THE INTERSECTION OF
Antibiotic Resistance (AR), Antibiotic Use (AU), and COVID-19
for the Presidential Advisory Council on Combating Antibiotic-Resistant Bacteria as of November 2021

Arjun Srinivasan, MD
CAPT, USPHS
Associate Director for Healthcare-Associated Infection (HAI) Prevention Programs
Division of Healthcare Quality Promotion
National Center for Emerging and Zoonotic Infectious Diseases

November 30, 2021
Proven prevention efforts should be expanded and sustained.

By 2025: CDC will invest $2.1 billion through the American Rescue Plan to enhance infection prevention and control across U.S. public health and health care.

With U.S. health departments and partners:

▪ Expand support to healthcare facilities to improve the quality of health care

▪ Assist healthcare workers in preventing infections, support rapid response to detect and contain infectious organisms

▪ Engage in innovations to combat infectious disease threats

▪ Support state-based nursing home and long-term care strike teams

▪ Address the rise of HAI / AR threats, which increased during the pandemic
Key Takeaways: AR Infections

- Healthcare infection control is critical to fight AR and COVID-19.
  - We continue to see higher rates of hospital-onset infections, including those caused by resistant organisms, and outbreaks of AR infections in COVID-19 units.
  - COVID-19 can create a perfect storm for AR infections in healthcare settings by increasing length of stay, patient volume and acuity, staffing shortages, and antibiotic use, plus creating challenges in implementing infection prevention and control.

- Many types of healthcare-associated infections have gone up dramatically during the pandemic, including MRSA bloodstream infections.
  - Many of the device-associated infections are caused by resistant pathogens.

- Findings highlight continued importance of healthcare infection control as one of the foremost tools needed to address emerging infectious diseases.
Key Takeaways: Antibiotic Use

- **Hospitals:** Increased use of some agents.
  - Overall increases in agents used to treat community acquired pneumonia (azithromycin/ceftriaxone).
  - No national increases in use overall or of broad-spectrum agents.

- **Outpatient:** Significant drop seen in 2020 is on the rise again.
  - Drop appears related to decrease in healthcare utilization in 2020.
  - Antibiotic prescribing decline seen in 2020 has rebounded near pre-pandemic levels.
  - Azithromycin use increases with higher numbers of COVID-19 cases.

- **Nursing Homes:** Increased use of some agents.
  - Increases in agents used to treat community acquired pneumonia (azithromycin/ceftriaxone).
  - Increases were largest early in the pandemic and subsequent increases were smaller, despite COVID-19 waves being larger.
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 260+ hospitals and 14,000 hospital discharges
- Antibiotic use data from approx. 750 hospitals
- **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
Incidence of HAIs in 2020 and 2021, Compared to 2019

<table>
<thead>
<tr>
<th></th>
<th>2020 Q1</th>
<th>2020 Q2</th>
<th>2020 Q3</th>
<th>2020 Q4</th>
<th>2021 Q1</th>
<th>2021 Q2*</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLABSI</td>
<td>-11.8%</td>
<td>27.9%</td>
<td>46.4%</td>
<td>47.0%</td>
<td>44.9%</td>
<td>14.0%</td>
</tr>
<tr>
<td>CAUTI</td>
<td>-21.3%</td>
<td>No change</td>
<td>12.7%</td>
<td>18.8%</td>
<td>10.7%</td>
<td>No change</td>
</tr>
<tr>
<td>VAE</td>
<td>11.3%</td>
<td>33.7%</td>
<td>29.0%</td>
<td>44.8%</td>
<td>50.5%</td>
<td>27.1%</td>
</tr>
<tr>
<td>MRSA</td>
<td>-7.2%</td>
<td>12.2%</td>
<td>22.5%</td>
<td>33.8%</td>
<td>39.3%</td>
<td>8.5%</td>
</tr>
<tr>
<td>C. difficile</td>
<td>-17.5%</td>
<td>-10.3%</td>
<td>-8.8%</td>
<td>-5.5%</td>
<td>-15.9%</td>
<td>-13.8%</td>
</tr>
</tbody>
</table>

For most of these infections, the increases seen in 2020 present a strong contrast to success seen prior to the pandemic in reducing the incidence of those infections.

