COVID-19:
U.S. Impact on
Antimicrobial Resistance

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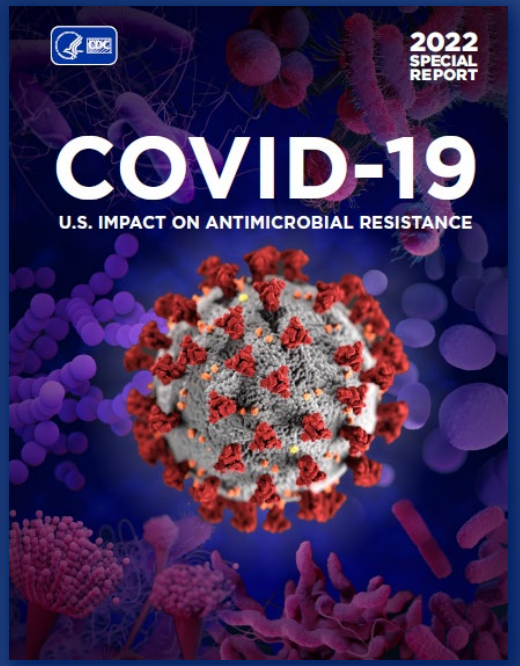
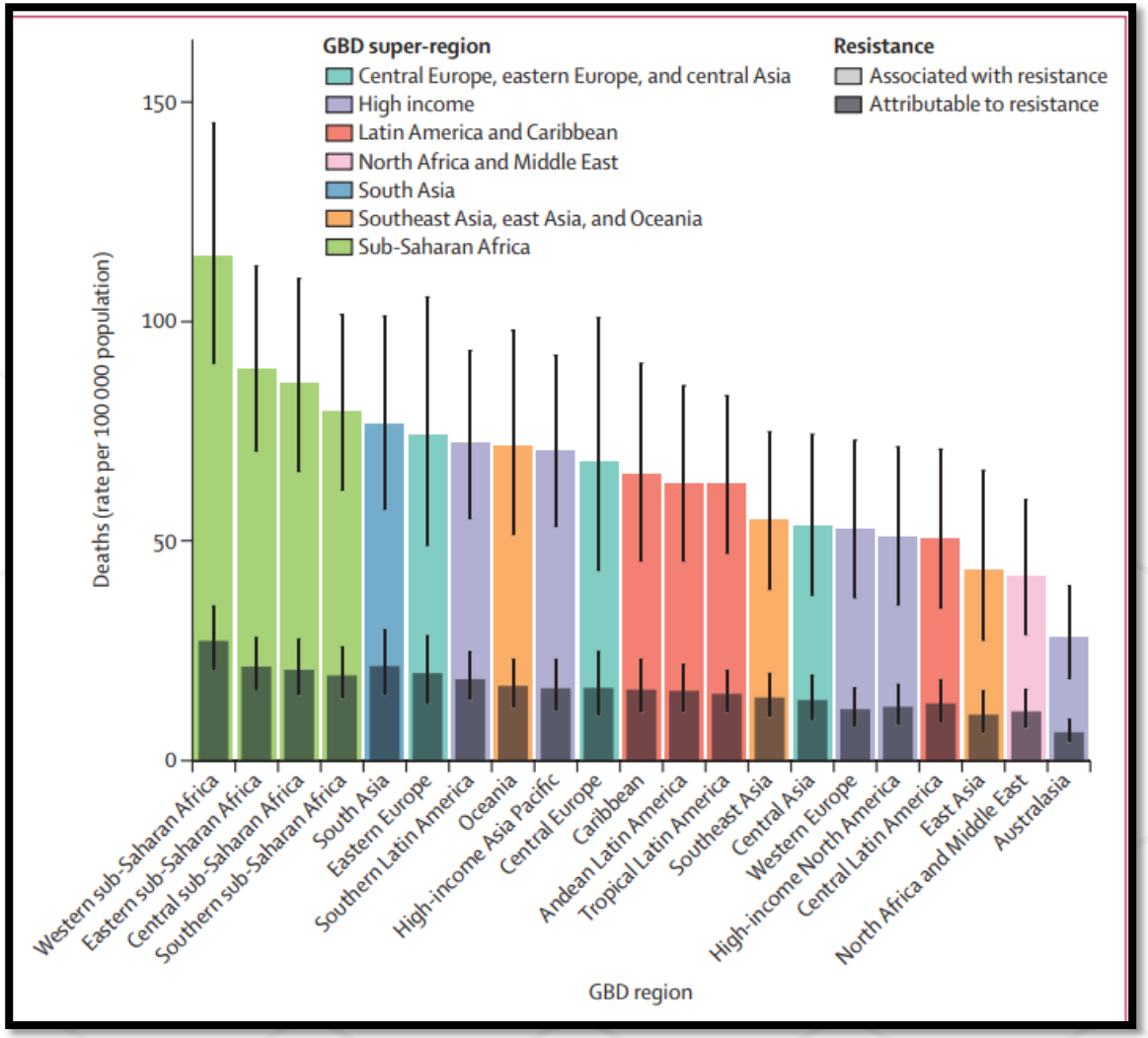


High-Burden of AR before COVID-19

- 1.27 million deaths estimated to be caused by bacterial AMR in 2019
  - Higher than previous estimates

- Leading pathogens: *E. coli, S. aureus, K. pneumoniae, S. pneumoniae, A. baumannii*, and *P. aeruginosa*



