Use of Wastewater Surveillance in the Coordinated Response to COVID-19 in Utah, USA

Erica Brown Gaddis, PhD
August 2020
Wastewater Monitoring of Virus

- Homes with the virus.
- Homes without the virus.

After wastewater is processed, the virus is no longer detected as facilities remove all pathogens, including viruses.

Wastewater samples are collected at the influent to the treatment plant and is then tested for the virus.
Utah’s Pilot Study

Study design
- 10 wastewater treatment plants (~40% of population)
- Composite samples
- 2x week (April 20 – May 21)
- Weekly since May 21
- 2 samples each of sewer line samples for subareas of districts

Laboratory methods
- RT-qPCR
- Standardized across 3 Utah university labs
- 48 hour turn-around-time (24 hrs rush)

Data management and analysis
- Corrected for flow and population
- Averaged to generate daily value per facility
- Dashboard to display and communicate findings
Key Findings

Virus was found in the influent of all ten facilities (64% of all samples). Large increases of virus were measured at the Logan and Hyrum facilities in late May. Highest concentrations of virus were found in urban areas. Tourist communities showed higher concentrations than others of similar size. Virus was not detected in the effluent leaving the sewage treatment plants.

Key findings

Background

COVID-19 information

For information regarding COVID-19 guidance and cases, see the Utah Department of Health COVID-19 information page.

Background

SARS-CoV-2 (the virus that causes COVID-19, hereafter referred to as the virus) is shed in feces by infected individuals. Virus concentrations in the sewage can be measured by collecting a sample at the inlet of sewage treatment plants. Although the virus is unlikely to be viable or infectious at sewage treatment plants, more
Use Case: Early detection of rising infections

Virus concentrations in Logan City and Hyrum City WWTPs and Cache County COVID-19 active case counts.

Note: non-detections plotted at 1. MGC = million gene copies.
Cache County

Logan

Hyrum

Case count

MGC/person/day

Apr 12 2020
Apr 26
May 10
May 24

0
50
100
150
200
250

0

Use Case: Confirmation of low infection rates

Tremonton WWTP
Estimated population served: 12,451

Price River WID
Estimated population served: 17,312

Time series
Note: non-detections plotted at 1. MGC = million gene copies.

log ▼

MGC/person/day

Apr 12 2020 Apr 26 May 10 May 24

Other facilities
Selected facility

log ▼

MGC/person/day

Apr 12 2020 Apr 26 May 10 May 24

Other facilities
Selected facility
Use Case: Monitoring overall infection trends
Use Case: Targeting community level monitoring
Ongoing Wastewater Monitoring in Utah

Sample locations
- 30 treatment plants > 1 MGD (~10,000 people)
- 10 rural treatment plants based on health improvement index, meat packing industries, and tourism communities
- ~80% of Utah’s population

Frequency
- Weekly samples July – September at 40 sites
- Capacity for 20 additional samples as needed by public health
- Surge sampling available if needed

Budget: $275,000
- ~ $220/sample for urban samples ($0.005/person)
- ~ $525/samples for rural samples ($0.10/person

Future work
- Increase sample frequency at sentinel sites
- University campuses
- Long-term care facilities
- Neighborhoods
Planning considerations

Planning and logistics of expanding effort
- 40 facilities more than 600 km apart
- Composite v. grab sampling
- Holding time considerations
- Laboratory capacity was a key constraint to sample design

Identifying triggers for more monitoring/actions
- Increase, decrease, and plateau statistics
- Percent versus absolute change
- Interpreting data in urban, rural, and tourism-based communities

Data management and dashboard
- Concentrations converted to per capita units to account for infiltration and inflow at wastewater facilities
- Mapping of sewersheds is necessary to relate data to population and correlation with recorded case counts
- Online data spreadsheet increases efficiency and minimizes errors
- Data dashboard provides seamless display of new information to public and health officials
Lessons learned

A pilot study can effectively demonstrate the utility of the tool and work out logistical and method issues at relatively low cost.

Public health partners should be included in the design of the surveillance plan!! Minimize demands on public health time !!

Consider partnering with wastewater regulatory agency to assist with coordination of facilities, universities, and public health.

Laboratory methods should focus on delivering consistent and comparable data to track trends and broad patterns.

Communication is KEY.
- Facilities, scientists, sampling staff, and health officials must coordinate frequently.
- Data dashboard can be valuable to both public and health officials

Be prepared to adapt to new requests and new science – but don’t let perfection be the enemy of the really good
Partners and Collaborators

Research Partners
Jennifer Weidhaas, PhD, P.E., University of Utah
D. Keith Roper, PhD, Utah State University
Zach Aanderud, PhD, Brigham Young University
Jim VanDerslice, PhD, University of Utah
Erica Gaddis, PhD, Utah Division of Water Quality
Jake VanderLaan, Utah Division of Water Quality
Jeff Ostermiller, Utah Division of Water Quality
Ken Hoffman, Utah Division of Water Quality
Nathan LaCross, PhD, Utah Department of Health, Bureau of Epidemiology
Matt McCord, Utah Department of Health, Bureau of Epidemiology
Marissa Taddie, University of Utah

Wastewater Treatment Facility Collaborators
Tiffini Adams, Snyderville Basin WRD
Giles Demke, Orem WRF
Paul Fulgham, Tremonton WWTP
Phil Heck, PhD, PE, Central Valley WRF
Issa Humud, Logan City WWTP
Kevin Maughan, Hyrum City WWTP
Rich Mickelsen, Timpanogos SSD
Jeff Richens, Price River WID
Obe Tejada, Moab City WWTP
Jamey West, Salt Lake City WRF