ACHA COVID-19 “Ask the Expert” Series: Wastewater Surveillance
September 25, 2020

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Moderator:

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National Wastewater Surveillance System
Science to Implementation

Amy E. Kirby, PhD MPH

Community Interventions and Critical Populations Task Force
COVID-19 Response

American College Health Association Webinar
September 25, 2020
Wastewater Surveillance | Public Health Toolbox

- Wastewater is an efficient pooled sample of community (or sub-community) infection prevalence
- Captures sub-clinical infections
- Independent of healthcare-seeking behavior and testing access
- Data available within days of shedding onset versus up to 2-week lag for other surveillance data
SARS-CoV-2 Sewage Assessment  |  Trend classification
NWSS | Launches In September

NATIONAL WASTEWATER SURVEILLANCE SYSTEM (NWSS)

Data submission → Data analysis → Information/data sharing

Communities → Data submission → CDC

State, tribal, local, and territorial health departments

Wastewater treatment plants → Data analysis

Laboratories → Data submission

NWSS is a collaboration between Centers for Disease Control and Prevention (CDC), the US Department of Health and Human Services (HHS), and agencies throughout the federal government.

cdc.gov/coronavirus
Sewage Surveillance Data

Current potential: *based on state of the science*

- Provide county and sub-county level total infection *trends*
- **Leading indicator** of potential infection increases following reopening of communities
- **Early warning** to inform re-closure decisions – particularly for high-risk facilities like senior living centers, university campuses, prisons, nursing homes
- **Tracking** virus evolution and global origin upon emergence in US

More data needed: estimating overall daily infection prevalence within a sewershed
COVID-19 Sewage Assessment | Limitations

- Decentralized wastewater treatment facilities will not be captured
- ~25% of US residences are not connected to sewer
- Low incidence may be below the limit of detection
- Cannot be used to “clear” a community or facility
- May be impacted by pre-treatment of sewage for odor or worker safety
Targeted Use Cases | Potential early warning

Building-level applications:
- Long-term care facilities
- University dormitories
- Correctional facilities

Potential benefits:
- Early warning for new cases
- More efficient
- Cheaper for routine surveillance
Targeted Use Cases | Limitations

- Surveillance limit of detection is unknown
  - How many people need to be infected in a system to be reliably detected in wastewater?
- In many facilities, wastewater may not be accessible for sampling
- High per test cost ($250 - $1200 per sample)
- Requires multiple samples per week and fast turnaround to be useful
- No standard method yet
- Competition for resources (lab capacity, lab supplies, sampling equipment)
  - With other wastewater surveillance efforts
  - Potential impact on clinical testing supplies (RT-PCR)
For more information, contact CDC
1-800-CDC-INF0 (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.
UNIVERSITY OF SOUTH CAROLINA

Flagship campus in Columbia, SC

- “R1: Doctoral University with Highest Research Activity”
- >359 acres
- ~35,364 students
  - 27,502 Undergraduate
  - 5,987 Graduate
  - 1,875 Professional
- 25 residence halls
- Courses (100% online/face-face, hybrid)
  - Undergrad. 42%/58%
  - Grad./Pro. 14%/86%
COVID DASHBOARD (AS OF SEPTEMBER 21)

Campus Case Tracker
Case data as of September 21, 2020

**Daily Case Data**
- Counting active cases
- Active: 2,299
- Recovered: 39
- New Cases: 2,238

**Current Total Active Cases**
Counts represent distinct people

- Students: 90
- Employees: 5
- Total: 95

**Total Recovered Since Aug. 1**
Counts include distinct people from on- and off-campus testing

- Students: 2,209
- Employees: 34
- Total: 2,243

**Total Cases Since Aug. 1**
Counts include distinct people from on- and off-campus testing

- Students: 2,299
- Employees: 39
- Total: 2,338

**On-Campus Testing**
Prior reporting period data will be updated based on pending results

- Reporting Period:
  - 9/18 - 9/21
  - 9/15 - 9/17
  - 9/11 - 9/14
  - Since 8/1

- Overall Test Results:
  - 909
  - 1,446
  - 1,021
  - 15,537

- Positive Rate:
  - Overall: 3.2%
  - 9/11 - 9/14: 6.7%
  - 9/18 - 9/21: 6.7%
  - Since 8/1: 10.0%