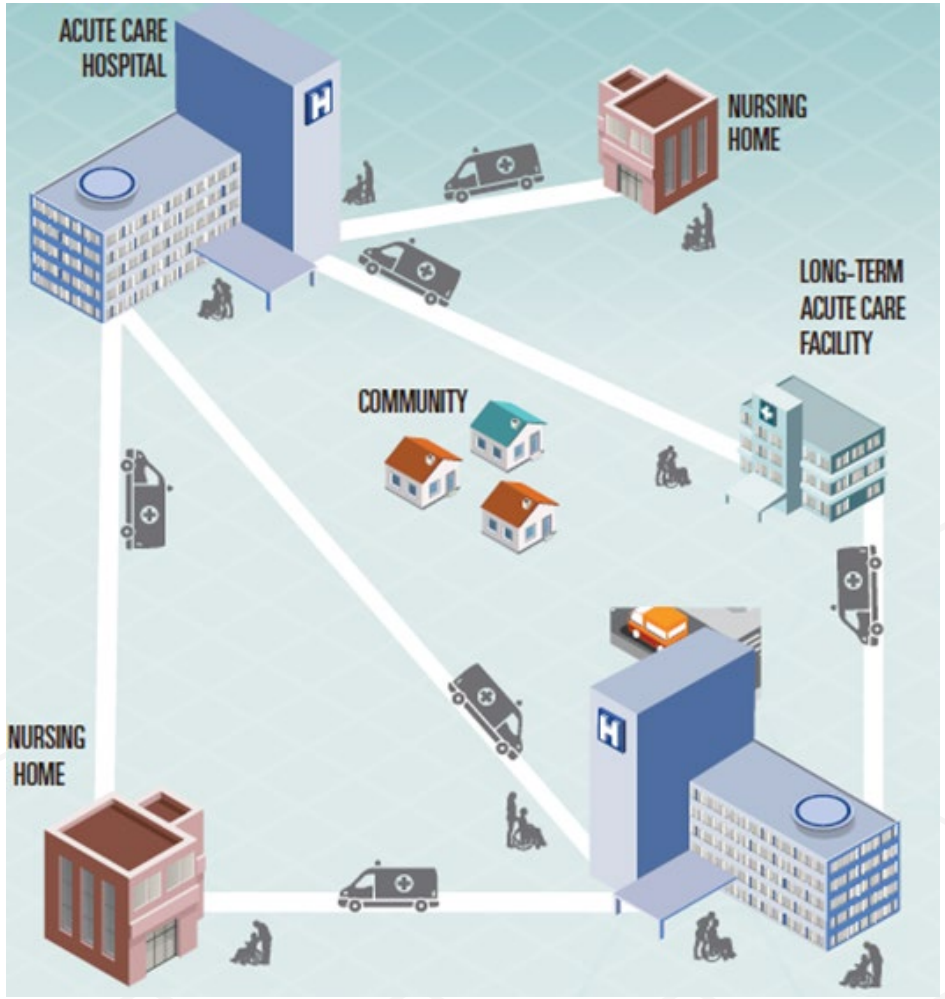
1. Antimicrobial resistance collaborators, the Lancet, 2022 https://doi.org/10.1016/S0140-6736(21)02724-0

Germs Can Spread to People in Many Ways

- Close contact
- In the air
- Contaminated water
- Contact with contaminated surfaces (e.g., medical devices, countertops)
- Animals
- Sexual contact

Antibiotic Resistance Can Be Amplified in Health Care

- Disproportionally impacts the vulnerable—young, elderly, and sick—who receive medical care
- Germs spread from patient to patient and across healthcare facilities through patient transfer
- When not stopped, these germs can spill over into communities, becoming much harder to control



CDC AR Threats Report

CDC AR Threat Reports

Current Antibiotic Resistance Threats in the U.S.

Urgent Threats

- Carbapenem-resistant *Acinetobacter*
- *Candida auris*
- *C. difficile*
- Carbapenem-resistant *Enterobacteriaceae*
- Drug-resistant *Neisseria gonorrhoeae (N. gonorrhoeae)*