*2021 Q2 data are preliminary
## Comparison of Flu & COVID-19 Discharges

<table>
<thead>
<tr>
<th></th>
<th>Patients with Influenza-Like Illness (Jan-June 2019)</th>
<th>Patients with COVID-19 (Jan 2020-June 2021)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean length of stay</td>
<td>6.1 days</td>
<td>8.2 days</td>
</tr>
<tr>
<td>Discharges with bacterial/fungal culture</td>
<td>60.4%</td>
<td>58.5%</td>
</tr>
<tr>
<td>Discharges with an AR-positive culture with a susceptibility result</td>
<td>12.5%</td>
<td>11.1%</td>
</tr>
</tbody>
</table>

Influenza-Like Illness Definition: A hospitalization with a discharge during January 1, 2019–June 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 2020–June 2021 or ICD-10-CM code of B97.29 (suspected) with a discharge date March–April 2020, and admission dates February–April 2020

Data collected October 12, 2021
Cultures from Patients with COVID-19 and Influenza-Like Illness (ILI) Grew Organisms at Similar Frequency

Proportion of discharges with a positive culture

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Overall</td>
<td>-11%</td>
<td>+77%</td>
</tr>
<tr>
<td>Community-Onset (CO)</td>
<td>-30%</td>
<td></td>
</tr>
<tr>
<td>Hospital-Onset (HO)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Preliminary unpublished analysis, please do not reproduce without permission
Antibiotic-Resistant Pathogens in Hospitalized Patients: Community-Onset

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

- MRSA: Methicillin-resistant *Staphylococcus aureus*
- ESBL: extended-spectrum beta-lactamases
- CRE: carbapenem-resistant Enterobacterales
- VRE: vancomycin-resistant enterococci
- CRAB: carbapenem-resistant *A. baumannii*
- CRPA: carbapenem-resistant *Pseudomonas aeruginosa*

- MRSA: -51%
- ESBL: -5%
- CRE: -46%
- VRE: -28%
- CRAB: -52%
- CRPA: -64%
Antibiotic-Resistant Pathogens in Hospitalized Patients: Hospital-Onset

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

- **Influenza-Like Illness (2019)**
  - MRSA: Methicillin-resistant *Staphylococcus aureus*
  - ESBL: extended-spectrum beta-lactamases
  - CRE: carbapenem-resistant Enterobacterales
  - VRE: vancomycin-resistant enterococci
  - CRAB: carbapenem-resistant *A. baumannii*
  - CRPA: carbapenem-resistant *Pseudomonas aeruginosa*

- **COVID-19 (2020-2021)**

<table>
<thead>
<tr>
<th>Organism</th>
<th>Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>MRSA</td>
<td>+65%</td>
</tr>
<tr>
<td>ESBL</td>
<td>+183%</td>
</tr>
<tr>
<td>CRE</td>
<td>+251%</td>
</tr>
<tr>
<td>VRE</td>
<td>+23%</td>
</tr>
<tr>
<td>CRAB</td>
<td>+25%</td>
</tr>
<tr>
<td>CRPA</td>
<td>+120%</td>
</tr>
</tbody>
</table>
Antibiotic Use During the COVID-19 Pandemic: HOSPITALS
Aggregate Hospital Antibiotic Use: All Antibacterial Agents, Compared to 2019

National Healthcare Safety Network (746 hospitals)
Days of Therapy per 1,000 Days Present – All Antibacterial Agents

Note: NHSN AU days present denominator counts any portion of a day when a patient was hospitalized. % indicates percent difference in pooled mean rates by year.
Aggregate Hospital Antibiotic Use: Azithromycin, Compared to 2019

