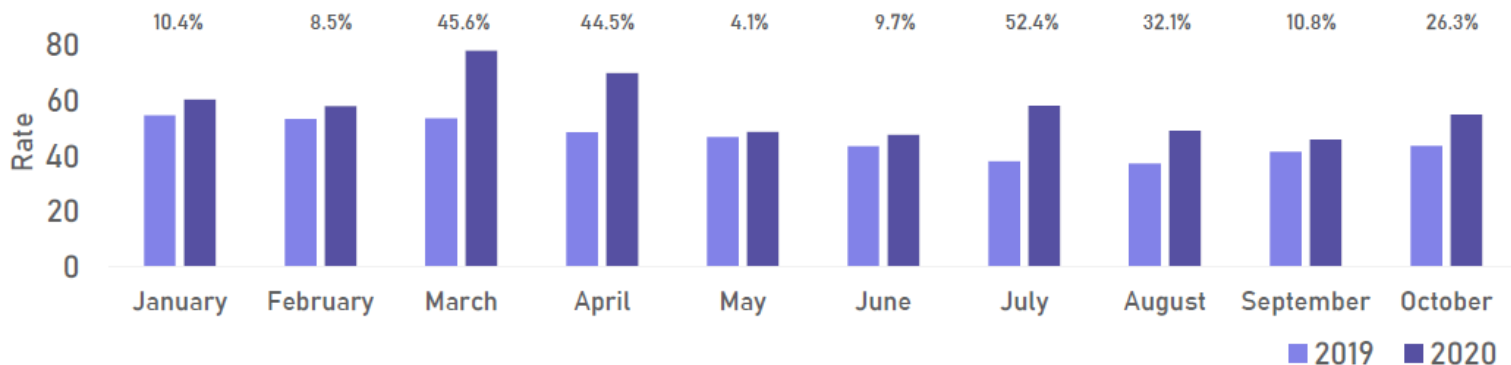
Note: NHSN AU days present denominator counts any portion of a day when a patient was hospitalized and thus is larger than the Premier patient day denominator, which counts 24-hour periods.
% indicates percent difference in pooled mean rate by year.

Aggregate Hospital Antibiotic Use: Azithromycin

National
Healthcare
Safety Network
(710 hospitals)
Days of Therapy per
1,000 Days Present -
Azithromycin



Premier
Healthcare
Database
(716 hospitals)
Days of Therapy per
1,000 patient days-
Azithromycin

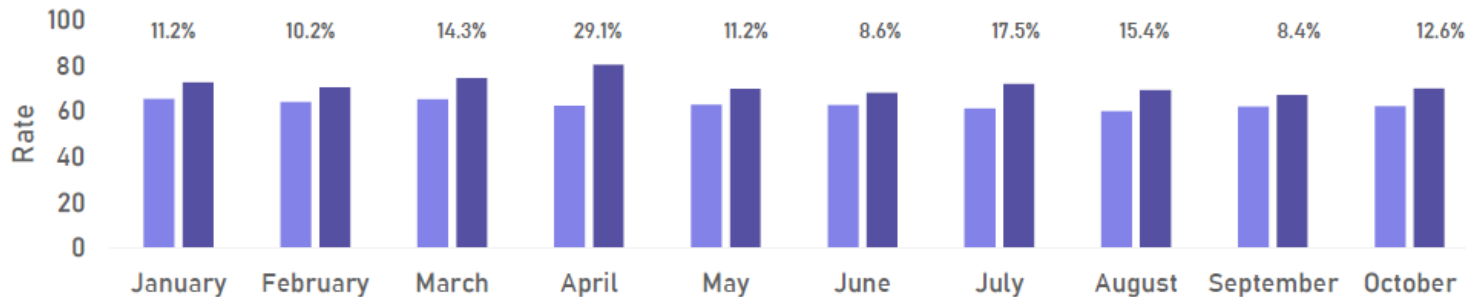


Note: NHSN AU days present denominator counts any portion of a day when a patient was hospitalized and thus is larger than the Premier patient day denominator, which counts 24-hour periods.
% indicates percent difference in pooled mean rate by year.

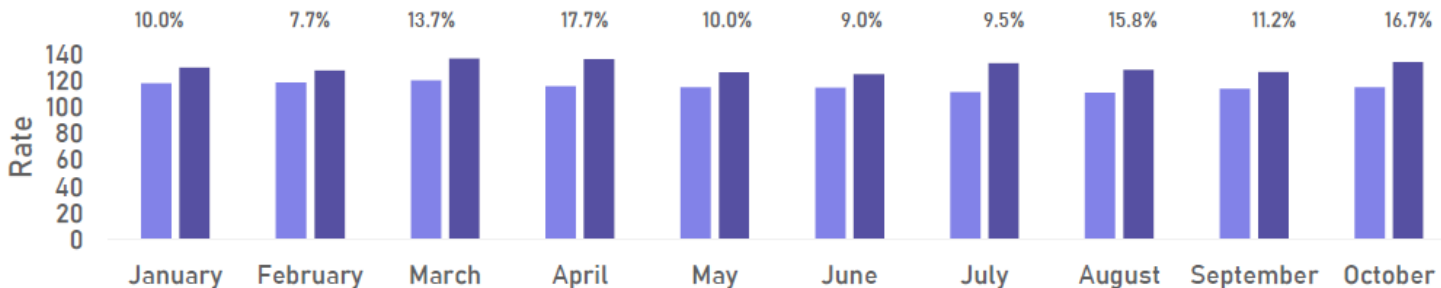
Preliminary unpublished analysis, please do not reproduce without permission

Aggregate Hospital Antibiotic Use: Ceftriaxone

National
Healthcare
Safety Network
(710 hospitals)
Days of Therapy per
1,000 Days Present –
Ceftriaxone



Premier
Healthcare
Database
(716 hospitals)
Days of Therapy per
1,000 patient days–
Ceftriaxone



