# PREPARING VIRGINIA'S CORRECTIONAL FACILITIES FOR AN INFECTIOUS DISEASE OUTBREAK

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**Disclaimer**

The author conducted this study as part of the program of professional education at the Frank Batten School of Leadership and Public Policy, University of Virginia. This paper is submitted in partial fulfillment of the course requirements for the Master of Public Policy degree. The judgments and conclusions are solely those of the author, and are not necessarily endorsed by the Batten School, by the University of Virginia, Virginia Department of Health, the Commonwealth, or by any other agency.

**Honor Statement**

On my honor as a student, I have neither given nor received unauthorized aid on this assignment.

## Glossary

VDH: Virginia Department of Health
VADOC: Virginia Department of Corrections
COVID-19: Coronavirus disease (COVID-19) is an infectious disease caused by the SARS-CoV-2 virus (World Health Organization).
Sars-COV-2: The virus that causes a respiratory disease called COVID-19. SARS-CoV-2 is a member of a large family of viruses called coronaviruses (National Cancer Institute).

## Executive Summary

This document will cover the nuances surrounding infection control and surveillance in Virginia's correctional facilities. Although COVID-19 is the most relevant pandemic, this document looks to find transferrable options for any infectious disease. The intended goal is to explore pathways to reduce the spread of COVID-19 in correctional facilities, but also increase knowledge of outbreak so that the Virginia Department of Health has can effectively react. Moving forward, it is imperative that the Virginia Department of Corrections expedites the pathway of information to the Virginia Department of Health.

The central question of analysis is how to protect the health and safety of the incarcerated while also giving them the tools to take their health into their own hands. Many of the prisoners in Virginia have lower levels of education and they are from lower socio-economic status. Therefore, there may be hesitation in the acceptance of new medical practices.

The following proposal assesses three policy options that are evaluated in two different manners: the first is the actual detection of cases, and the second is increased protection, and the third is increasing the knowledge of infections.

1. **Expand wastewater surveillance for infectious diseases across facilities.**
   Wastewater surveillance is a method of monitoring the presence of pathogens, such as SARS-CoV-2, in a community by analyzing wastewater samples from buildings or homes that could contain human waste, including water from toilets, sinks, and showers. This alternative looks to identify various pathogens in wastewater to identify budding infection.

2. **Establish stricter isolation and quarantine protocols.**
   This alternative would correctional facilities to establish stricter protocols and procedures for the isolation and quarantine of prisoners who have been exposed to or are suspected of having an infectious disease. Protocols would have to be created in collaboration with correctional facilities and the Department of Health.

3. **Promote health education campaigns.**
   This alternative requires correctional facilities to engage with and educate prisoners about the risks and prevention of infectious diseases and provide them with the knowledge and tools they need to protect their own health and the health of others. This can help to empower prisoners to take an active role in their own health and well-being, and to prevent the spread of infection within the prison population.

These policy options will be evaluated by the following criteria: Cost, Political and Administrative Feasibility, Effectiveness, and Equity between the prisoner and staff populations.

Ultimately, I recommend that Virginia's correctional facilities expand wastewater surveillance for infectious diseases. This is a cost-effective option – wastewater surveillance has a recurring cost of $5,200 weekly, resulting in a higher variable cost; however, this is significantly less compared to weekly nasal swab tests. This alternative also upholds the privacy and safety of prisoners. These criteria show that this is a very strong alternative. As wastewater surveillance is an existing program, I will recommend steps for a wider-spread implementation.

## Client: Virginia Department of Health

The Virginia Department of Health (VDH) is the primary agency responsible for promoting and protecting the health of Virginia's residents. It is a state government agency that oversees a wide range of health programs, including disease control and prevention, health education, maternal and child health, environmental health, and emergency preparedness and response. VDH's mission is to promote and protect the health of all Virginians. The agency works towards achieving this mission through five main goals: (1) maintain a competent and valued workforce; (2) foster healthy, connected, and resilient communities; (3) be a trusted source of public health information and services; (4) assure the conditions that improve health opportunity; (5) provide internal systems that deliver consistent and responsive support.

VDH plays a crucial role in ensuring that the residents of Virginia have access to high-quality health services and resources to maintain and improve their health and well-being. VDH is responsible for tracking and monitoring the spread of infections throughout the state, including COVID-19. This includes conducting testing, contact tracing, and surveillance of outbreaks to identify and control the spread of the virus. They collect and analyze data on infections and related outcomes throughout the state, including COVID-19. This data is used to inform decision-making and guide public health interventions. Additionally, VDH provides education and outreach to healthcare providers, businesses, and the public to promote prevention strategies such as hand hygiene, social distancing, and vaccination. VDH works with healthcare providers, emergency responders, and other stakeholders to coordinate a comprehensive response to infectious diseases. This includes developing and implementing response plans, ensuring access to medical supplies and personal protective equipment, and providing guidance on testing and treatment protocols.

## Introduction

In this report, I look to cover how to better prepare Virginia's correctional facilities for infectious disease outbreak. My problem statement is as follows: **Too many correctional facilities in Virginia are inadequately prepared for an infectious disease outbreak.** Particularly, COVID-19 is 5.5 times more prevalent in correctional facilities than the general population (Times, 2020). COVID-19 not only continues to plague Virginia's jails and prisons, but their surrounding communities as well. Correctional facilities typically have an immunocompromised population, and the overcrowding tends to increase chance of spread. Through careful analysis, I have identified ways to increase accuracy of detection of cases, as well as increase knowledge of infection in a prisoner population.

I will begin by giving a background of COVID-19 in prisons and expand to talk about costs to society and consequences of not solving this problem. From there, existing literature is explored. There has been pilot programs and studies that give evidence on how to approach this issue. I particularly dive into how Virginia's Governor initially responded to the pandemic, as well as give background on my alternatives. I am proposing three separate alternatives: wastewater surveillance, stricter isolation protocols, and a health education campaign. In the existing evidence section, I provide information on previous studies that have been conducted on health education campaigns and how they are able to change the attitudes of a population. I explain a study that was conducted on wastewater surveillance that addresses any and all concerns, and how to combat these concerns.

Each alternative receives its own analysis, with the following evaluate criteria: Cost, Effectiveness, Administrative and Political Feasibility, and Equity. Through careful analysis, I identify which alternative scores high in each criterion, and therefore would want to implement. Lastly, I provide an outcomes matrix and give my final recommendation.