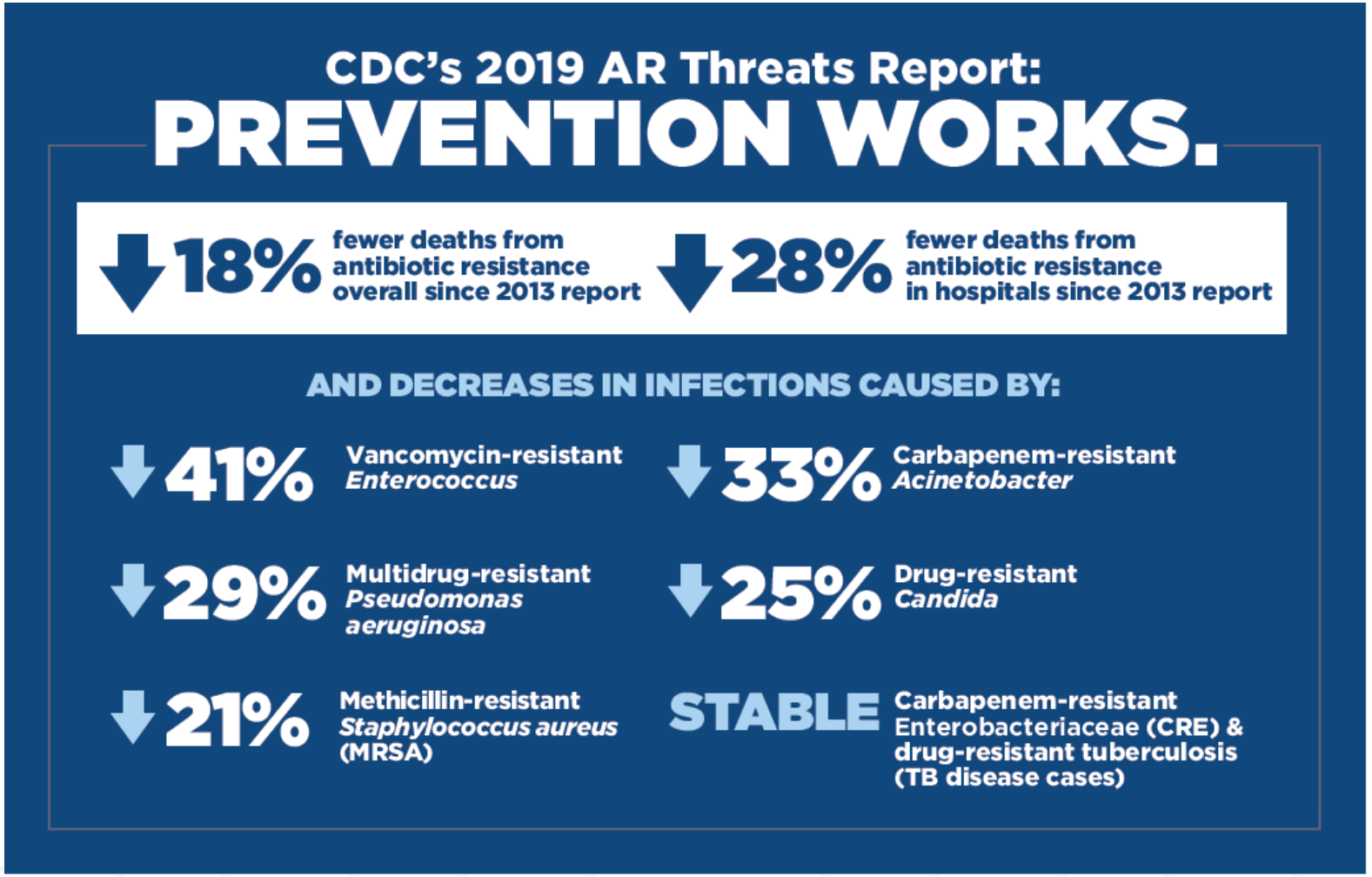
Serious Threats

- Drug-resistant *Campylobacter*
- Drug-resistant Candida
- ESBL-producing Enterobacteriaceae
- Vancomycin-resistant *Enterococci*
- Multidrug-resistant *Pseudomonas aeruginosa*
- Drug-resistant nontyphoidal *Salmonella*
- Drug-resistant *Salmonella* serotype Typhi
- Drug-resistant *Shigella*
- Methicillin-resistant *Staphylococcus aureus*
- Drug-resistant *Streptococcus pneumoniae*
- Drug-resistant Tuberculosis

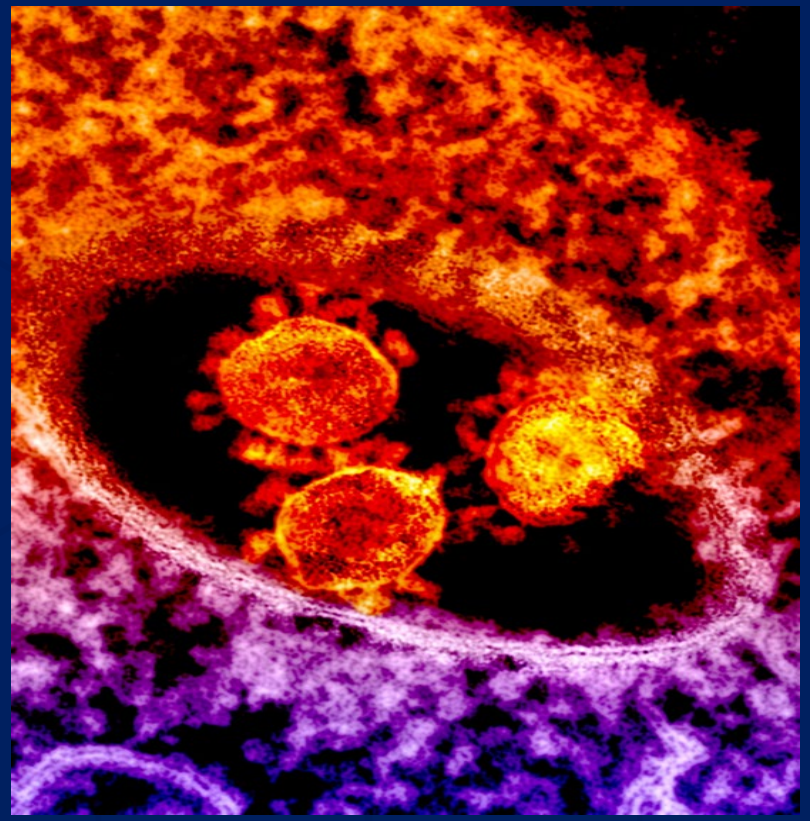
Concerning Threats

- Erythromycin-resistant Group A *Streptococcus*
- Clindamycin-resistant Group B *Streptococcus*

Infection Prevention in Hospitals Works



COVID-19



Factors Impacting Antimicrobial Resistance during COVID-19 Pandemic

- Increased number of hospitalizations for severe cases
  - Critically ill patients exceeded ICU capacity in many countries during peaks of COVID-19
  - Prolonged mechanical ventilation
  - Long hospital stay
- Hospital staff shortages
- Insufficient supply of personal protective equipment (PPE) in hospitals
- Increase in antimicrobial use in inpatient settings
- Disruption to long-term preventive measures (e.g. immunization)

Euroweekly news- March 2020- https://www.euroweeklynews.com/2020/03/29/coronavirus-intensive-care-patients-in-the-uk-given-50-chance-of-survival-says-shock-report/

Fujii, MedRix https://doi.org/10.1101/2020.06.20.20136150/
ISARIC 2020 https://www.medrxiv.org/content/10.1101/2020.07.17.20155218v4/
Langford BJ. Clin Microbiol Infect. 2020

Several publications report **high rates of antibiotic use (50-100%,** depending on the definition) and **low rates of bacterial co-infection/superinfection (4-8%** on average) in patients with COVID-19.