■ 2019 ■ 2020

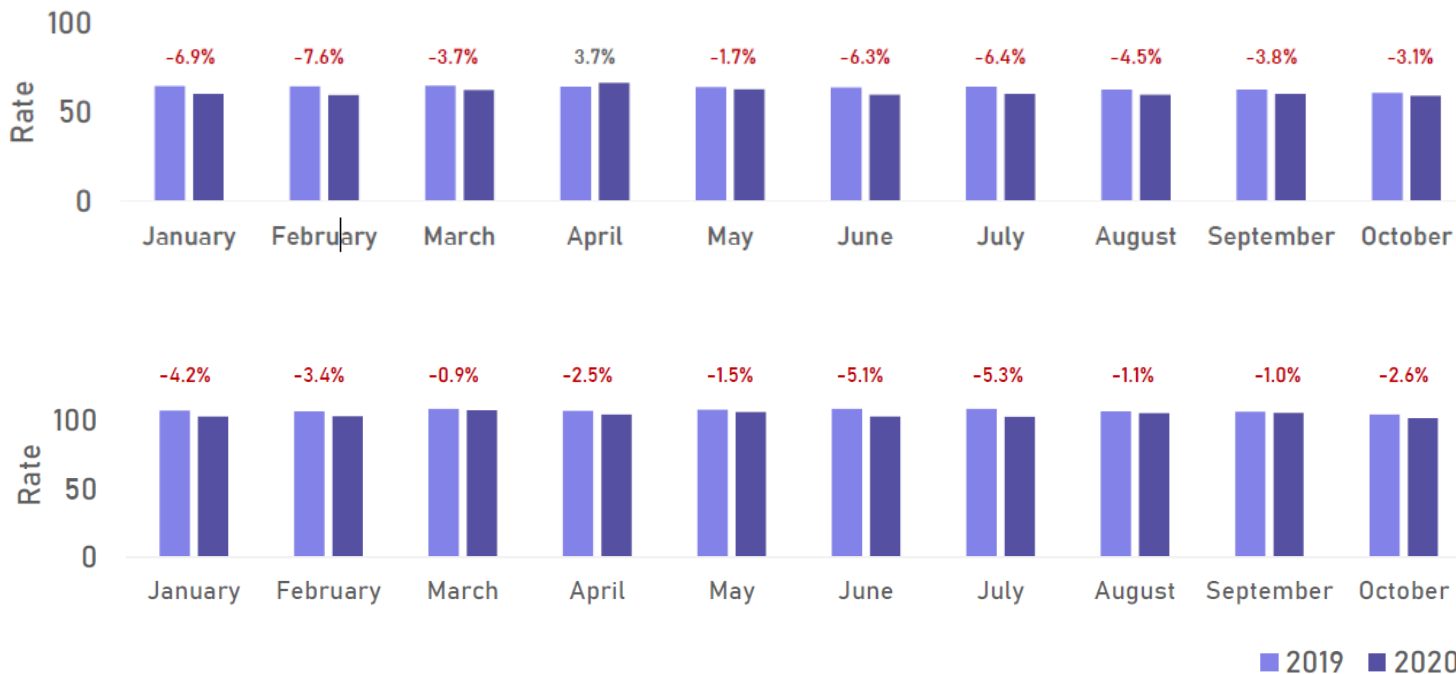
Note: NHSN AU days present denominator counts any portion of a day when a patient was hospitalized and thus is larger than the Premier patient day denominator, which counts 24-hour periods.
% indicates percent difference in pooled mean rate by year.

Preliminary unpublished analysis, please do not reproduce without permission

Aggregate Hospital Antibiotic Use: Piperacillin-Tazobactam

National
Healthcare Safety
Network (710
hospitals)
Days of Therapy per
1,000 Days Present –
Piperacillin-
Tazobactam

Premier
Healthcare
Database
(716 hospitals)
Days of Therapy per
1,000 patient days–
Piperacillin-Tazobactam



Note: NHSN AU days present denominator counts any portion of a day when a patient was hospitalized and thus is larger than the Premier patient day denominator, which counts 24-hour periods.
% indicates percent difference in pooled mean rate by year.

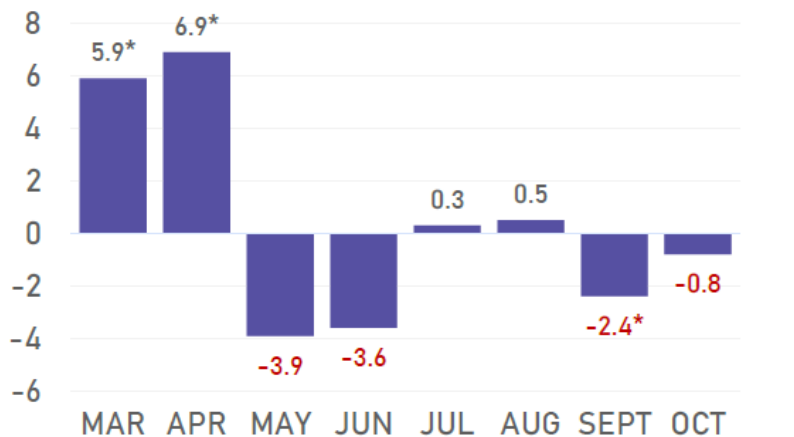
Preliminary unpublished analysis, please do not reproduce without permission

Hospital-Level Antibiotic Use: Azithromycin

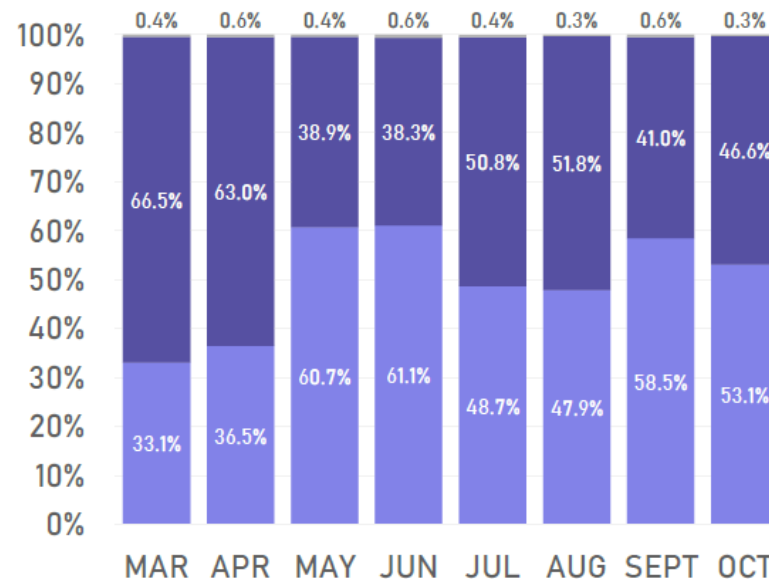
National Healthcare Safety Network (710 hospitals)

