

**SEWAGE SURVEILLANCE TOOL FOR TRACKING OF SARS-CoV-2 IN URBAN  
BANGLADESH**

**ASSESSING THE STRUCTURAL AND CULTURAL REASONS FOR THE HIGH  
RATES OF VACCINE PREVENTABLE DISEASES IN BANGLADESH**

An Undergraduate Thesis Portfolio  
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By

Claire Reagan

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## **SOCIOTECHNICAL SYNTHESIS**

While improvements to the health system in Bangladesh have bolstered modern hospitals, those resources are unavailable to a majority of the population, resulting in poor health overall. In the current COVID-19 health crisis, the technical research project has developed a dashboard that can track the spatiotemporal prevalence of the SARS-CoV-2 virus using sewage surveillance data in the wards and sites of Dhaka, Bangladesh. The product of this project will provide public health officials with critical information on where further clinical testing resources need to be allocated to prevent further spread of the disease. The science, technology, and society (STS) research builds off this project by analyzing the major structural and cultural factors, using the Actor Network Theory STS framework, that contribute to elevated rates of vaccine preventable diseases in Bangladesh and suggests changes to the social governing structure that could aid in improving access to basic health needs. Both the technical report and STS paper focus on health disparity in Bangladesh, and seek to increase the availability of health resources to those who currently do not have access.

The COVID-19 dashboard created for public health officials in Bangladesh will provide immediate, up to date information on the state of the spread of disease in their country. Samples are collected from the wastewater using sewage surveillance techniques, qRT-PCR is performed, and a viral load is calculated. The sewage data as well as available case data are compiled into the dashboard in real time, revealing the spatiotemporal prevalence of COVID-19. The dashboard and all of the figures and maps were created in R shiny and published to a server based out of the University of Virginia.

The dashboard was successfully completed and includes three main tabs of critical information. The tabs include a large map that visually compares collected case and sewage

data, time series plots that reveal trends over time of viral load in case and sewage data in each ward and site, and a current situation tab that advises the need for further intervention under certain conditions. Usability testing revealed small changes that needed to be made to make the dashboard more intuitive. Once these changes were made, the dashboard was accepted by the Bangladeshi health officials and will be used to track COVID-19. These officials will be able to make informed decisions and decide where scarce testing resources need to be further allocated.

The STS research project sought to answer the question: why is the rate of contraction of vaccine preventable diseases higher in Bangladesh than other parts of the world? A flawed actor network between the government, health system, and Bangladeshi people is responsible for this health crisis. Using the framework of Actor Network Theory, the STS report suggests improvements to actor communication that can lead to decreasing the high rate of preventable transmission. Data from the World Bank and the World Health Organization (WHO) were studied to identify and compare economic and health resources in Bangladesh as compared to other countries. Case studies of Bangladeshi cultural practice were used to identify cultural practices that could have an impact on health.

After examining resources, it was concluded that the government and health system fail to account for three main factors that shape health practice in their country: poverty, poor hygiene, and cultural beliefs on western medicine. Bangladesh is among the poorest countries in the world, hygiene is very poor, and there is no universal healthcare system. As a result, many are not able to afford proper medical care and disease transmission is very high. Additionally, it is more common for Bangladeshi's, particularly if they are poor, to seek out medical care from an unlicensed pharmacist instead of a medical professional. The government and the health system require a unique solution for keeping in touch with the specific needs of their citizens.

The best solution to this disconnect is to implement sewage surveillance for a broad range of preventable diseases as was proven feasible in the technical work for COVID-19.

Despite a broad range of unique needs and constraints globally, each person is entitled access to adequate health resources. Through this STS and technical report, it has been shown that, even in countries with very few resources and poor access to western medical care, there is always an alternative solution that can provide greater access to necessary healthcare. Sewage surveillance is the cost-effective solution that can identify vaccine needs and provide the critical information for the government to bring healthcare to its people efficiently.

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Technical advisor: Shannon Barker, Department of Biomedical Engineering

#### **ASSESSING THE STRUCTURAL AND CULTURAL REASONS FOR THE HIGH RATES OF VACCINE PREVENTABLE DISEASES IN BANGLADESH**

STS advisor: Catherine D. Baritaud, Department of Engineering and Society

### **PROSPECTUS**

Technical advisor: Shannon Barker, Department of Biomedical Engineering;

STS advisor: Kathryn Neeley, Department of Engineering and Society