My final recommendation is to build out a wastewater surveillance program to encompass all infectious diseases. Currently, wastewater surveillance is being used to monitor COVID-19; however, there is potential to expand this program to identify more pathogens to detect infection. Wastewater surveillance is cost-effective option – costing $5,200 across all facilities statewide. This is a weekly number, so this would be an investment and a recurring cost; however, the accuracy of detection makes this investment worth it.

As this is an existing program, I will lay out steps for implementation in the final section of this report.

## Background

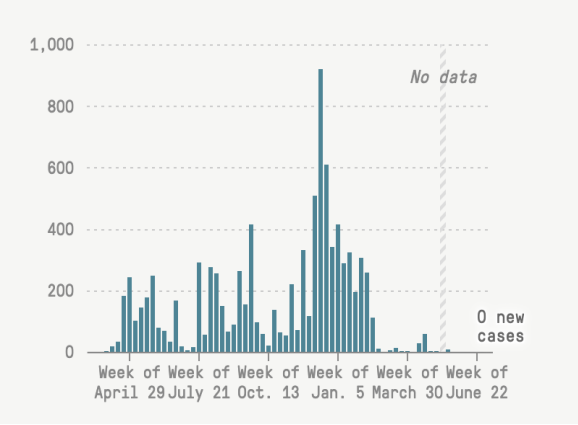
Even before the pandemic hit, access to sufficient healthcare in the prison system posed several challenges. Prisons have limited resources, as they usually do not have enough medical staff, equipment, or supplies to meet the needs of all inmates. Virginia has had challenges with recruiting and retaining its medical staff – personnel may not have the same level of training as those working in hospitals and other healthcare settings (Initiative, 2020). They may not be equipped to deal with complex medical conditions, which can result in delays in treatment and inadequate care. Virginia's incarcerated have faced unique challenges as there has been inadequate mental health care and an opioid epidemic on top of being an underserved population (Initiative, 2020). Inmates are also required to pay for healthcare services if they have more than $10 in their account, which can be a significant barrier to access for inmates (Marshall Project, 2021).

Adding the pandemic to existing conditions has left prisons inadequately prepared for an infectious disease outbreak. The COVID-19 pandemic has had a significant impact on the Americans' health and continues to show up in different variants. The toll has varied by state, but the United States prison system is amongst one of the most underserved populations. They have limited access to healthcare, education, legal resources, support, and are subject to overcrowding. Prisons and correctional facilities are high-risk environments for the spread of infectious diseases due to the close proximity of inmates, staff, and visitors. As a result, COVID-19 has spread rapidly throughout the prison population, leading to high rates of infection and death.

The Marshall Project started tracking COVID-19 rates in March 2020 and concluded their findings in June 2021. Figure 1 is pictured below as a chart depicting how cases rose in the initial 15 months of the pandemic. Virginia reported 9,112 cases amongst prisoners, and 2,621 cases amongst staff, which is likely an underestimation (Marshall Project, 2020). COVID-19 was, and remains to be, 5.5 times more prevalent in correctional facilities than the general population.

**Figure 1**

*Prisoner population*




*Staff population*

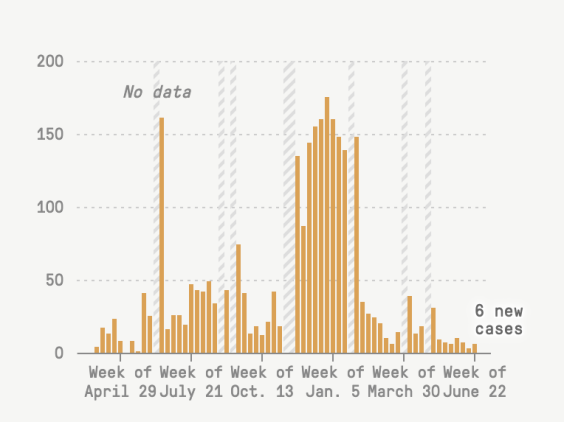



*Figure 1 Source: The Marshall Project*

Virginia, compared to other states, had an adequate response, and ranked at 11th in 2022 for response and management of the pandemic. This rank is based on COVID-specific measures like vaccinating residents, hospitalization rates, and mortality rates. Virginia was in line with other states in terms of vaccine release, and approximately 90% of the general population has received at least the first dose (Commonwealth Fund, 2022).

Vaccine hesitancy has been a major issue in prison, from both staff and prisoners. Inmates have expressed distrust in prison employees, including healthcare providers, and have cited a lack of information and incentives as reasons for their hesitancy. The slow rollout of vaccines in prisons has exacerbated inmate skepticism, with some prison staff also declining the vaccines. Virginia's correctional facilities are comprised of 69,000 prisoners. Below is a Table 1 laying out how many employees and prisoners are vaccinated as of last year.

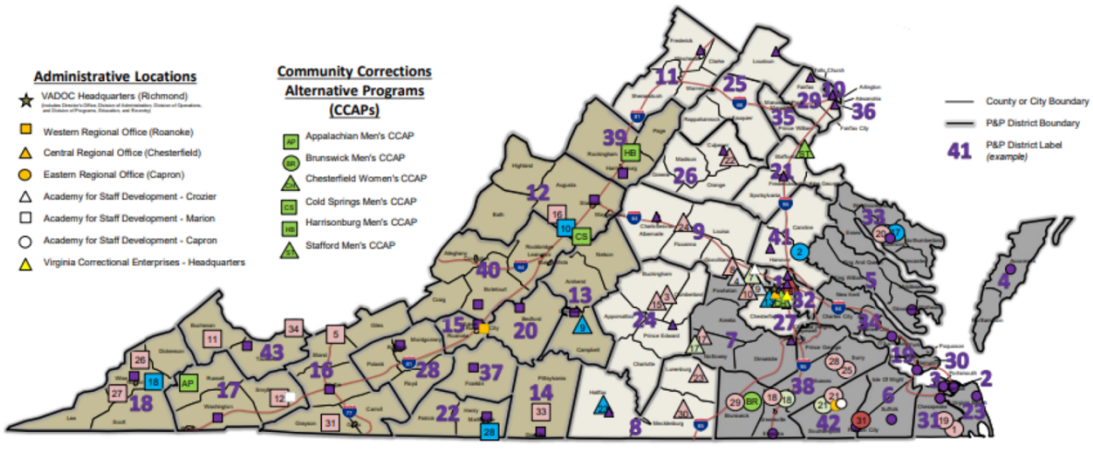
**Table 1: VADOC Vaccination Rates of 2022**

| # of employees vaccinated | # of employees | % of employees vaccinated | # of incarcerated vaccinated | # of incarcerated | % of incarcerated vaccinated |
|---|---|---|---|---|---|
| 4,290 | 10,931 | 39.2 | 25,025 | 31,548 | 79.3 |

*Source: VADOC*

Virginia has a general population of 8.642 million, and approximately 73.8% of them are vaccinated (CDC, 2022). Comparably, the incarcerated population is not behind in terms of vaccination at this point.