Median shifts in prescribing when a hospital is compared to itself and normalized to January 2020 – Azithromycin

Percent of facilities with a positive increase in antibiotic use, normalized to January 2020 – Azithromycin



*indicates statistical significance



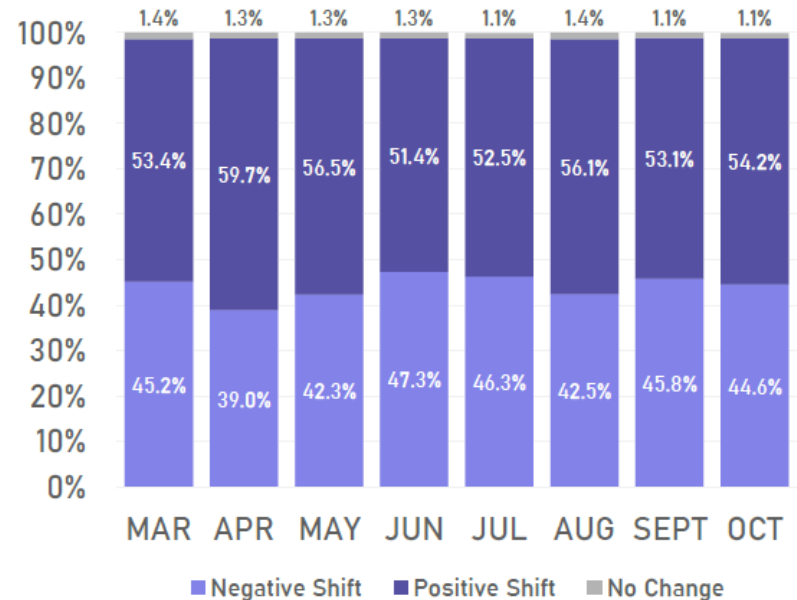
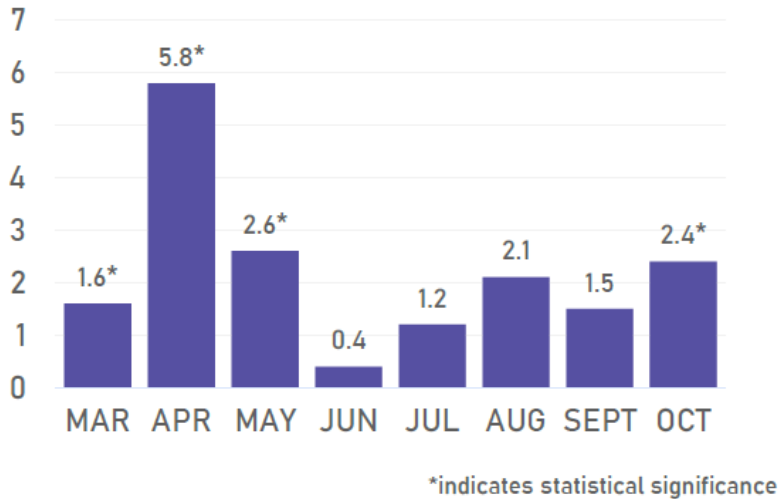
■ Negative Shift ■ Positive Shift ■ No Change

Hospital-Level Antibiotic Use: Piperacillin-Tazobactam

National Healthcare Safety Network (710 hospitals)

Median shifts in prescribing when a hospital is compared to itself and normalized to January 2020 – Piperacillin-Tazobactam

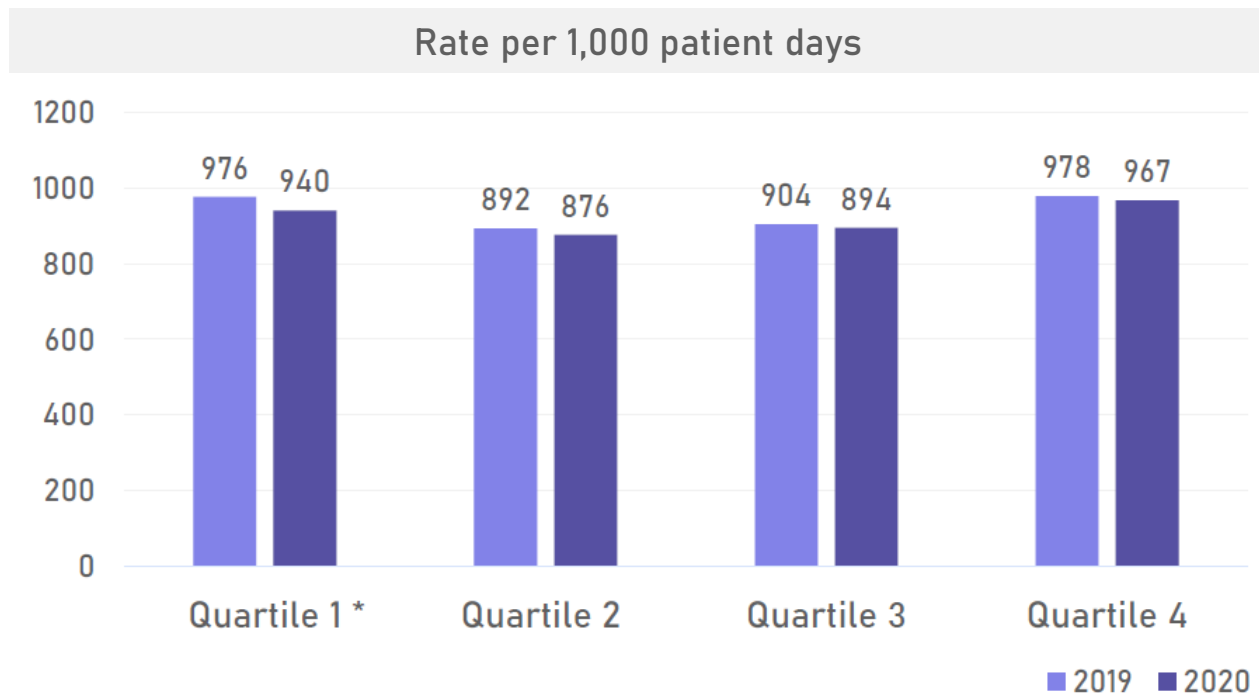
Percent of facilities with a positive increase in antibiotic use, normalized to January 2020 – Piperacillin-Tazobactam



Hospital Antibiotic Use: All Antibiotics

Based on COVID-19 Burden – Premier Data

Premier Healthcare Database
(716 hospitals)
Median Total Antibiotic Use during
March-October per 1,000 patient days by
COVID-19 Hospital Burden



Hospitals were categorized into quartiles by COVID-19 burden based on the rate of COVID-19 cases per 10,000 discharges for each hospital and month.