National Healthcare Safety Network (746 hospitals)
Days of Therapy per 1,000 Days Present – Azithromycin

<table>
<thead>
<tr>
<th></th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct</td>
<td>13.7%</td>
<td>24.7%</td>
<td>16.0%</td>
</tr>
<tr>
<td>Nov</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dec</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Jan</td>
<td></td>
<td></td>
<td>15.1%</td>
</tr>
<tr>
<td>Feb</td>
<td></td>
<td></td>
<td>-11.4%</td>
</tr>
<tr>
<td>March</td>
<td></td>
<td></td>
<td>-22.7%</td>
</tr>
<tr>
<td>April</td>
<td></td>
<td></td>
<td>-9.2%</td>
</tr>
<tr>
<td>May</td>
<td></td>
<td></td>
<td>-11.2%</td>
</tr>
<tr>
<td>June</td>
<td></td>
<td></td>
<td>-8.3%</td>
</tr>
<tr>
<td>July</td>
<td></td>
<td></td>
<td>14.8%</td>
</tr>
</tbody>
</table>

Note: NHSN AU days present denominator counts any portion of a day when a patient was hospitalized. % indicates percent difference in pooled mean rates by year.
Aggregate Hospital Antibiotic Use: Ceftriaxone, Compared to 2019

National Healthcare Safety Network (746 hospitals)
Days of Therapy per 1,000 Days Present – Ceftriaxone

<table>
<thead>
<tr>
<th>Month</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct</td>
<td>14.1%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nov</td>
<td>17.4%</td>
<td></td>
<td></td>
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<tr>
<td>Dec</td>
<td>14.7%</td>
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<tr>
<td>Jan</td>
<td>21.3%</td>
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<tr>
<td>Feb</td>
<td>10.0%</td>
<td></td>
<td></td>
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<tr>
<td>March</td>
<td>3.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>8.7%</td>
<td></td>
<td></td>
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<tr>
<td>May</td>
<td>9.9%</td>
<td></td>
<td></td>
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<tr>
<td>June</td>
<td>8.3%</td>
<td></td>
<td></td>
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<tr>
<td>July</td>
<td>16.3%</td>
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</table>

Note: NHSN AU days present denominator counts any portion of a day when a patient was hospitalized. % indicates percent difference in pooled mean rates by year.
Aggregate Hospital Antibiotic Use: Piperacillin/Tazobactam, Compared to 2019

National Healthcare Safety Network (746 hospitals)
Days of Therapy per 1,000 Days Present - Piperacillin/Tazobactam

<table>
<thead>
<tr>
<th>Month</th>
<th>2019</th>
<th>2020</th>
<th>2021</th>
</tr>
</thead>
<tbody>
<tr>
<td>October</td>
<td>56</td>
<td>57</td>
<td>58</td>
</tr>
<tr>
<td>November</td>
<td>55</td>
<td>56</td>
<td>57</td>
</tr>
<tr>
<td>December</td>
<td>54</td>
<td>55</td>
<td>56</td>
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<tr>
<td>January</td>
<td>53</td>
<td>54</td>
<td>55</td>
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<tr>
<td>February</td>
<td>52</td>
<td>53</td>
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<td>March</td>
<td>51</td>
<td>52</td>
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<tr>
<td>April</td>
<td>50</td>
<td>51</td>
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<tr>
<td>May</td>
<td>49</td>
<td>50</td>
<td>51</td>
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<tr>
<td>June</td>
<td>48</td>
<td>49</td>
<td>50</td>
</tr>
<tr>
<td>July</td>
<td>47</td>
<td>48</td>
<td>49</td>
</tr>
</tbody>
</table>

Note: NHSN AU days present denominator counts any portion of a day when a patient was hospitalized. % indicates percent difference in pooled mean rates by year.
Antibiotic Use During the COVID-19 Pandemic: OUTPATIENT
National Monthly Outpatient Antibiotic Prescription Trends

August 2021
25% year-over-year increase
5% month-over-month increase (compared with 3% MOM decrease in August 2020)