VADOC is comprised of 26 major institutions, 43 probation and parole districts, and 6 community corrections alternative programs, all of which are denoted on this map.




*Source: VADOC Agency Insights*

## Cause of the problem

The spread of infections in prisons can be attributed to a variety of factors. Prisons are often overcrowded, with many inmates living in close quarters. This makes it easy for infection to spread from person to person. Prisons house high-risk populations, including those with underlying health conditions and those who are immunocompromised, which can increase the risk of infection spread. As stated above, inmates do not have easy access to medical care, and limited resources to test all inmates and staff for infections regularly makes it difficult to identify and contain infection. Prison staff members move in and out of the facility daily, which increases the risk of bringing infections into the prison or spreading infection to the outside community.

Prisons are often compared to retirement homes, as they have a similar living style (Winner, 2021). Though one typically houses a younger population, and one houses an older, both tend to see immunocompromised individuals. In prisons, factors such as close living quarters, limited access to personal protective equipment, and difficulty implementing social distancing measures can all contribute to a higher risk of transmission (Winner, 2021). Additionally, inmates may have underlying health conditions that can make them more vulnerable to severe outcomes from COVID-19. In comparison, retirement homes may also have close living quarters, but residents may be more likely to have access to medical care and support, as well as more consistent access to personal protective equipment. However, residents may also have underlying health conditions that can increase their risk of severe outcomes from COVID-19.

One major difference between prisons and retirement homes is that the populations of these environments are very different. Retirement homes tend to house elderly individuals, who may be more vulnerable to severe outcomes from COVID-19. In contrast, prisons tend to house a younger population, although there may still be significant numbers of individuals with underlying health conditions (Winner, 2021).

## Direct Costs to Society

The direct costs of COVID-19 to society have been estimated to be in the trillions of dollars. Direct costs include the costs of prevention and treatment, such as individual protection equipment, contact tracers, tests, and vaccines. In October 2020, David Cutler and Lawrence H. Summers published an article in JAMA Viewpoint estimating that COVID-19 would cost the United States $16 trillion dollars when combining economic damages and monetized health and life loss Cutler and Summers, 2020). A more recent update to their estimate, using facts about the disease and its costs to society that have become known since their paper was published, found that the total harms of COVID-19 to the U.S. are still about $16 trillion (with a range of $10 trillion and $22 trillion) (Pike, 2023). They performed a systematic review of studies that assessed the economic burden of COVID-19 found that an estimation of a 20% COVID-19 infection rate based on a Monte Carlo simulation in the United States led to a total direct medical cost of $163.4 billion over the course of the pandemic (Pike, 2023). The COVID-19 pandemic has generated a considerable economic burden on patients and the general population.

## Indirect Costs to Society

Indirect costs, on the other hand, account for the costs of morbidity, mortality, and quarantines in terms of losses of productivity. The disruption of supply chains and supply also has a direct impact on employment and productivity. The true cost of COVID-19 will be far greater than the direct health costs of treating cases, and the extent of these indirect costs, including the economic damage,

will outstrip the costs of testing, treating, and hospitalization of patients. Indirect costs also include the opportunity cost of idle healthcare resources that remain unused during the pandemic, should the epidemic worsen, reserved for potential COVID-19. The economic consequences of the indirect health harms of the COVID-19 pandemic are significant, with the highest costs resulting from failing to mitigate rising rates of depressive symptoms among adults (*Economist*, 2020).

An economist at the University of Virginia (Kelly, 2020), Anton Korinek, explains that the societal costs of COVID-19 outweigh individual costs, with the virus imposing a social cost of trillions of dollars on the US economy compared to letting the disease spread uncontrolled. The "social cost" of a person becoming infected with COVID-19 is roughly $55,000, which reflects how much people are willing to pay to reduce their risk of death. Indirect costs also incorporate productivity losses arising from worker absenteeism and the adoption of protective measures that households and businesses would not otherwise have spent money on, such as purchasing hand sanitizer and disinfectants (Kelly, 2020).

## CLIA Waiver

To mitigate costs, some facilities have adopted the CLIA Waiver. The Clinical Laboratory Improvement Amendments of 1988 (CLIA) regulates all laboratory testing, and they provide a waiver for test systems cleared by the FDA. Waived tests are deemed by the FDA to be simple and can be administered by anyone. By obtaining a CLIA certificate of waiver, one can perform tests in the case of absent healthcare professionals (Centers for Medicare and Medicaid Services, 2023). The certificate can be requested on the CDC website by completing an application, or obtainable from a local state agency. Obtaining this waiver has saved short-staffed healthcare facilities thousands of dollars, as they don't have to seek out new professionals, and go through extensive training.

## Consequences

The consequences of not preparing prisons for COVID-19 can be severe and potentially deadly for both inmates and staff. Prisons are crowded places where social distancing is difficult to achieve. If proper precautions are not taken, the virus can spread quickly among inmates and staff. This can result in a rapid increase in the number of cases, putting a strain on the local healthcare system and potentially overwhelming it. Inmates are a vulnerable population, and many have preexisting medical conditions that make them more susceptible to COVID-19. If they contract the virus, they are at a higher risk of developing severe symptoms and even dying. Staff members who work in the prison are also at risk of contracting the virus and spreading it to their families and communities. If prisons fail to take appropriate measures to prevent the spread of COVID-19, they may face legal consequences. Inmates and their families may file lawsuits alleging that the prison did not provide adequate care or take appropriate steps to protect their health and safety. Prisons are not isolated from the outside world, and outbreaks in prisons can quickly spread to the surrounding community. This can lead to a wider public health crisis that affects everyone in the area.

## VADOC Funding

Prisons in Virginia are primarily funded by taxpayer money. The Virginia Department of Corrections receives funding from the state's general fund, which is made up of taxes and other revenue sources. In addition to operational costs, such as paying correctional officers, some states may also fund additional rehabilitation programs, drug treatment centers, and juvenile justice initiatives through these state agencies. Virginia has also outsourced some of its prisons to private, for-profit corporations. However, this has not resulted in better prison management or cost savings. In fact,

due to aggressive lobbying by the prison industry, overall prison costs may have actually gone up. The Commonwealth of Virginia continues to pay a price tag of $29,000 per inmate per year. In VADOC's FY2022 Report, they detail that $203,263,625 was spent on medical and clinical services/supplies (*VADOC — Grants & Collaborations*).