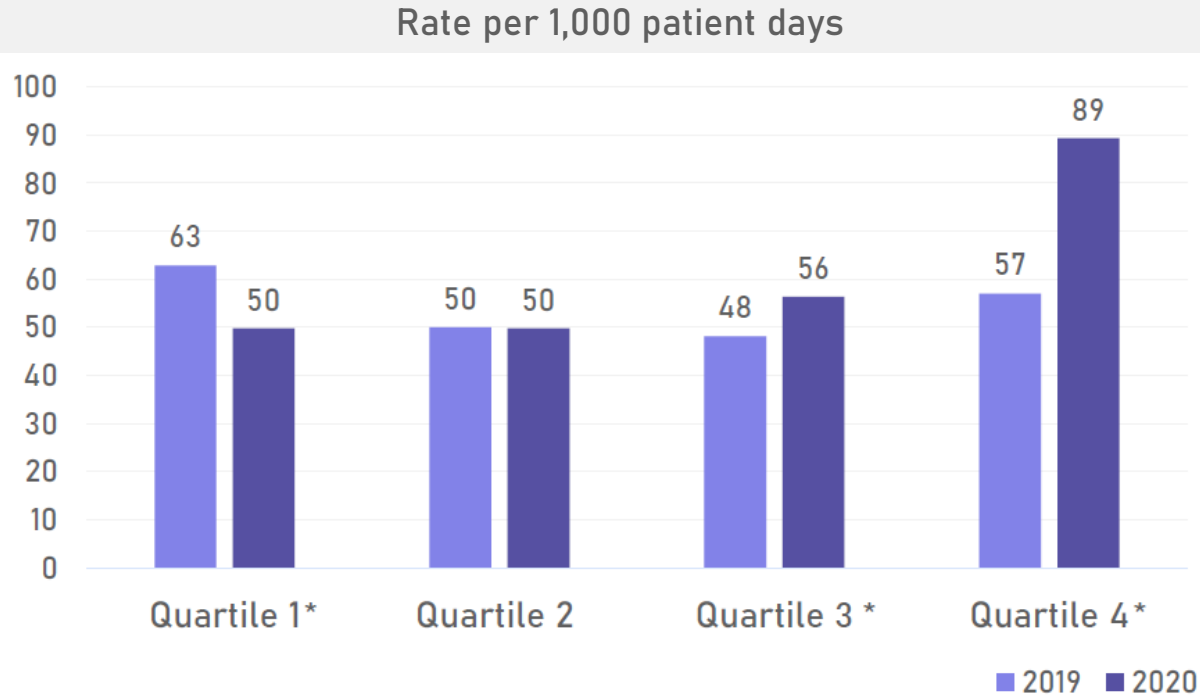
*indicates statistical significance

Preliminary unpublished analysis, please do not reproduce without permission

Hospital Antibiotic Use: Azithromycin

Based on COVID-19 Burden – Premier Data

Premier Healthcare Database
(716 hospitals)
Median Azithromycin Use per 1,000
patient days by COVID-19 Hospital Burden



Hospitals were categorized into quartiles by COVID-19 burden based on the rate of COVID-19 cases per 10,000 discharges for each hospital and month.

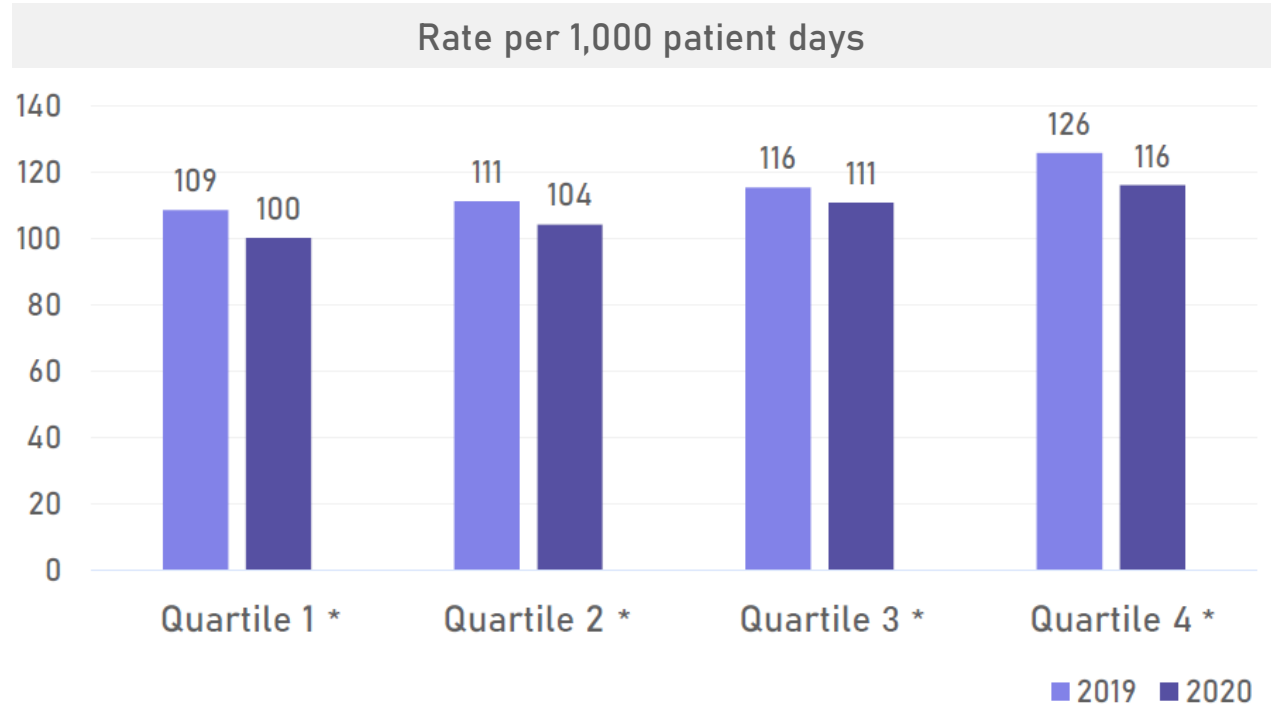
*indicates statistical significance

Preliminary unpublished analysis, please do not reproduce without permission

Hospital Antibiotic Use: Piperacillin-Tazobactam Based on COVID-19 Burden – Premier Data

Premier Healthcare Database
(716 hospitals)

Median Piperacillin-Tazobactam Use per
1,000 patient days by COVID-19 Hospital
Burden



Hospitals were categorized into quartiles by COVID-19 burden based on the rate of COVID-19 cases per 10,000 discharges for each hospital and month.