Antibiotic prescriptions dispensed from retail pharmacies

Source: IQVIA National Prescription Audit
Last update: October 8, 2021
National Monthly Outpatient Azithromycin Prescription Trends

August 2021

86% year-over-year increase

29% month-over-month increase (compared with 7% MOM decrease in August 2020)

Azithromycin prescriptions dispensed from retail pharmacies

Source: IQVIA National Prescription Audit
Last update: October 8, 2021

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Outpatient Antibiotic Prescriptions Track with COVID-19 Cases and Visits Among Adults > 65 Years of Age

% visits     25.7       17.5          20.6         29.3        29.7         30.9         33.3         33.1        31.9          30.7        27.1         24.3         25.4

Source: 100% Medicare carrier claims and Part D event files
Antibiotic Use During the COVID-19 Pandemic: NURSING HOMES
Nursing Home Antibiotic Use, 2019-2021

- **Antibiotic use**: Graph showing the trend of antibiotic use per 1000 residents serviced.
- **Total Residents**: Graph showing the total number of residents.

Key Events:
- **COVID-19 pandemic**: Impact on antibiotic use.
- **Vaccine roll-out in nursing homes**: Impact on antibiotic use.

**Legend**:
- Yellow vertical dashed line: COVID-19 pandemic
- Orange vertical dashed line: Vaccine roll-out in nursing homes
Increased Prescribing Rates of Antibiotic Agents Used for Respiratory Infections, 2019-2021

Percent change compared to same month 2019

COVID-19 pandemic
+150%
+43%
+86%
+32%
+21%
+19%

Vaccine roll-out in nursing homes
+82%

Number of residents with antibiotic per 1000 residents


Number of residents with antibiotic per 1000 residents

+0%
What's Next
Announcing Next Week:
New Global Projects to Combat AR & Other Infectious Diseases

CDC’s Global AR Lab & Response Network

- Rapid detection of and response to AR
- Anywhere AR can occur: healthcare, community, food, environment
- Targeting emerging & AR Threats Report pathogens

The Global Action In Healthcare Network (GAIHN)

- Prevent and respond to emerging healthcare threats
- Anywhere human healthcare is delivered
- Targeting emerging infectious disease threats in healthcare (e.g., COVID-19, AR)
New Global Projects to Combat AR & Other Infectious Diseases (cont'd)
Lessons Learned from COVID-19

- We cannot treat our way out of a pandemic, epidemic, or outbreak.

- We get what we pay for now. If we don’t invest in effective public health capacity and prevention today, we will not have these when we need them most:
  - Early detection and containment;
  - Response capacity to stop transmission;
  - Infection control; and
  - Evidence-based prevention interventions including vaccines and preventives.

- Preventing AR infections is preparedness.
  - Preparedness is not exercises, table tops, and planning documents alone.
  - Prevention must span One Health.
  - Leverage preventives like vaccines and decolonization.
Join CDC for the Next #AMRExchange!

- **What:** Hooves, Paws, or Feet: A Multispecies Examination of Antimicrobial Use and Stewardship Practices
- **Who:** CDC and experts from Ohio State University, Iowa State University, and EpiX Analytics
- **When:** Tuesday, December 14, 9am EST
- **Register:** Head to @CDC_AR Twitter handle for all the details!
# Acknowledgements

<table>
<thead>
<tr>
<th>James Baggs</th>
<th>Jonathan Edwards</th>
<th>Sarah Kabbani</th>
<th>Erin O’Leary</th>
<th>Alicia Shugart</th>
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<tbody>
<tr>
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<td>Anthony Fiore</td>
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<td>Lindsay Parnell</td>
<td>Dawn Sievert</td>
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<td>Heather Dubendris</td>
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<td>Shae Duka</td>
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<td>Hannah Wolford</td>
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<td>Hsiu Wu</td>
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For more information, contact CDC
1-800-CDC-INFO (232-4636)

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.