Co-infections in peopl
meta-analysis

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Introduction

Since December 2019, the COVID-
its epicentre in Wuhan, China to
with over 200,000 deaths associated
The pathogen responsible, severe ac
(SARS-CoV-2), is an enveloped RNA
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Clinical Infectious Disease

MAJOR ARTICLE

Empiric Antib
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Coronavirus I
Cohort Study

Valerie M. Vaughn,[1,2] Tejal N. Gandh
Vineet Chopra,[1,2] and Scott A. Flande

[1]Department of Internal Medicine, University

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Conclusions. The prevaler
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Keywords. SARS-CoV; C

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Nanshan Chen*, Min Zhou*, Xuan Dong*

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developed acute respiratory distres
and died of multiple organ failure

Interpretation The 2019-nCoV infe
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Clinical Infectious Diseases

MAJOR ARTICLE

IDSA Infectious Diseases Society of America | hivma hiv medicine association | OXFORD

Bacterial and Fungal Coinfection in Individuals With Coronavirus: A Rapid Review To Support COVID-19 Antimicrobial Prescribing

Timothy M. Rawson,[1,2,3] Luke S. P. Moore,[1,4,5] Nina Zhu,[1] Nishanthy Ranganathan,[3,4] Keira Skolimowska,[3,4] Mark Gilchrist,[3,4] Giovanni Satta,[3,4] Graham Cooke,[3,4] and Alison Holmes[1,2,3,4]

[1]National Institute for Health Research, Health Protection Research Unit in Healthcare Associated Infections and Antimicrobial Resistance, Imperial College London, London, United Kingdom, [2]Centre for Antimicrobial Optimisation, Imperial College London, London, United Kingdom, [3]Department of Infectious Diseases, Imperial College London, South Kensington, United Kingdom, [4]Imperial College Healthcare NHS Trust, Hammersmith Hospital, London, United Kingdom, and [5]Chelsea & Westminster NHS Foundation Trust, London, United Kingdom

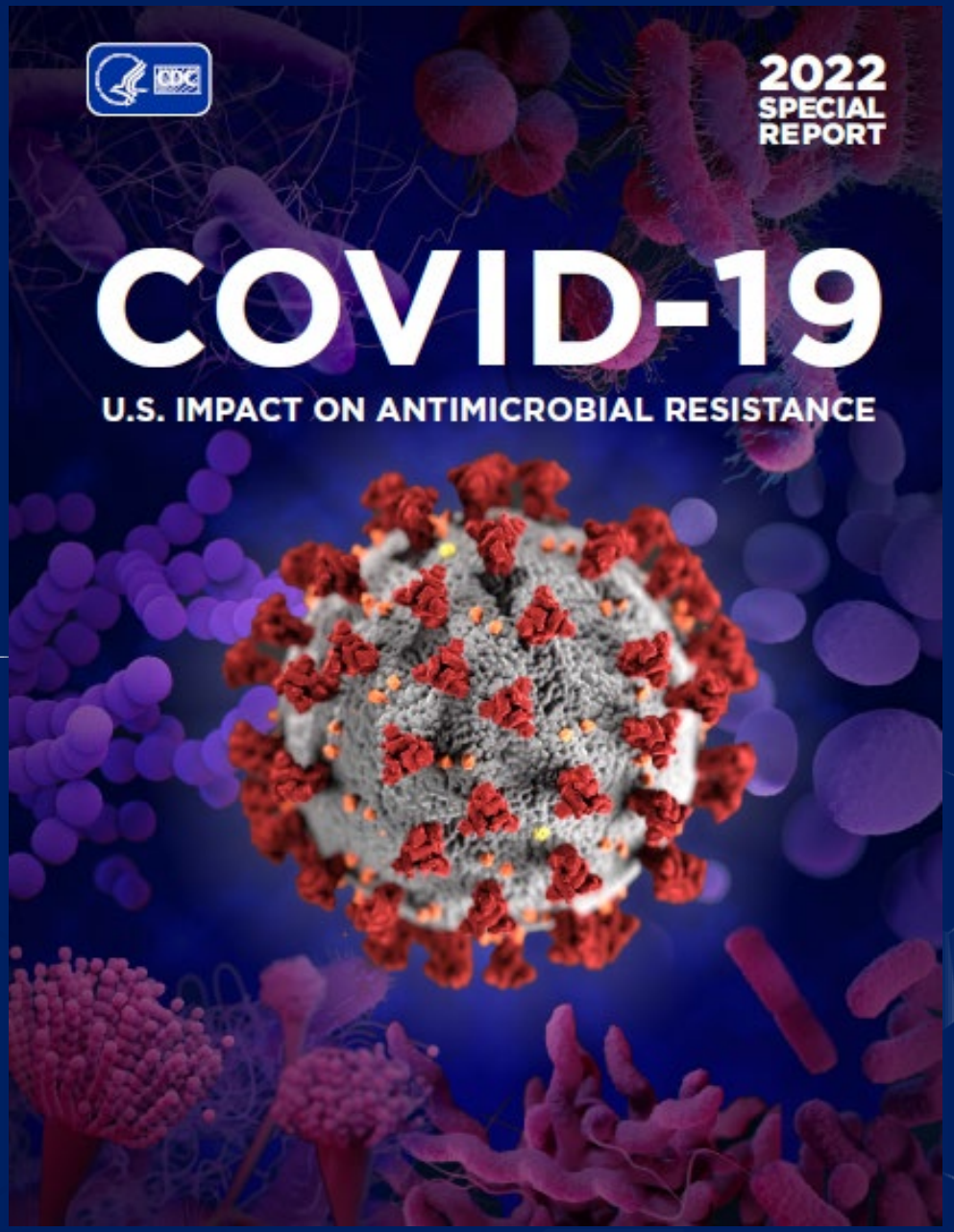
Conclusions. Despite frequent prescription of broad-spectrum empirical antimicrobials in patients with coronavirus-associated respiratory infections, there is a paucity of data to support the association with respiratory bacterial/fungal coinfection. Generation of prospective evidence to support development of antimicrobial policy and appropriate stewardship interventions specific for the COVID-19 pandemic is urgently required.

Keywords. SARS-CoV-2; antimicrobial stewardship; antimicrobial resistance.