*indicates statistical significance

Preliminary unpublished analysis, please do not reproduce without permission

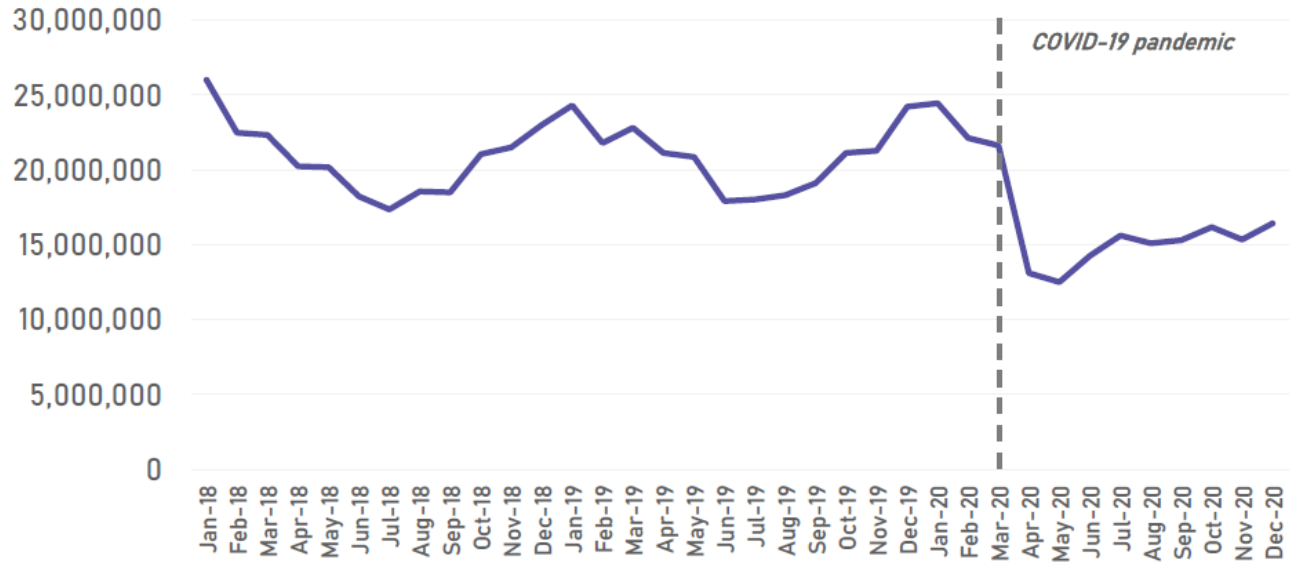
Antibiotic Use During the COVID-19 Pandemic - Outpatient



National Outpatient Antibiotic Prescription Trends

December 2020
32% year-over-year decrease
7% month-over-month
increase (*compared with 14%
MOM increase in Dec 2019*)

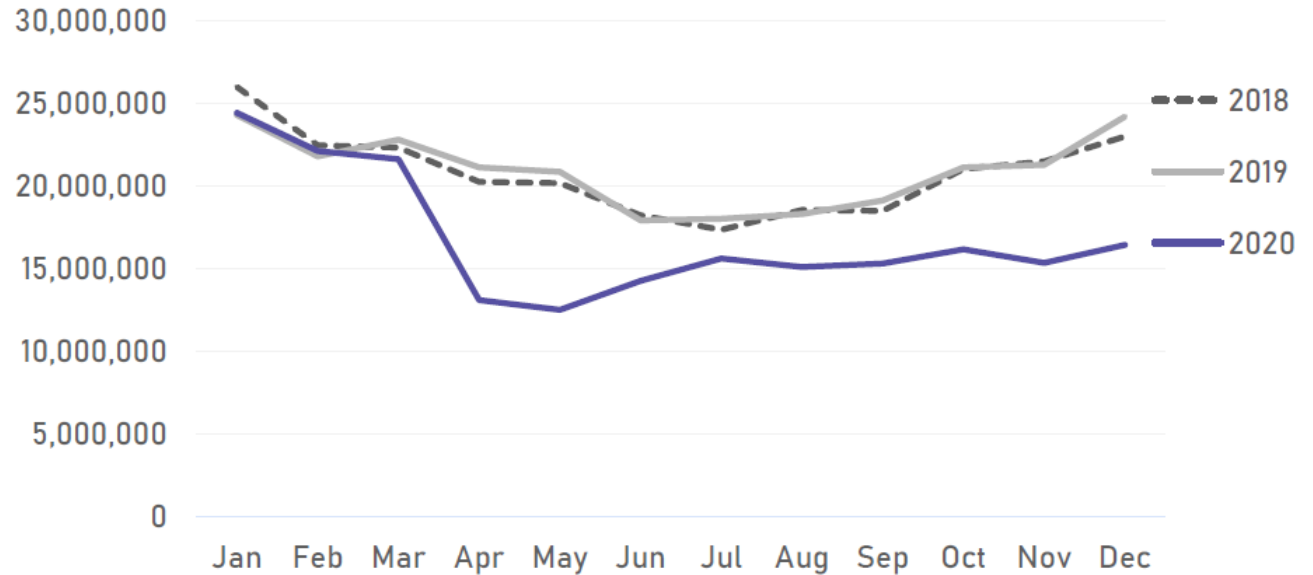
Number of antibiotic prescriptions dispensed from retail pharmacies