## VDH Funding

VDH is funded through a combination of federal, state, and local funds. The VDH received a $11.5 million allocation in the Governor's Budget Bill approved on August 10, 2021, to help low-income homeowners repair or replace well and septic systems, which is part of the Commonwealth's funding from the American Rescue Plan Act (ARPA). The VDH was awarded $30.6 million from the CDC to address health equity for racial and ethnic minority groups and rural populations within state, local territorial, and freely associated state health jurisdictions (Clayton, 2021). VDH also secures funding through grants and partnerships with organizations such as the Virginia Environmental Endowment and the Smithfield Foundation. VDH's budget is appropriated by the Virginia General Assembly. $593,241,117 was allocated to their Federal Covid Budget in FY2023 (Hilbert, 2022).

## Existing Evidence

In this portion of my report, I will talk about methods that have been tried in the past. I am exploring both programs done by the state, as well as studies that prove the effectiveness of alternatives I have proposed. I will touch on gaps in the literature to conclude this section.

### Early Release Programs

Initially, Virginia's Governor Ralph Northam reacted to the pandemic by proposing an early release program. He reviewed individuals in Virginia's Department of Corrections Facilities for early release, in hopes to depopulate prisons. Depopulating prisons was a popular first move, as prisons didn't have the capacity to allow inmates to effectively social distance, quarantine, and they're oftentimes not a particularly hygienic place. Virginia Department of Corrections developed an early release plan specifically for state responsible inmates held in local correctional facilities who were at higher risk for COVID-19 complications (Demleitner, 2021). To qualify for early release, the prisoner needed to have less than a year left in their sentence and couldn't have been charged with a violent crime. The plan aimed to ensure that inmates who were at higher risk of developing severe forms of COVID-19 had the resources and access to care in their community needed to mitigate the severe health risks to the inmate. The plan required that inmates have a medium or low risk of recidivism to be considered for early release. However, the Virginia Department of Corrections' authority to release state inmates early due to the coronavirus pandemic terminated at midnight on July 1, 2021. By that time, 2,114 state responsible inmates had been released early (Demleitner, 2021).

In addition to an early release consideration, Governor Northam tightened visitation. Visitation regulations heavily depend on the facility itself now, but generally, visitors aged 12 and up are required to take a rapid antigen test and test negative to see the prisoner in person. Masks are required as well. Vaccinations have been made available for all inmates and staff. If the prisoner is not vaccinated, video visits have been made available. As of September 1, 2021, the Virginia Department of Corrections began a registration process in a visitor scheduler. Visits can be scheduled up to 14 days in advance (Demleitner, 2021)

### Health education campaign

Southwest Virginia has seen a higher caliber of cases, and so some efforts are focused to this region. Over the course of the pandemic, epidemiologists have gone into facilities to answer any questions prisoners and staff may have, in order to quell any concern. Their approach, in addition to face time with the prisoners, has been distributing a video that explains the benefits of being prepared for COVID-19, and other infectious diseases. Health education campaigns generally look to produce a behavioral change. In other communities, social marketing is a method for a comprehensive approach; however, there is question as to how effective an education campaign can be, particularly amongst a prisoner population. This question is addressed below by a study that was conducted in Rural China.

In 2019, a study was conducted amongst Rural Chinese adolescents to explore the effectiveness of a health promotional program. This study was focused on increasing knowledge and healthy behaviors related to nutrition, physical activity, and tobacco use. This was a school-based program, which means that they were receiving information in person through educational sessions and posters. These materials were made possible through collaboration with local health authorities and community members (Duplaga, 2019). Participants were divided into two groups in a randomized controlled trial design, where there was the intervention group receiving the health promotional

program, and the control group receiving no intervention. Changes were measured at a 6-month and 12-month follow-up period. This study ultimately found that approximately 53% of respondents were convinced that health education campaigns are effective (Duplaga, 2019). The intervention group saw improvement in dietary intake, physical activity, and tobacco use behavior compared to the control group as well. The authors highlighted the potential for success in a school-based health promotional campaign, as students spend a significant amount of time in this space, and social norms and behaviors can be influenced. This was also a rural community, where healthcare services and health education may be limited (Duplaga, 2019).

A 2020 study was conducted on the effectiveness of leaflets and posters as a health educational method. This study found that overwhelming a population with printed materials can lead to avoidance. It was discovered that people much prefer PowerPoint presentations and audio-visuals. Posters are effective in the sense that it allows a population to subconsciously digest information over time; however, studies have proven that handing someone a printed material repeatedly doesn't show an increase in knowledge (Hasanica et al., 2020).

Modeling a health education campaign after the results of these studies has the potential to prosperous in a prisoner population, as there are similar parameters.

### Wastewater surveillance

Wastewater surveillance is a method of monitoring the presence of pathogens, such as SARS-CoV-2, in a community by analyzing wastewater samples from buildings or homes that could contain human waste, including water from toilets, sinks, and showers. This method is particularly helpful for estimating the amount of a pathogen in a community, as it can be an early indicator that the number of people with COVID-19 in a community is increasing or decreasing. Wastewater surveillance has been slowly implemented nation-wide over the course of the pandemic. The virus can be found in feces even if a person is not showing symptoms of the infection. Wastewater flows into a sewershed, and the level of SARS-CoV-2 can be measured by public health officials. The virus is no longer active when it is released through feces, and therefore cannot cause new cases of COVID-19. There have been no reports of COVID-19 cases being transmitted through wastewater, according to the CDC (CDC, 2022).

Virginia was one of the first state prison systems to begin using wastewater surveillance. A regional study was conducted in Hampton Roads, Virginia to assess the prevalence of SARS-CoV-2 and its variants in the area. The study analyzed samples collected from four wastewater treatment plants in the region between January and March 2021. Researchers then measured the concentration of the pathogen in the water and compared it to the COVID-19 cases reported in the area during the same period. The study found that the concentration of the virus in the wastewater was higher in areas with a higher number of COVID-19 cases. They were also able to identify the presence of the B.1.1.7 (Alpha) variant in the wastewater samples, which was consistent with the increase in variant cases reported in the area (Gonzalez et al., 2020). The results suggest that wastewater surveillance can provide an early warning system for the emergence of new SARS-CoV-2 variants and could be used as a tool for monitoring the spread of the virus in specific regions. Wastewater is collected from 25 wastewater treatment plants in Virginia, and results typically return in 3-7 days (Cleary, 2021).