- Positive Results:
  - Students: 25
  - Employees: 74
  - Total: 99

- Negative Results:
  - Students: 745
  - Employees: 1,382
  - Total: 2,127

- Pending Results:
  - Students: 38
  - Employees: 0
  - Total: 38

- Students Tested:
  - 651
  - 1,128
  - 670
  - 16,022

- Student Positive Rate:
  - Overall: 4.0%
  - 9/11 - 9/14: 7.6%
  - 9/18 - 9/21: 7.6%
  - Since 8/1: 12.2%

- Student Positive Results:
  - Students: 25
  - Employees: 71
  - Total: 96

- Student Negative Results:
  - Students: 595
  - Employees: 1,057
  - Total: 1,652

- Employees Tested:
  - 157
  - 328
  - 151
  - 2,915

- Employee Positive Rate:
  - Overall: 0.0%
  - 9/11 - 9/14: 1.3%
  - 9/18 - 9/21: 1.3%

- Employee Positive Results:
  - Students: 0
  - Employees: 3
  - Total: 3

- Employee Negative Results:
  - Students: 150
  - Employees: 325
  - Total: 475

- Overall Alert Level:
  - Total: 1.26
  - New Normal: 0
  - Low: 1
  - Moderate: 2
  - High: 3

Campus Alert Factors:
- Testing
- Contact Tracing
- Isolation and Quarantine Capacity
- Environmental Monitoring
- Infection Prevention Supplies
- Campus Health Center Capacity
- Community Health Center Capacity
- Mitigation Behaviors
- Campus Impact on Operations
- Community Impact on Operations
SEWAGE SURVEILLANCE AT THE CAMPUS-LEVEL

Logistical Questions:
1. Safety
2. Sample locations
3. Sampling frequency
4. Collection method (grab vs composite)
5. Sample processing method
6. RT-qPCR methods
7. Data integration/interpretation
Sample Processing Procedures

- Collect sewage sample
- Filter and homogenize
- Centrifuge
- Quantify using internal and external standards

ΔRn vs Cycle
## ALERT MATRIX (AS OF SEPTEMBER 8)

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<tr>
<th></th>
<th>New Normal</th>
<th>Alert Level 1</th>
<th>Alert Level 2</th>
<th>Alert Level 3</th>
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<tbody>
<tr>
<td>Campus Testing</td>
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<td>Contact Tracing</td>
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<td>Isolation and Quarantine</td>
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<td>Environmental Monitoring</td>
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<td>Campus Impact on Operations</td>
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<td>Community Impact on Opns</td>
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<td>Composite Alert Level</td>
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### Comments and Observations:

- Saliva testing has resumed, will increase capacity deliberately; daily testing (all means) between 400-600/day
- Contact tracing on track and pace
- 500+ (from 1200+) positive cases in the past week
- Environmental monitoring is consistent with campus burden
- No evidence of community spread or spread to faculty and staff
- Continuing to expand I/Q capacity to meet case burden needs
- Student behavior is being closely monitored, 22 interim suspensions and 12 Greek houses quarantined
- Anxiety is elevated among faculty, staff, students, parents and community members; receiving increasing messages of support and a determination to continue
- Students continue to be asymptomatic or very low symptoms and no significant health issues

**Composite Alert Level:**

1.00
Wastewater Surveillance – Use in directing mitigation testing

9/25/20, ACHA
Kacey C. Ernst MPH, PhD Professor of Epidemiology
● Location: Tucson, AZ (city size: 545,975)
● Hispanic Serving Institution
● Research 1 institution with $687 million in annual research expenditures
● Student Body
  ○ Undergraduates: 35,801
  ○ Graduates: 9,944
Current COVID-19 Metrics

- Phase 1: All online except essential face to face
- Testing of UA Students
  - Test All / Test Smart
  - Test all:
    - Walk-ins for anyone who wants testing (on or off-campus)
    - Mitigation testing: whole dorms with triggers
  - Test Smart
    - Random samples of on-campus dorm residents
    - Random samples of UA employees and off-campus students
Current Wastewater Testing

- **Current results**
  - 0 (non-detect), 2, 3 levels of concern – reported by dorm site tested

- **Current Sampling**
  - On campus only – 11 Dorm sites (total of 21 dorms)
    - Some wastewater sampling sites serve multiple dorms
    - Sampled roughly 2x per week – more often with Level of Concern 3