The emergence of and subsequent pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) virus has required major adjustments to healthcare systems and frameworks [1–3]. As part of the response, infection-control and antimicrobial stewardship programs have had to explored—for example, hydroxychloroquine and azithromycin [7]. Antimicrobial therapy has a role in the treatment of suspected or confirmed bacterial or fungal (bacterial/fungal) respiratory coinfection. This may be empiric or targeted in patients presenting to the hospital or for the management of

COVID-19 Impact on AR Threats

Special Report



	Resistant Pathogen	2017 Threat Estimate	2018 Threat Estimate	2019 Threat Estimate	2017-2019 Change	2020 Threat Estimate and 2019-2020 Change
URGENT	Carbapenem-resistant *Acinetobacter*	8,500 cases 700 deaths	6,300 cases 500 deaths	6,000 cases 500 deaths	Stable*	7,500 cases 700 deaths Overall: 35% increase* Hospital-onset: 78% increase*
URGENT	Antifungal-resistant *Candida auris*	171 clinical cases†	329 clinical cases	466 clinical cases	Increase	754 cases Overall: 60% increase
URGENT	*Clostridioides difficile*	223,900 infections 12,800 deaths	221,200 infections 12,600 deaths	202,600 infections 11,500 deaths	Decrease	Data delayed due to COVID-19 pandemic
URGENT	Carbapenem-resistant Enterobacterales	13,100 cases 1,100 deaths	10,300 cases 900 deaths	11,900 cases 1,000 deaths	Decrease*	12,700 cases 1,100 deaths Overall: Stable* Hospital-onset: 35% increase*
URGENT	Drug-resistant *Neisseria gonorrhoeae*	550,000 infections	804,000 infections	942,000 infections	Increase	Data unavailable due to COVID-19 pandemic
SERIOUS	Drug-resistant *Campylobacter*	448,400 infections 70 deaths	630,810 infections	725,210 infections	Increase	Data delayed due to COVID-19 pandemic‡ 26% of infections were resistant, a 10% decrease
SERIOUS	Antifungal-resistant *Candida*	34,800 cases 1,700 deaths	27,000 cases 1,300 deaths	26,600 cases 1,300 deaths	Decrease*	28,100 cases 1,400 deaths Overall: 12% increase* Hospital-onset: 26% increase*
SERIOUS	ESBL-producing Enterobacterales	197,400 cases 9,100 deaths	174,100 cases 8,100 deaths	194,400 cases 9,000 deaths	Increase*	197,500 cases 9,300 deaths Overall: 10% increase* Hospital-onset: 32% increase*
SERIOUS	Vancomycin-resistant Enterococcus	54,500 cases 5,400 deaths	46,800 cases 4,700 deaths	47,000 cases 4,700 deaths	Stable*	50,300 cases 5,000 deaths Overall: 16% increase* Hospital-onset: 14% increase*

	Resistant Pathogen	2017 Threat Estimate	2018 Threat Estimate	2019 Threat Estimate	2017-2019 Change	2020 Threat Estimate and 2019-2020 Change
SERIOUS	Multidrug-resistant *Pseudomonas aeruginosa*	32,600 cases 2,700 deaths	29,500 cases 2,500 deaths	28,200 cases 2,400 deaths	Decrease*	28,800 cases 2,500 deaths Overall: Stable* Hospital-onset: 32% increase*
SERIOUS	Drug-resistant nontyphoidal *Salmonella*	212,500 infections 70 deaths	228,290 infections	254,810 infections	Increase	Data delayed due to COVID-19 pandemic‡ 14% of infections were resistant, a 3% decrease
SERIOUS	Drug-resistant *Salmonella* serotype Typhi	4,100 infections <5 deaths	4,640 infections	6,130 infections	Increase	Data delayed due to COVID-19 pandemic‡ 85% of infections were resistant, a 10% increase
SERIOUS	Drug-resistant *Shigella*	77,000 infections <5 deaths	215,850 infections	242,020 infections	Increase	Data delayed due to COVID-19 pandemic‡ 46% of infections were
SERIOUS	Methicillin-resistant *Staphylococcus aureus*	323,700 cases 10,600 deaths	298,700 cases 10,000 deaths	306,600 cases 10,200 deaths	Stable*	279,300 cases 9,800 deaths Overall: Stable* Hospital-onset: 13% increase*
SERIOUS	Drug-resistant *Streptococcus pneumoniae*	12,100 invasive infections 1,500 deaths†	See pathogen page if comparing data over time	12,000 invasive infections 1,200 deaths	Stable	Data delayed due to COVID-19 pandemic
SERIOUS	Drug-resistant Tuberculosis (TB)	888 cases 73 deaths†	962 cases 102 deaths	919 cases	Stable	661 cases Decrease‡
CONCERNING	Erythromycin-resistant group A *Streptococcus*	5,400 infections 450 deaths†	See pathogen page if comparing data over time	6,200 infections 560 deaths	Increase	Data delayed due to COVID-19 pandemic
CONCERNING	Clindamycin-resistant group B *Streptococcus*	13,000 infections 720 deaths†	See pathogen page if comparing data over time	15,300 cases 940 deaths	Increase	Data delayed due to COVID-19 pandemic

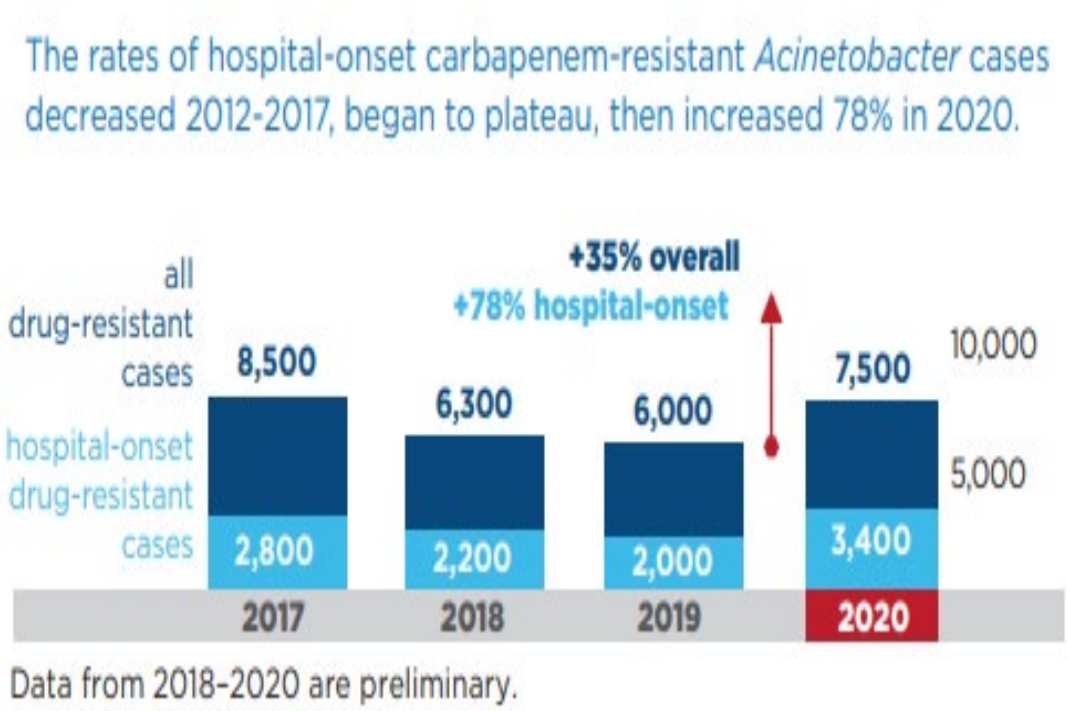
†CDC's database allows for continuous updates for TB, *C. auris*, and *Streptococcus*. Variations in historical TB data are attributable to updated information submitted in the interim by reporting areas; this report includes data reported through June 14, 2021. For *Streptococcus*, table reflects infection increase for 2017 data as of October 2021. For *C. auris*, this report reflects clinical case increase for 2018 data.