The Water Environment Federation (WEF) conducted a pilot program for onsite testing of SARS-CoV-2 in correctional facility wastewater, in conjunction with the CDC. This pilot was intended to test how feasible implementing wastewater surveillance in a correctional facility would be. WEF collaborated with 18 correctional facilities in four different states, one of which was Virginia. Five correctional facilities were sampled in Virginia, each one being a different institution type in rural and urban areas with varying levels of residents. The study went on for a total duration of 31 weeks, all of which was conducted on-site (Water Environment Federation, 2022).

In addition to exploring the administrative feasibility of wastewater surveillance in correctional facilities, WEF aimed to identify any barriers that state corrections would face. All technicians in Virginia had some sort of laboratory experience; however, they lacked the specific training to work with pathogens in wastewater (Water Environment Federation, 2022). This created concern for quality assurance and quality control – how could correctional facilities be certain that they were detecting SARS-CoV-2 accurately?

The most cited barrier to use included technology use – there was concern as to how much time staff could dedicate to analyzing the samples. As mentioned above, laboratory technicians had varying levels of experience, and testing methods were viewed as complex. Additionally, laboratory technicians were confused with what to do with this data (Water Environment Federation, 2022). Wastewater surveillance became widely known as the pandemic hit, and the infrastructure was built from the ground up. Therefore, this pilot was necessary to understand how effectively the infrastructure could be built out to the whole state.

### Importance of Wastewater

An article was published in the American Society for Microbiology Journal (Colosi et al., 2021) explaining the importance of wastewater surveillance in congregate living spaces. COVID-19 is an airborne disease, and spreads like wildfire in indoor spaces. The authors specifically talk about the aerosolization of respiratory diseases, and how aerosols accumulate in indoor spaces for longer than respiratory droplets. When an infected person talks, coughs, or sneezes, respiratory droplets can be produced and released into the air. These droplets are relatively large and heavy and can travel only a short distance before falling to the ground or nearby surfaces (Colosi et al., 2021). If someone else is in close proximity to the infected person, they can inhale these droplets and become infected. Unlike respiratory droplets, aerosols are much smaller and lighter, and can remain suspended in the air for longer periods of time. When an infected person talks, breathes, or sings, they can produce aerosols that contain the virus. If these aerosols are not adequately ventilated or filtered, they can accumulate in indoor spaces and potentially infect others who inhale them (Colosi et al., 2021).

Santarpia et al. (2020) found that SARS-CoV-2 can be present in aerosols generated by infected individuals during breathing and talking, as well as coughing and sneezing. The study found that infectious virus particles were present in aerosols as small as 1-4 micrometers, which can remain suspended in the air for extended periods of time (Santarpia et al., 2020).

Another study published in the Journal Indoor Air in 2021 analyzed air samples from hospital rooms where COVID-19 patients were being treated. The study found that SARS-

CoV-2 RNA was present in air samples collected more than 2 meters away from patients, indicating that the virus can be present in aerosols and can travel beyond the immediate vicinity of infected individuals (Sousan et al., 2022). Similarly, a study published in the Journal JAMA Network Open (Srikrishna, 2022) which analyzed air samples from an indoor fitness facility where a COVID-19 outbreak had occurred. The study found that the virus was present in air samples collected up to 4 meters away from infected individuals, indicating that aerosols may have played a role in transmission (Srikrishna, 2022).

These studies find that detecting the presence and prevalence of an airborne disease, like COVID-19, can be done through wastewater monitoring effectively. When infected individuals shed the virus, it can be present in their bodily fluids; however, it loses contamination in their feces. Wastewater can provide a more comprehensive picture of the overall burden of the disease in a community (Colosi et al., 2021). Clinical testing, such as a PCR test, for an airborne disease can give inaccurate results – this testing is oftentimes limited to individuals who are symptomatic or who have been exposed to known cases. Wastewater testing, on the other hand, can detect the presence of the virus in a wider population, including asymptomatic individuals, who wouldn't have been tested otherwise.

## Gaps in the Literature

There are several important knowledge gaps in understanding how airborne transmission of SARS-CoV-2 spreads, and this is a partially why it has been so difficult to find an effective route of detection and treatment. It has been difficult to decipher the minimum amount of virus required to cause infection in humans through airborne transmission (Santarpia et al., 2020). Understanding the infectious dose is important for determining the risk of infection in different settings, like correctional facilities, as well as for developing strategies to mitigate transmission. The role of environmental factors such as temperature, humidity, and air flow in airborne transmission is not yet fully understood. Different environmental conditions may affect the survival and transmission of viruses in the air, but more research is needed to determine the specific effects of these factors.

Although ventilation is known to be important for controlling airborne transmission, there is still question as to how to effectively approach this in different settings. Settings like correctional facilities have limited ventilation capabilities, and it is not clear how frequently air should be exchanged in a room to reduce the risk of transmission, or how to optimize ventilation systems in buildings with different designs and occupancy levels (Santarpia et al., 2020).

Additional limitations to the pre-existing evidence include a concern about accuracy and efficiency of preventative measures, like ventilation. As variants continue to get more intense and more vaccinations are required, it's unclear if prisoners will receive the same level of protection from these regulations. The VADOC struggles with releasing information in a timely manner, and there isn't a direct pipeline to the VDH. Therefore, by the time notice of an infection reaches VDH, they may not be able to act efficiently.

## Evaluative Criteria

***Cost***

Cost will be assessed by considering an estimation of upfront costs associated with developing, expanding, and implementing each policy alternative. These upfront costs will solely reflect the impact on Virginia Department of Health's budget, and may include cost factors such as personnel, equipment, materials, etc. When applicable, cost-effectiveness will be considered, in comparison to a program that an alternative may replace. A direct cost estimate will be given, and each alternative will be ranked as Low, Medium, or High. All cost calculations are shown in Appendix A. Below is a rubric on how cost is evaluated.

| Low: not met | Medium: satisfactory | High: meets |
|---|---|---|
| < $10,000 | $10,000 - $1M | $1M + |

***Feasibility***

Feasibility will be assessed through both political and administrative feasibility. To measure political feasibility, the state of the budget will be considered, as funding generally comes from the state. Should there be a request for a higher budget for an alternative, the political arena may have an impact on any grants. To measure administrative feasibility, the access to appropriate staff will be considered. Each alternative is highly dependent on public health officials and trained staff to lead initiative. All alternatives will be scored from Low, Medium, or High. "Low" reflects this alternative having little concern to implementation, and "High" reflecting large concern to implementation.