- **Future Sampling**
  - Expand to *most* dorms (several inaccessible)
  - Expand to Greek system (site of significant transmission)
  - Expand to nearby off-campus apartment housing
## Wastewater Surveillance follow up - Use & Limitations

<table>
<thead>
<tr>
<th>Assumed interpretation of the results</th>
<th>WWS “positive”</th>
<th>WWS non-detect</th>
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<tbody>
<tr>
<td>➢ A COVID-positive (presymptomatic, asymptomatic or symptomatic) person who was shedding virus pooped in the dorm</td>
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<td>➢ No one living in the dorm has COVID-19</td>
</tr>
<tr>
<td>➢ The timing of this WW sampling is such that, if we do follow up antigen/PCR testing, we will “catch” the presymptomatic, asymptomatic or symptomatic person(s) thereby preventing transmission to others</td>
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| Other possible explanations for these results | | |
| ➢ Resident? The person/people shedding the virus who pooped in the dorm may not live in the dorm | | ➢ Shedding variability: 39-52% of COVID+ people shed virus in their feces. Not all COVID+ persons shed virus in the same way and in the same amount. There may still be undetected COVID+ within dorms |
| ➢ Late Stage Illness? Some individuals shed virus for 3-4 weeks and may therefore be in late stage illness or past the infectious stage, therefore follow up testing may yield no benefit | | ➢ Detectability: The level shed/present in the sample was <LOD but there may still be someone living in the dorm who is COVID+ |
| ➢ Clearing? Person may have already moved to isolation and there may be delay in clearing of the WW | | ➢ Timing: The sample was taken at a time when the COVID+ stool was “missed.” The COVID+ person is constipated or pooped in another building |
Dorm 2 – example timeline

* Not tested on that day, otherwise WW was non-detect
Case counts and WWS

- 29% false negative rate
- One dorm had 42 cases and negative wastewater
- Isolation dorm has never gone over 2 – negative for 3 days after move in

<table>
<thead>
<tr>
<th>Wastewater level of concern</th>
<th>Cases identified in dorm (same day)</th>
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<tr>
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<td>0</td>
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<tr>
<td>Level 0</td>
<td>56</td>
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<tr>
<td>Level 2</td>
<td>21</td>
</tr>
<tr>
<td>Level 3</td>
<td>3</td>
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</tbody>
</table>
Surveillance Iceberg

Up to 80% of people age 10-19 are asymptomatic (Davies, et al. Nature Medicine) means when we get symptomatic cases at Campus Health they are the TIP OF THE ICEBERG

Where you are on the iceberg with different testing indicators

1. Campus Health Positives
   - All students have access
   - Less bias

2. TATS Surveillance

3. Wastewater surveillance

Likelihood there is a higher level of transmission
Recommendations to prioritize testing

Preliminary scoring system has been developed, but requires further validation with more stable system. In general we recommend:

1. **Campus Health cases rank as #1 flag**
   a. Cluster of 2-3 cases per 100 over 2 day period - without dorm testing in past 3 days - drop everything and test this dorm

2. **Previous TATS percentage as #2 flag**
   a. TATS % positive for a dorm >5% OF THOSE TESTED (Not the total residential denominator) - Needs to be tested twice per week until test positive is below 2%

3. **Wastewater testing results as #3 flag**
   a. Wastewater level 3 two days in a row in the absence of other indicators - Test priority IF there is capacity after addressing 1 and 2
Limitations of WWS that must be considered

- Not all dorms can feasibly be monitored via WWS - this creates some level of disparity and differential risk of transmission if these dorms receive more testing resources.

- Interpretation of non-detect should not provide a false sense of security - as identified in the previous slides, there are several possible reasons for a non-detect. Further comparisons between WWS and case data from CH and other sources is needed to improve our interpretation of results.

- WWS is typically used as a community-level indicator - not a trigger for identifying individual infections, this means there is limited precedent in the literature for methodologies and protocols (poliovirus etc.).

- Sampling frequency may impact sensitivity - careful assessment of the sampling design is warranted.
Acknowledgements

University of Arizona
Wastewater Principal Investigators
● Chuck Gerba, PhD
● Ian Pepper, PhD
● Walter Betancourt

The University of Arizona sits on the traditional lands of the Tohono O’odham people.
QUESTIONS AND ANSWERS

ACHA’s YouTube Channel: https://www.youtube.com/channel/UCzAFwNzF8GU5mLkSftxlacg

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