*Changes are in rates, not comparisons of counts. Data for healthcare pathogens show a significant increase in hospital-onset rates of resistant infections in 2020, likely due to smaller number of overall hospitalizations during the pandemic.

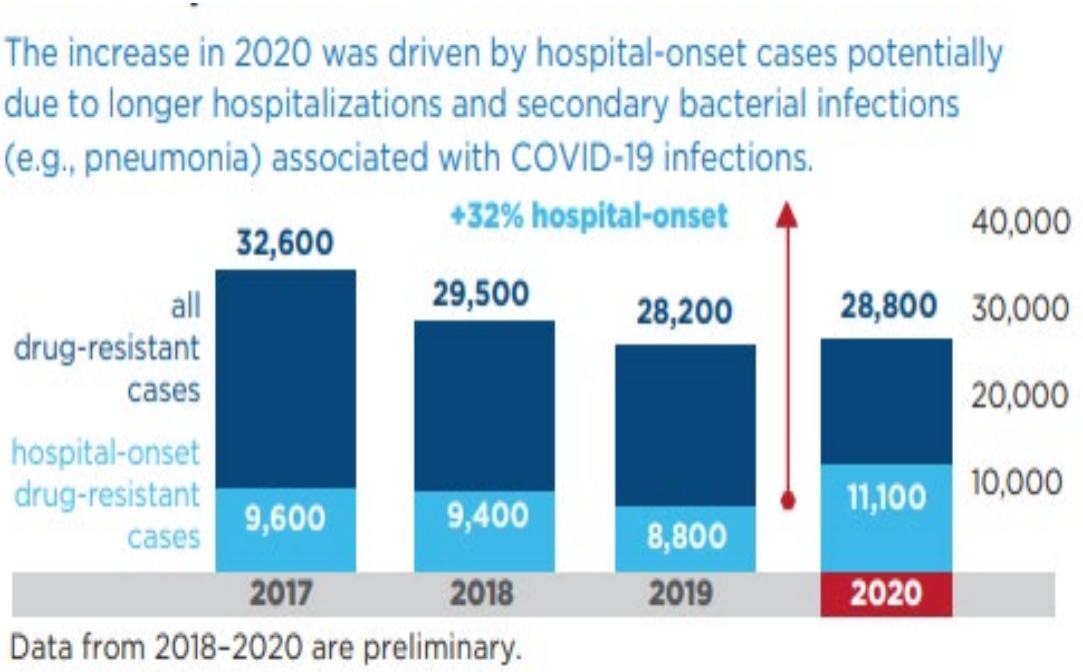
‡For TB, 2019 and 2020 death reports are not available due to a 2-year lag. For enteric pathogens, 2018-2020 death estimates and 2020 estimates of total number of resistant infections are not available at this time.

COVID-19 Reverted our Progress

Carbapenem-resistant *Acinetobacter* (often resistant to all antibiotics)

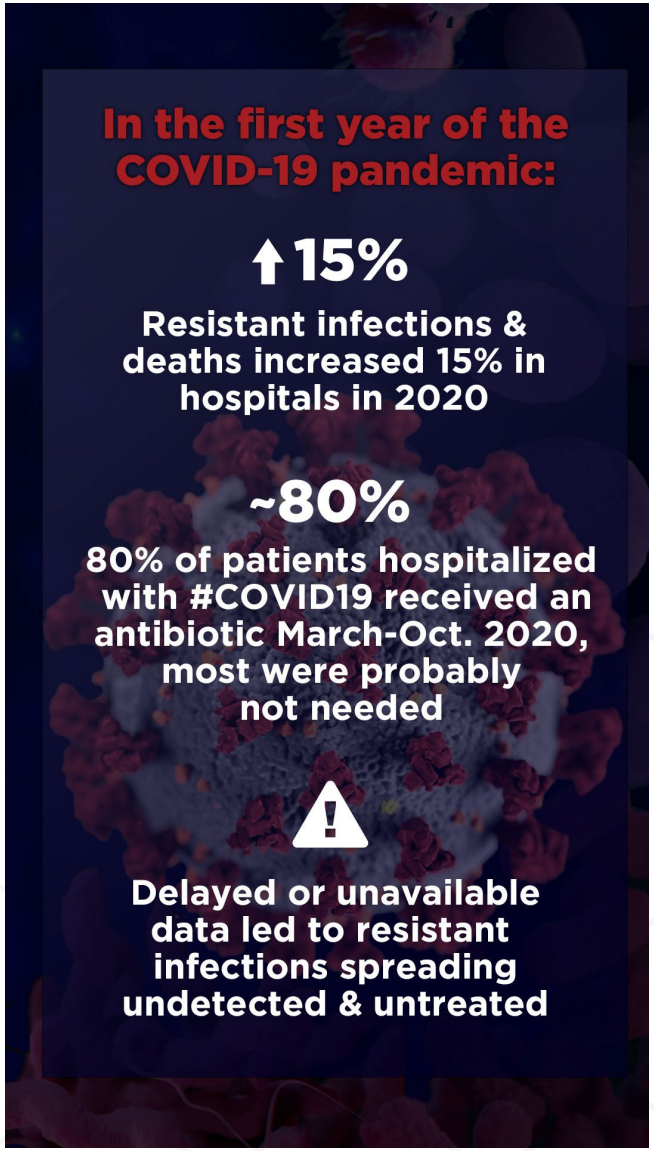


Multi-drug resistant *P. aeruginosa* (some resistant to all antibiotics including carbapenem)