*Political Feasibility*

| Low: not met | Medium: satisfactory | High: meets |
|---|---|---|
| This alternative will require seeking additional funding from the state. Governor Youngkin and local government are likely to block this alternative from passing. | This alternative could require initiative from state government. | No sign off or additional funding is needed. |

*Administrative Feasibility*

| Low: not met | Medium: satisfactory | High: meets |
|---|---|---|
| Wastewater surveillance will not be implemented fast enough to have an effect. The process is not accurate in detection and won't help to mitigate spread. | Expanding wastewater surveillance can be implemented quickly; however, there will be a learning curve. | Wastewater surveillance will benefit VADOC. It will be reliable in detection and give VDH the opportunity to act to mitigate spread. |

***Effectiveness***

To measure effectiveness, time of implementation and accuracy is key. The spread of infectious diseases can escalate very quickly, so if an alternative takes too much time, it may not be worth spending the effort on. Effectiveness will be evaluated differently for alternative 1, 2 and 3, as they

are looking to achieve different goals. Rubrics for each alternative are included in the analysis portion below.

***Equity***

Equity will be evaluated by assessing whether the alternative has the ability to balance the safety and happiness of prisoners and staff. Prisoner populations are vulnerable, and many individuals are immunocompromised. It is necessary to evaluate if prioritization of prisoners over staff is possible in this criterion. In the past, staff populations generally didn't have to adhere to protocols as tightly. Equity will be evaluated from Low, Medium, or High. The rubric below details what constitutes these ratings.

| Low: not met | Medium: satisfactory | High: meets |
|---|---|---|
| The prisoner population will receive a lower level of care. | Prisoners and staff have the ability to receive equal treatment; however, staff may take priority still. | The prisoner population will be prioritized. |

## Alternatives and Analysis

***Alternative 1: Expand wastewater screening to encompass all infectious diseases.***

This alternative suggests that correctional facilities expand their wastewater screening initiatives to screen for all infectious diseases, such as HIV, hepatitis B and C, tuberculosis, and influenza. This can help to identify and treat cases early and to prevent the spread of infection within the prison population. Wastewater collection is typically done weekly. The sample would be sent to the Virginia Division of Consolidated Laboratory Services within VDH, and results take 3-7 days to analyze. LuminUltra technology was recently introduced to a Fluvanna County Women's Correctional Facility, and the results have a turnaround of two hours (Cleary, 2020). The results would be monitored by environmental and epidemiology staff, who could in turn build out a dashboard. The dashboard would give the general public, and public health officials the opportunity to keep track of increasing cases. I am proposing that wastewater take place of a PCR or antigen test for COVID-19, or the appropriate test for other infectious diseases. Should there be early warning signs of infection, the protocol would be for VDH to send personal protective equipment and allow prisoners the ability to isolate, if the facility has the capacity for this. This alternative would have a pilot program to allow laboratory technicians the ability to become comfortable searching for other pathogens in the wastewater and ensuring that the laboratory has the capacity to expand. A phase-in program would work best to begin with established facilities in areas like Hampton Roads and Fairfax (Gonzalez et al., 2020). From here, the program can begin phasing out to Central and Southwest Virginia.

*Cost*

The existing upfront cost of wastewater surveillance is $5,200 weekly. This number encompasses all statewide facilities. Whereas PCR testing costs $180,000 weekly statewide (Cleary, 2020). This alternative is highly cost-effective, and therefore it is ranked as low cost.

*Feasibility*

*Political*

Political feasibility for this alternative is high. There is ample room in budget to continue performing wastewater testing, and therefore, would not require a request from the state for an increase in budget.

*Administrative*

Administrative feasibility for this alternative is medium. Laboratories may have to seek out other technicians that have increased familiarities with a broader array of infections. However, this program has been slowly expanding since the beginning of the pandemic, and the evidence from pilot program shows that this is doable.

*Effectiveness*

*Goal: early detection of infection and mitigate spread*

| Low: not met | Medium: satisfactory | High: meets |
|---|---|---|
| Wastewater surveillance will not be implemented fast enough to have an effect. The process is not accurate in detection and won't help to mitigate spread. | Expanding wastewater surveillance can be implemented quickly; however, there will be a learning curve. | Wastewater surveillance will benefit VADOC. It will be reliable in detection and give VDH the opportunity to act to mitigate spread. |

This alternative is ranked high for effectiveness. Wastewater surveillance has a proven track record with high analytical sensitivity, high accuracy rates and early warning capability, and it can be implemented quickly.

*Equity*
This alternative is ranked high. Wastewater surveillance is entirely anonymous, doesn't require an opt-in/opt-out system, and would not result in a disparity between staff and prisoner populations.

***Alternative 2: Establish stricter isolation and quarantine protocols.***
This option requires correctional facilities to establish stricter protocols and procedures for the isolation and quarantine of prisoners who have been exposed to or are suspected of having an infectious disease. This can help to limit the spread of infection and to protect the health of other prisoners and staff. Implement infection control measures, such as hand hygiene, respiratory etiquette, and environmental cleaning, to prevent the spread of infection in the prison environment. This can help to create a safe and healthy environment for all prisoners and staff. Initially, CDC had recommended zoning for correctional facilities (CDC, 2020). Three zones are asymptomatic/perfectly healthy, symptomatic, and severe cases. Although this is not mandated by the CDC, taking these zones into consideration would help mitigate the spread. This would require more on-site staff to continuously evaluate the conditions. VADOC and VDH will have to create protocols themselves, as correctional facilities are less likely to implement change from the CDC if the behavior is not mandated.

*Cost*
This alternative has an implementation cost of $4.48 million, putting this alternative at a rank of high cost. Direct costs for this alternative look like staffing healthcare officials, supplying personal protective equipment, etc.

*Feasibility*

*Political*
Xavier Becerra is the Secretary of Health and Human Services. He was appointed by President Biden in March 2021. Given Democrats hold the Presidency, it is very likely that establishing stricter protocols would be doable; however, there's a need for Virginia's Governor Youngkin to take initiative in the prison system. Political feasibility is ranked at medium.

*Administrative*
Administrative feasibility is ranked as low for this alternative. There is concern as to employing enough staff to keep track of quarantine protocols, and continuously monitor conditions. Again, protocols will need to come from Youngkin and VADOC staff, which may or may not be listened to.

