Using Sanitary Wastewater as an Early Indicator of COVID-19 Cases in Derry Township of Pennsylvania

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Background & Significance

Water-based Epidemiology (WBE) can be used for population-surveillance of infectious illnesses such as COVID-19. Despite the fact that COVID-19 is a respiratory illness, viral RNA can be found in wastewater because infected patients excrete SARS-CoV-2. [1]

During 2020-21, researchers have been working to link wastewater viral concentrations to case numbers and hospitalizations. The use of wastewater is challenging because most treatment plants do not treat just human sewage, but also wastewater from other sources, which can affect viral concentrations. Additionally, studies suggest that variables such as climate change (storm water, heavy precipitation, heat waves, and droughts) can contribute to the transmission of infectious illness [2].

This study examined the concentration of specific pharmaceuticals, viral concentrations, and flow rates at the Derry Township Wastewater Treatment Plant with confirmed COVID hospitalizations at the local hospital. Because of the challenges of widespread human testing for infectious diseases, especially for asymptomatic and pre-symptomatic patients, this analysis will highlight how WBE can be used to determine the degree of infection.

Methods

1. 1 L of wastewater influent from Derry Township Municipal Authority (DTMA) was collected and shipped to Penn State on a weekly basis from (November 30, 2020 - June 15, 2021). Samples analyzed include: viral concentration, flow rate & pharmaceutical concentration (Acetaminophen, Naproxen, and Dexamethasone).
2. Fully Vaccinated County Level Data was obtained from the PA Department of Health’s website.
3. The COVID-19 hospitalization data of Hershey Medical Center was obtained from healthdata.gov.
4. The data were separated into two groups: early vaccination (November 30, 2020 - March 7, 2021) and large-scale vaccination (March 8 – June 15, 2021) and the time series were graphed using Excel.
5. Using spearman correlation in Mini Tab, the correlation coefficient and p-values was determined. P-values ≤ 0.10 = significant due to limited data.

Results

<table>
<thead>
<tr>
<th>Sample 1</th>
<th>Sample 2</th>
<th>Early Vaccination</th>
<th>Large Scale Vaccination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Virus Concentration</td>
<td>COVID-19 Hospitalization Cases</td>
<td>0.364</td>
<td>0.245</td>
</tr>
<tr>
<td>Virus Concentration</td>
<td>% Fully Vaccinated</td>
<td>-0.329</td>
<td>0.296</td>
</tr>
<tr>
<td>Virus Concentration</td>
<td>Acetaminophen</td>
<td>0.371</td>
<td>0.236</td>
</tr>
<tr>
<td>Virus Concentration</td>
<td>Flowrate (MGD)</td>
<td>-0.329</td>
<td>0.297</td>
</tr>
<tr>
<td>Virus Concentration</td>
<td>Naproxen</td>
<td>0.018</td>
<td>0.931</td>
</tr>
<tr>
<td>Virus Concentration</td>
<td>Dexamethasone</td>
<td>-0.535</td>
<td>0.073</td>
</tr>
</tbody>
</table>

Discussion

Thus, the data suggests:

- As Vaccination Increased, Virus Concentration Decreased
- As Virus Concentration Decreased, Hospitalization Cases also Decreased
- Acetaminophen & Naproxen decreased with lower virus concentration

No Significance found for:
- Flow Rate during both vaccination phases
- Acetaminophen, Naproxen, hospitalizations during the early vaccine rollout
- Dexamethasone after vaccine availability and uptake increased

Future Directions

- Analyze the rest of the Derry wastewater sample until end of August.
- Throughout summer, the tourist data might be helpful in providing information regarding asymptomatic and pre-symptomatic individuals that came to Hershey Park or other entertainment resorts within Derry Township.
- Data from other similar wastewater treatment plants in PA may also be examined for comparison purposes.

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References