Report Overview

- More than **3 million Americans** acquire an antimicrobial-resistant infection or *Clostridioides difficile* infection.
  - Nearly **50,000 people** die from these threats.
- Associated with the COVID-19 pandemic:
  - **Increased antibiotic use**
  - **Difficulty following infection prevention and control (IPC) best practices**
  - Increase in healthcare-associated (HAI), antimicrobial-resistant (AR) infections in U.S. hospitals.
- Resistant **HAIs and deaths both increased at least 15%** during the first year of the pandemic.
- Limited data in 2020 for many pathogens that spread in the community, like sexually transmitted drug-resistant gonorrhea.
- Necessary to invest in effective prevention-focused public health actions such as **accurate laboratory detection**, **rapid response and containment**, **effective IPC**, and expansion of innovative **strategies to combat AR**.



“These setbacks *can* and *must* be temporary.
The COVID-19 pandemic has made it clear—
prevention is preparedness.
We must prepare our public health systems to fight multiple threats, simultaneously.
Because antimicrobial resistance will not stop,
we must meet the challenge.”

Rochelle P. Walensky, MD, MPH
Director, Centers for Disease Control and Prevention

Global Actions to Combat Antibiotic Resistance

Infection prevention and control: Prevent infections and reduce the spread of germs

Tracking and data: Share data and improve data collection to stay ahead of antibiotic resistance and prevent infections

Antibiotic use and access: Improve appropriate use of antibiotics and reduce unnecessary use (called antibiotic stewardship), and ensuring access to antibiotics

Vaccines, therapeutics, and diagnostics: Invest in development and improved access to vaccines, therapeutics, and diagnostics for better prevention, treatment, and detection

Environment and sanitation: Keep antibiotics and antibiotic-resistant threats from environment entering the environment through actions like improving access to safe water

COVID-19 Impacts on: Preventing Infections

- Pandemic-related challenges **hindered many IPC practices (e.g., personal protective equipment shortages; space limitations for isolation)** —undoing some progress on combating AR.
- More and sicker patients during the pandemic who required more frequent and longer use of invasive devices such as catheters and ventilators.
- U.S. hospitals saw:
  - AR infections and deaths rise 15% in 2020
  - Significantly higher rates for four out of six types of HAIs in 2020
  - Increase in *Candida auris* cases

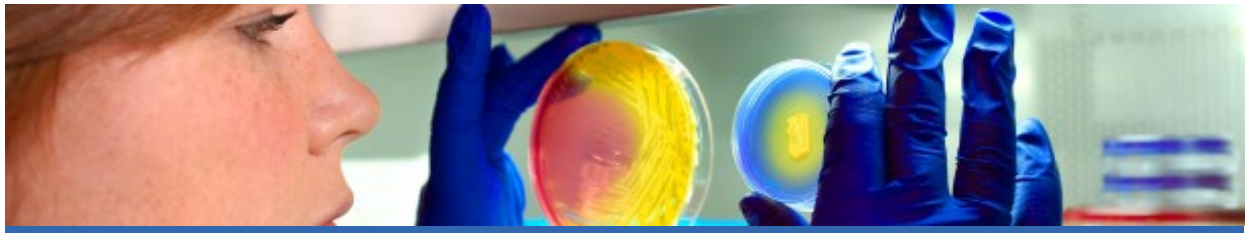
What's Next

- High-quality infection prevention and control training for all healthcare professionals.
- Increasing IPC implementation in facilities beyond hospitals (e.g., hospitals and long-term care).
- Communicating clearly to the public and fostering conversations on topics like how germs spread.
- Identifying barriers to implementing and maintaining IPC best practices
- Pandemic preparedness and support response to new threats.
- Increasing investments in state/local health depts.

COVID-19 Impacts on: Antimicrobial Resistance Tracking & Data

- During the COVID-19 pandemic, the detection and reporting of antimicrobial **resistance data slowed tremendously** due to:
  - Difficulties managing patient volume and resource consumption
  - Lab and testing supply shortages
  - Limited bandwidth for hospital staff to care for increasing number of patients while maintaining normal reporting operations
- Because of the pandemic impacts, 2020 data are delayed or unavailable for 9 of the 18 antimicrobial resistance threats.

CDC's AR Lab Network received and tested 23% fewer specimens or isolates in 2020 than in 2019.[2]



What's Next

- Supporting uninterrupted laboratory supplies and equipment for patient care, infection control, and data tracking during emergencies and surge outbreaks.
- Merging strategies to respond to COVID-19 and antimicrobial resistance.
- Expanding the use of automated data to national HAI and AR surveillance to reduce manual data collection and submission.

COVID-19 Impacts on: Antibiotic Use

- Increased antibiotic use, much of it likely unnecessary
- From March 2020 to October 2020, **almost 80% of patients hospitalized with COVID-19 received an antibiotic.**
- While antibiotic use was lower overall in 2021 compared with 2019, in August 2021, antibiotic use exceeded prescribing in 2019 by 3%.
- Azithromycin use was 150% higher in April 2020 and 82% higher in December 2020 than the same months in 2019.

What's Next

- Optimizing antibiotic and antifungal use and prescribing across all healthcare settings.
- Tracking antibiotic and antifungal prescribing.
- Evaluation for improvements toward optimal use.
- Enhancing communication of the latest antibiotic and antifungal use recommendations and guidance to healthcare workers.
- Supporting the development of new vaccines.
- Supporting research and development for new antibiotics and antifungals, therapeutics, and vaccines.