*Effectiveness*
*Goal: mitigate spread and change behavior*

| Low: not met | Medium: satisfactory | High: meets |
|---|---|---|
| Stricter isolation protocols are unlikely to work in a prison population. Prisons do not have the capacity to effectively quarantine individuals, and this will not create a change in behavior. | Stricter isolation protocols will somewhat mitigate spread. Mask adherence will work in certain areas of the prison, and the prison has the capacity to divide prisoners into different zones. Existing staff may be able to help. This may be able to change behavior. | Stricter isolation protocols will change behavior, and there is no concern to implementation. |

This alternative is ranked as medium effectiveness. As the CDC guidelines are not mandated, correctional facilities aren't obliged to implement them. Stricter isolation protocols could somewhat mitigate spread; however, employing the appropriate personnel and the cost of this would be a challenge.

*Equity*
Equity is ranked at medium. Prisoners may not like this option, as they've been through so much back and forth with the pandemic. There may be some hesitancy to implementing new protocols, and this could lead to potential backlash, but it's possible this option would be annoying for staff. Additionally, protocols may look different for prisoners and staff, which could lead to inequity within the facility.

***Alternative 3: Health education campaigns***
This alternative requires correctional facilities to engage with and educate prisoners about the risks and prevention of infectious diseases and provide them with the knowledge and tools they need to protect their own health and the health of others. This can help to empower prisoners to take an active role in their own health and well-being, and to prevent the spread of infection within the prison population. The Virginia Department of Health can create and provide educational materials and supplies (hand sanitizer and other personal protective equipment). These educational materials would look like workshops and posters around the facilities. This alternative should be modeled after the health promotional program in Rural China (Duplaga, 2019), as they have similar parameters to a prison population.

*Cost*
Health education campaigns would have an implementation and creation cost of $12,000. This ranks the cost at medium.

*Feasibility*
*Political*
This alternative wouldn't require political sign-off, and therefore has high feasibility. Materials would come within the VDH and wouldn't need outside input.

*Administrative*

Administrative feasibility is high. Materials would be created and produced from a staff member at VDH. It's likely that there are existing materials that can be added to and made applicable for a prison population. Part of this alternative would be conducting educational workshops, which would need to be led by an epidemiologist or someone from VDH. This is very doable, as epidemiologists visit correctional facilities to quell pandemic-related concerns often.

*Effectiveness*

*Goal: adequately inform prisoners of an infection and change behavior*

| Low: not met | Medium: satisfactory | High: meets |
|---|---|---|
| Health education materials is unlikely to be produced quickly and unlikely to change behavior within the prison population. | Health education may change behavior over time but there may be some hesitancy and it will require a continued effort. | Health education will absolutely change behavior. VDH and VADOC are prepared to release materials immediately and to answer any questions prisoners may have. |

Effectiveness is ranked at medium. VDH would need some time to create and provide materials to correctional facilities. This will not take long, but there will be a necessary creative period. Although an effective alternative, there may be a transition period of understanding the materials. There will likely be a lot of questions and professionals need to be prepared to ease worry.

*Equity*

Equity is ranked at medium. There is a chance that materials would look different for staff and prisoners, as staff have the ability to bring infection into the facility from outside. Staff would need to take tight precaution to ensure that they are reinforcing all information relayed to them. This alternative prioritizes prisoner safety.

## Outcomes Matrix

The table below provides an overview for each alternative based on the evaluative criteria.

| | Cost | Feasibility | Effectiveness | Equity |
|---|---|---|---|---|
| Wastewater monitoring | $5,200/week<br>Low | Political: High<br>Administrative: Medium | High | High |
| Establish protocols | $4.48M<br>High | Political: Medium<br>Administrative: Medium | Medium | Low |
| Health education campaign | $12,000<br>Medium | Political: High<br>Administrative: High | Medium | Medium |

## Recommendation

Based on the projected outcomes of each alternative, I recommend that Virginia's correctional facilities expand wastewater monitoring to encompass different types of infection. This is a highly cost-effective option, and it would not require any input from political figures, or prisoners or staff. It is entirely anonymous and has proven success nationally. Wastewater surveillance has a $5,200 cost weekly across state facilities. Though this is a recurring cost and would end up totaling more in the long run, this investment would give Virginia's correctional facilities the ability to identify infection in an effective and accurate manner. Establishing protocols and creating a health education campaign require one-time costs; however, these will not stand alone well. Isolation protocols are hardly mandated and correctional facilities are not required to take these protocols into account, making this alternative less effective. I gave an example of how health education campaigns have the potential to be effective in this population, but this alternative will not be able to give clear detection of cases, as it aims to achieve a different outcome.

If possible, I would recommend that wastewater monitoring be paired with a health education program to maximize knowledge, safety, and happiness of the prisoners. A health education campaign is mediumly priced as well as highly political feasible. Although less effective and equitable as wastewater monitoring, I believe that this pair would lead to excellent surveillance and detection of infectious diseases within corrections, and it would empower prisoners to take their health into their own hands. Establishing protocols is not only expensive, but facilities aren't mandated to adhere, and therefore, this could be a waste of resources. This leads me to believe the best option is a combination of two effective alternatives; however, wastewater monitoring should be the priority.

## Implementation

In hopes of increased communication between the Virginia Department of Corrections and the Virginia Department of Health in times of infectious disease outbreaks, I am recommending that wastewater surveillance be implemented in correctional facilities. Implementing wastewater surveillance in a prison system requires careful planning and consideration of the various challenges and barriers that may arise. By addressing these barriers proactively, prisons can help to ensure that their wastewater surveillance program is effective and ethical. Some key challenges may include a lack of infrastructure, resources, privacy concerns, and technical expertise. To quell these concerns, a combined effort by VDH and VADOC will be necessary to move forward.

Wastewater surveillance is an existing monitoring strategy nationally; however, it is not widespread. I recommend building out from the existing program in Hampton Roads, which was mentioned in the existing evidence portion of this report.

I am recommending these steps in the following sequence:

1. Establish program goals and objectives.
2. Conduct a feasibility assessment.
3. Develop a program plan. Start with one additional infection.
4. Pilot test the program.
5. Scale up the program to include more infections.
6. Evaluate the program.
7. Communicate results and outcomes.

By sequencing implementation steps in this way, we can ensure that the wastewater surveillance program is implemented in a thorough, efficient, and effective manner that addresses the specific needs and context of Virginia's prison system. Some state facilities will lack the infrastructure to start the monitoring process immediately, so it's possible there will need to be a trial period to evaluate if a wastewater surveillance program is reasonable for that particular facility.

Implementation will require the sign off from local health departments and perhaps local government officials; however, a major stakeholder will be the prisoners themselves. Although wastewater surveillance is entirely anonymous and there isn't an opt-in/opt-out system, there are still concerns about privacy and informed consent. However, there hasn't been a cited concern to date.