National Outpatient Antibiotic Prescription Trends

December 2020
32% year-over-year decrease
7% month-over-month increase (*compared with 14% MOM increase in Dec 2019*)

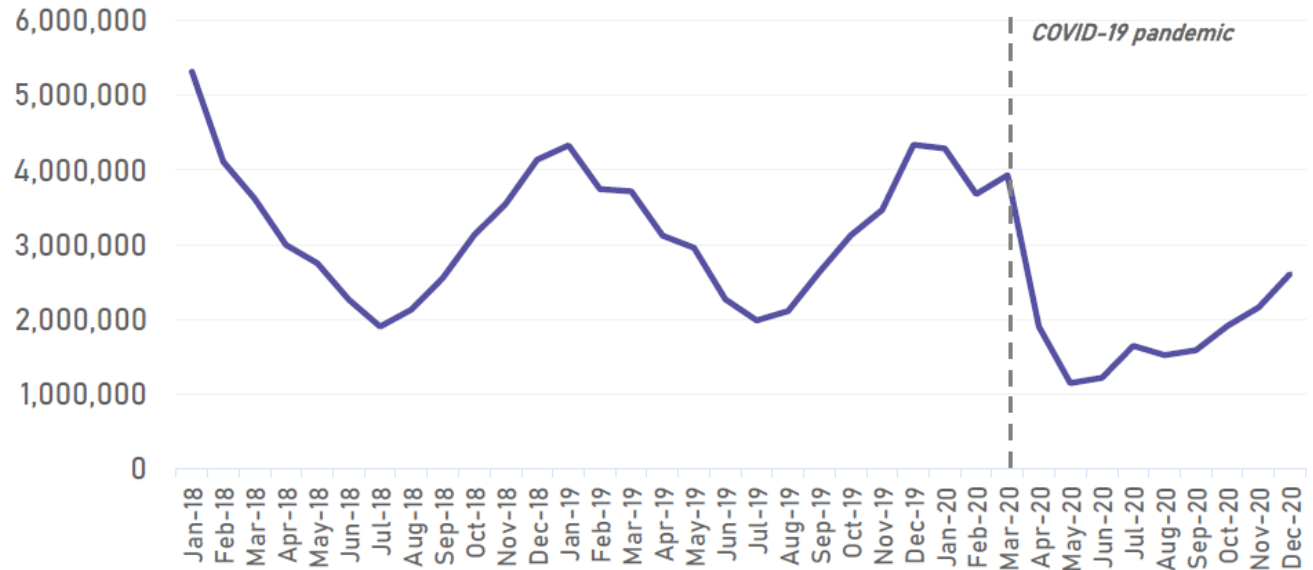
Number of antibiotic prescriptions dispensed from retail pharmacies



National Outpatient Antibiotic Prescription Trends: Azithromycin

December 2020
40% year-over-year decrease
21% month-over-month
increase (*compared with 25%
MOM increase in Nov 2019*)