COVID-19 Impacts on: Vaccines, Diagnostics, and Therapeutics

- The COVID-19 pandemic highlighted the importance of prevention. **We need more prevention products, not just new drugs,** to stop infections before they happen.
  - The PCV13 vaccine protects people from 13 types of pneumococcus, including resistant forms. This vaccine prevented more than 30,000 cases of invasive pneumococcal disease and 3,000 deaths from 2010 to 2013 alone.
- Since 2016, **CDC has invested more than $160 million in research** to address knowledge gaps with scalable, innovative solutions such as vaccines, therapeutics, diagnostics and other prevention tools.

What's Next

- Supporting more innovation and research on therapeutics, vaccines, and diagnostics.
- Enhancing interagency collaborations to accelerate research for developing new antibiotics, antifungals, therapeutics, and vaccines.
- Working to undo negative impacts the COVID-19 pandemic may have had on vaccine conversations.
- Supporting the widespread use of vaccines to prevent infections, slow the spread of resistance, and reduce antibiotic use.
- Building a vaccine data platform to inform and accelerate the development of new vaccines.

COVID-19 Impacts on: Environment (e.g., water, soil) and Sanitation

AR is a One Health Issue

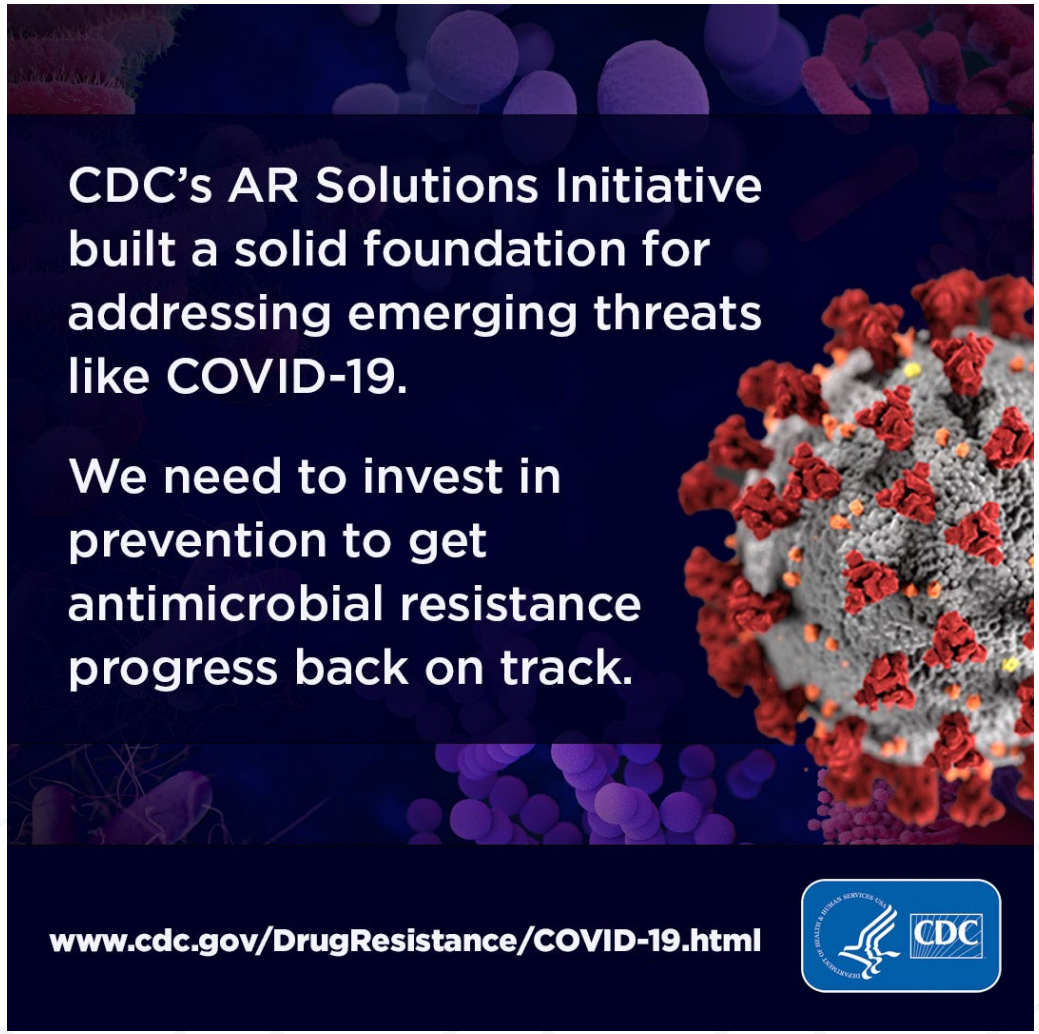
- CDC is looking at ways to **expand surveillance through existing systems** to monitor AR from multiple sources across One Health.
- In 2020, researchers leveraged an existing project funded by **CDC's AR Solutions Initiative** focused on AR to better understand the burden of COVID-19 in communities—using **wastewater**.
- Benefits of wastewater surveillance for AR:
  - Captures silently spreading germs
  - Operates independent of healthcare capacity
  - Quick and efficient
  - Provides an early warning system

What's Next

- Expanding the capacity of National Wastewater Surveillance to collect AR data from wastewater treatment plants and healthcare facilities to continue infectious disease surveillance.
- Studying AR in the community and healthcare wastewater, domestically and globally.
- Expanding global capacities to fight AR in the environment, as part of the CARB National Action Plan.
- Mapping existing AR ecology across One Health and monitoring shifts over time, as part of the CARB National Action Plan.

Building Public Health Capacity for Antimicrobial Resistance

- The COVID-19 response has demanded that **attention and resources be diverted away** from a needed focus on AR outbreak detection.
- We must continue to **invest in preparing public health systems across One Health** to address threats from multiple angles.
- As a direct result of CDC's prevention investments through its AR Solutions Initiative, the United States has made progress in slowing the spread of antimicrobial resistance and shown that preventing these infections is possible.
- **More sustainable funding is required to maintain momentum for AR work moving forward.**



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