Additionally, prison staff and healthcare providers can take steps to ensure that prisoners are informed about the purpose and scope of the wastewater surveillance program, as well as the steps being taken to protect their privacy and confidentiality. This may involve providing informational materials or holding educational sessions to answer questions and address concerns. Ultimately, while explicit consent may not be required for wastewater surveillance, it is important to take steps to ensure that the program is designed and conducted in an ethical and transparent manner that respects the rights and dignity of prisoners.

Technical issues could arise with the collection and analysis of wastewater samples. This could include problems with the sampling equipment, laboratory facilities, or data management systems. This was somewhat explored in the report by the Water Environment Federation (WEF). Technical issues could delay the program's implementation, reduce the accuracy of test results, or compromise the quality of the data; however, WEF quelled these concerns by reinstated that learning a new

system will require dedication and Virginia's Correctional Facilities were up to the task in the pilot program. These risks are not high enough to deter from implementation, as they have been troubleshooted through the course of the pandemic.

However, if done incorrectly, there may be legal and regulatory barriers to implementing a wastewater surveillance program in Virginia's prisons. These could include concerns around privacy, data protection, and the use of experimental testing methods. Failure to comply with legal and regulatory requirements could result in fines or other penalties or delay the program's implementation. Some stakeholders may be resistant to the implementation of a wastewater surveillance program. This could include prison staff who are concerned about the additional workload or privacy concerns or prisoners who may be wary of participating in the program. Resistance from stakeholders could delay or derail the program's implementation.

See Appendix B for implementation timeline.

## Conclusion

In this report, I have analyzed how to best support a correctional facility through an infectious disease outbreak. The best way to prevent the spread of infectious diseases is both by increasing knowledge and by increasing rate and accuracy of detection.

I gave a background of infectious diseases in prison, and what vaccination and case count looked like. VADOC and VDH have worked together to ensure prisoners are getting access to the information they need to take their health into their own hands. I gave examples of what has been tried in the past in Virginia – for example, Governor Northam attempted an early release program; however, this program was cut short and was not able to come to fruition the way he intended. I analyzed the potential of a health education campaign, and a pilot program for wastewater surveillance, both of which intertwined with my alternatives.

Ultimately, through analysis of existing evidence and three different alternatives, I have found that wastewater surveillance will uphold prisoner safety, happiness, and increase detection of cases. A cost-effective option, and an option that doesn't require a lot of extra heavy lifting, I am confident that the implementation of a wider spread wastewater surveillance program would benefit VADOC.

In terms of next steps, I recommend outlining which infectious diseases are plaguing Virginia's communities, and these can be highlighted in the surveillance program. Once these are identified, there can be a pilot program for picking up on these additional pathogens, as wastewater surveillance is only used for the Sars-COV-2 pathogen currently. I am looking to have this fully implemented by Summer of 2024.

To conclude, COVID-19 is not the last pandemic that Virginia will face. It is imperative that VDH and VADOC work together to keep prisoners safe in a public health emergency. A larger encompassing wastewater surveillance will give VADOC the ability to be proactive when faced with a pandemic in the future.

# Appendix A: Cost Calculations

***Wastewater***
*Source: subject matter expert at VDH*

PCR test: $180,000 / weekly or $9.36M / yearly
Wastewater: $200 / facility
$200 x 26 facilities = $5,200 / weekly or $270,400 / yearly

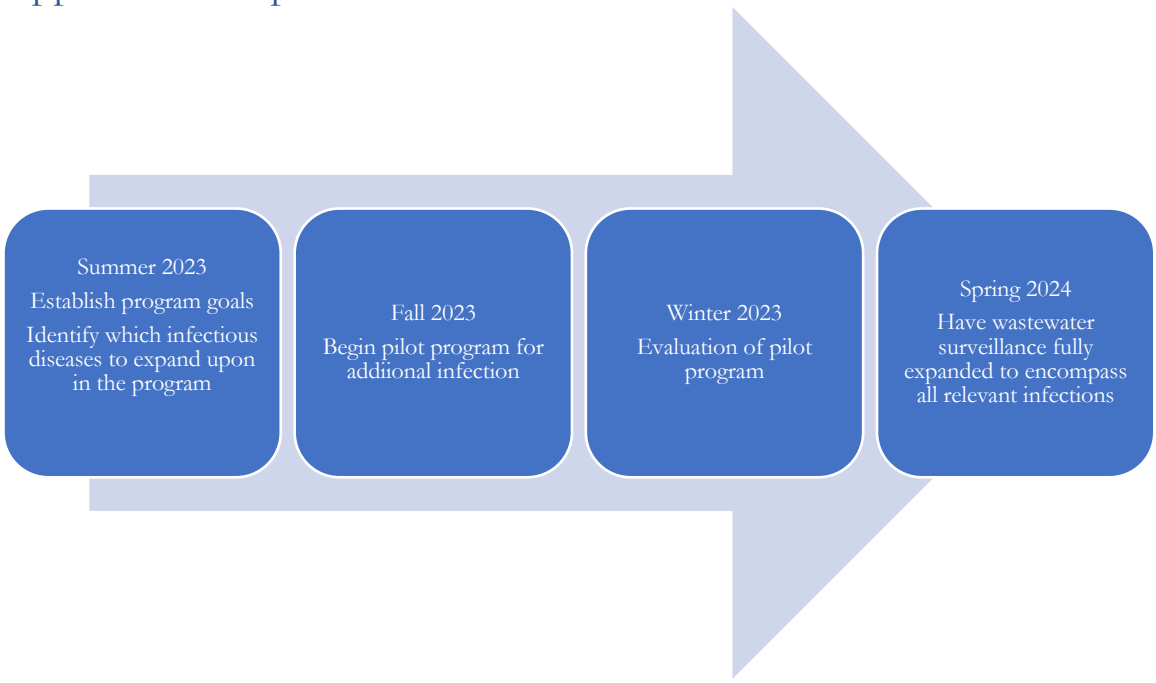
***Establishing protocols***
*Source: VADOC — Grants & Collaborations*

PPE: $20.40 / patient
69,000 prisoners x $20.40 = $1,407,600 / daily
$1,252 / employee training
Employing 5 trained officials per prison: $1,252 x 5 x 26 facilities = $162,760
Vaccination: $40 / dose
$40 x 69,000 prisoners = $2,760,000
This amounts to a direct total cost of $4,480,600.

***Health education***
*Source: subject matter expert at VDH*

Create materials: $30/hr for 10hr = $300
Plan and implement delivery: $30/hr for 10-15hr per facility = $11,700
Total cost: $12,000

# Appendix B: Implementation Timeline



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