Number of azithromycin prescriptions dispensed from retail pharmacies

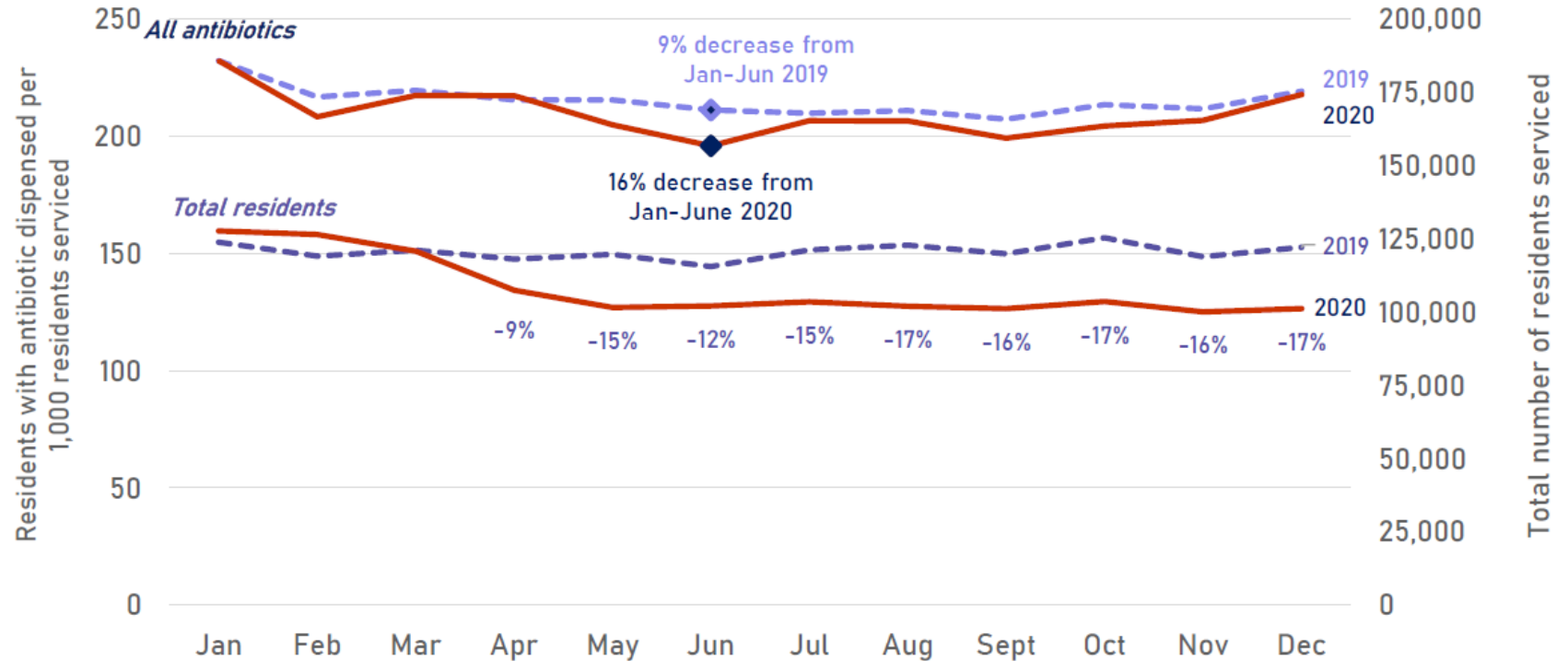


Antibiotic Use During the COVID-19 Pandemic – Nursing Homes



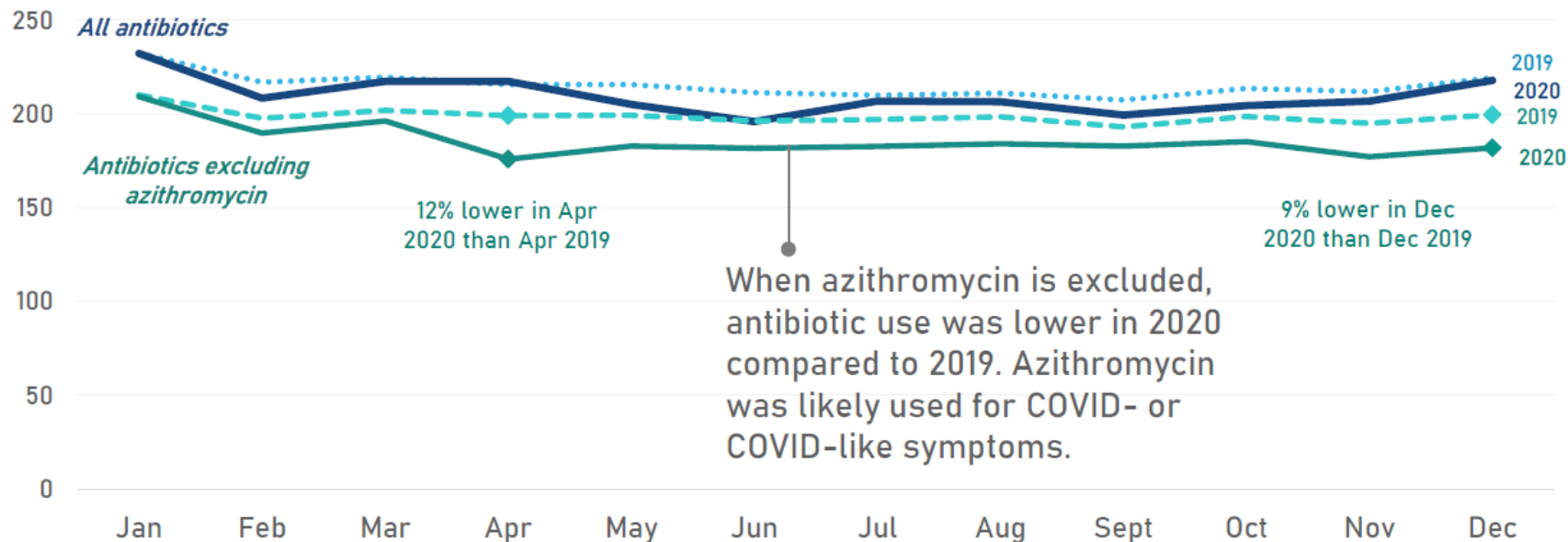
Nursing Home Antibiotic Dispensing Rates

Residents with antibiotic dispensed and total residents serviced, 2019 vs. 2020



Nursing Home Antibiotic Dispensing Rates

Residents with antibiotic dispensed per 1,000 residents serviced – Excluding Azithromycin



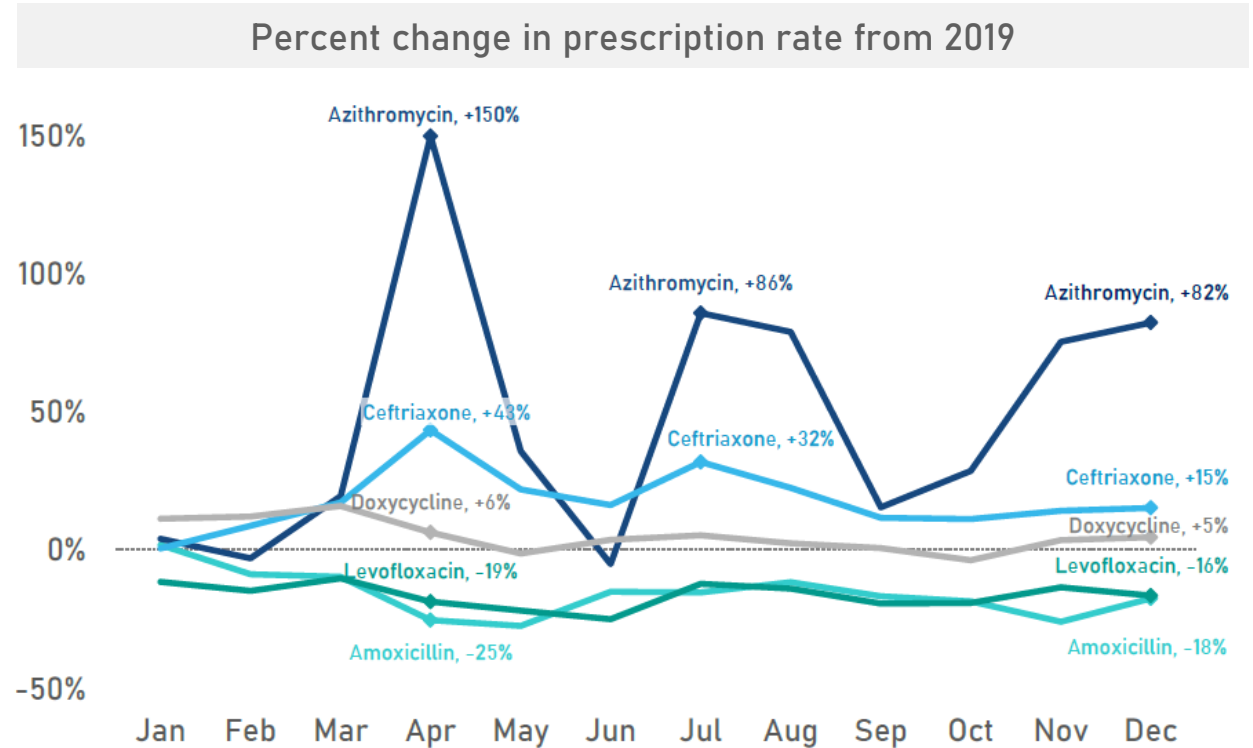
Higher Rates of Antibiotics Commonly Used for Respiratory Infections in Nursing Homes

Antibiotics higher in 2020 than 2019

- Azithromycin
- Ceftriaxone
- Doxycycline

Antibiotics lower in 2020 than 2019

- Levofloxacin
- Amoxicillin



More AR & COVID-19 Studies Coming from CDC

- Academic and healthcare collaborations to better understand COVID-19 and the impacts on AR/AU, some examples:
 - University of Pennsylvania
 - Washington University School of Medicine
 - Cook County Health, Rush University, and Northwestern Medicine
- Deeper dive on *C. auris* and COVID-19 in Orange County and Chicago
- **International collaborations** to explore bacterial/fungal infections and antibiotic use in patients with COVID-19 in South America and Asia
- Publications & additional studies from **preliminary data presented today**

Future Implications for AR & COVID-19

- Continued emphasis of **healthcare infection prevention and control** in infectious disease transmission **cannot be overestimated**
 - Spread of pathogens can be contained and outbreaks can be prevented but we must ensure ongoing robust infection control training, continuity of PPE supply, support for frontline healthcare providers
- **Support greater resiliency in antibiotic resistance and antibiotic use programs** in healthcare and state/local health departments
 - Without resiliency, critical work will not happen as new threats emerge
- Continued gathering and analysis of AR and AU data from multiple sources like those presented today is critically important as it allows resilience when some systems are impacted and provides a fuller picture of impact

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Maribeth Lovegrove
Natalie McCarthy
Melinda Neuhauser

Erin O'Leary
Lindsay Parnell
Sujan Reddy
Rebecca Roberts
Ashley Rose
Nadine Shehab
Alicia Shugart

Dawn Sievert
Minn Soe
Sharon Tsay
Maroya Walters
Amy Webb
Hannah Wolford
Hsiu Wu

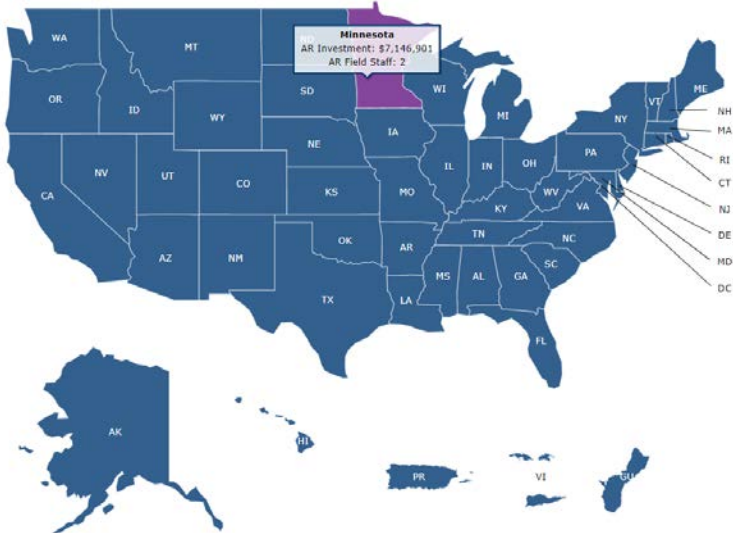
For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.



Find More Info on CDC's Efforts to Combat AR

CDC's AR Investment Map shows global-, state- and city-specific fact sheets showing how CDC invested \$118+ million in 2020 AR activities—plus a new AR & COVID-19 investment overview: <https://ARinvestments.cdc.gov>.



AR Solutions In Action
CDC's Investments to Combat Antibiotic Resistance Threats

FISCAL YEAR 2020

AR & COVID-19 Funding Help Stop Spread of Emerging Threats

Fiscal Year 2020
Sampling of Shared Activities

Many of the nation's efforts to prevent the spread of SARS-CoV-2 will also help in the fight against antibiotic resistance, including investments in infection control and prevention, training, surveillance, and public health personnel. The following represent many of those shared public health activities that CDC led in Fiscal Year 2020 using appropriations for AR or COVID-19.

- Building healthcare worker infection control capacity: Project Firstline**
 Project Firstline is a collaborative of healthcare and public health partners that provides engaging and innovative infection control training. Funded by COVID-19 supplemental appropriations, CDC works with health departments, academic institutions, and non-governmental healthcare and public health partners to provide the U.S. healthcare and public health workforce a foundational understanding of infection control to protect the nation from infectious disease threats, including COVID-19 and AR. [Learn more: www.cdc.gov/ProjectFirstline](http://www.cdc.gov/ProjectFirstline).
\$127,550,000
- Strengthening COVID-19 surveillance in healthcare personnel: Emerging Infections Program (EIP)**
 With COVID-19 supplemental appropriations, EIP has expanded existing HAI/AR surveillance projects to include COVID-19 surveillance among healthcare personnel. [Learn more: www.cdc.gov/hai/eip](http://www.cdc.gov/hai/eip).
\$6,300,000
- Infectious disease modeling to support prevention and response: MIND-Healthcare**
 AR funding supports the Modeling Infectious Diseases in Healthcare (MIND-Healthcare) Network, which uses mathematical modeling to guide prevention needs for AR pathogens. This network is now being leveraged to predict COVID-19's impact on healthcare resources and capacity. Grantees have developed statewide models of hospital and nursing home capacity, COVID-19 transmission dynamics within healthcare settings, models of transmission within specialty healthcare settings, and tools to leverage electronic health record data in real time to improve decision making. [Learn more: www.cdc.gov/ai/r/research/MIND-Healthcare](http://www.cdc.gov/ai/r/research/MIND-Healthcare).
\$4,875,665
- Supporting state, territorial, and local health departments: Epidemiology and Laboratory Capacity for Prevention and Control of Emerging Infectious Diseases (ELC)**
 AR funding supports more than 500 epidemiologists, laboratorians, and other public health professionals that serve in their states and local communities. These experts are critical to the nation's COVID-19 response, especially in health care. CDC provided funding to states, territories, and local jurisdictions through the ELC cooperative agreement to expand their capacity for COVID-19 response, including activities that will also help fight AR, such as improving healthcare infection control, especially in high-risk settings, and more effectively using data to drive prevention of emerging threats.
Varied by State

Page 2 of 2 This data represents CDC's largest funding categories for AR. It shows direct AR funding that supports AR activities from multiple fundings.

CDC provides critical support in the U.S. and abroad to protect people from antibiotic resistance.

ARinvestments.cdc.gov

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